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Systematics and biology of the African genus *Ferraria* (Iridaceae: Irideae)

P. GOLDBLATT* and J.C. MANNING**

Keywords: *Ferraria* Burm. ex Mill., floral biology, Iridaceae, new species, taxonomy, tropical Africa, winter rainfall southern Africa

ABSTRACT

Following field and herbarium investigation of the subequatorial African and mainly western southern African *Ferraria* Burm. ex Mill. (Iridaceae: Iridoideae), a genus of cormous geophytes, we recognize 18 species, eight more than were included in the 1979 account of the genus by M.P. de Vos. One of these, *F. ovata*, based on *Moraea ovata* Thunb. (1800), was only discovered to be a species of *Ferraria* in 2001, and three more are the result of our different view of De Vos's taxonomy. In tropical Africa, *F. glutinosa* is recircumscribed to include only mid- to late summer-flowering plants, usually with a single basal leaf and with purple to brown flowers often marked with yellow. A second summer-flowering species, *F. candelabrum*, includes taller plants with several basal leaves. Spring and early summer-flowering plants lacking foliage leaves and with yellow flowers from central Africa are referred to *F. spithamea* or *F. welwitschii* respectively.

The remaining species are restricted to western southern Africa, an area of winter rainfall and summer drought. We recognize three new species: *F. flava* and *F. ornata* from the sandveld of coastal Namaqualand, and *F. parva*, which has among the smallest flowers in the genus and is restricted to the Western Cape coastal plain between Ganzekraal and Langrietvlei near Hopefield. *Ferraria ornata* blooms in May and June in response to the first rains of the season. Among the remaining species, *F. uncinata* subsp. *macrochlamys* is now *F. macrochlamys* and is treated as comprising three subspecies: subsp. *macrochlamys* from central and northern Namaqualand has leaves with thickened, crisped margins; subsp. *kamiesbergensis* from the southern Kamiesberg has leaves with unthickened margins and blades curved in one direction; and subsp. *serpentina* from gravels and sands of coastal Namaqualand has serpentine leaves, also with unthickened margins. Among the remaining species, *F. divaricata* subsp. *arenosa* is now treated as a synonym of *F. divaricata*. Because of our re-interpretation of the type of *F. divaricata*, plants which were called *F. divaricata* subsp. *divaricata* and subsp. *australis* are now treated as synonyms under the name *F. variabilis*.

Flowers of *Ferraria* are unique in Iridaceae in having tepal limbs with crisped margins and a style that divides into flattened branches, each deeply forked with finely fringed adaxial margins. Despite relative floral uniformity, the genus displays a surprising range of discrete pollination systems for so small a genus. Pollinators include Diptera in the families Muscidae, Calliphoridae, and Sarcophagidae (*F. crispa* group); anthophorine and honey bees (*F. ferrariola*); eumenid wasps (*F. divaricata*, *F. macrochlamys*, *F. variabilis*); and Coleoptera in the families Meloidae and Melyridae (*F. uncinata*). Preliminary phylogenetic analysis using plastid DNA regions shows *F. glutinosa* to be sister to an unresolved cluster of southern African species and confirms as plesiomorphic the open branching habit, many-flowered inflorescences and exserted globose capsules that characterize *F. glutinosa* and its immediate allies in subgen. *Glutinosa*.

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INTRODUCTION

When last revised by De Vos (1979), *Ferraria* Burm. ex Mill. (Iridaceae: Iridoideae) was treated as comprising 10 species: nine native to the southern African winter rainfall zone and a broadly circumscribed *F. glutinosa* (Baker) Rendle, widespread across the summer rainfall interior of southern and tropical Africa. Field work in central and southern Africa in the past 10 years, often in conjunction with studies of pollination biology and examination of herbarium collections, has shown that the taxonomy of the genus needed major adjustment. Some nomenclatural changes have already been published. *F. ovata* (Thunb.) Goldblatt & J.C.Manning was added to the genus (Goldblatt & Manning 2002) after the rediscovery in the wild in 2001 of the plant named *Moraea ovata* by C.P. Thunberg in 1800. Subspecies *macrochlamys* of *F. uncinata* Sweet is now recognized as a separate species (Goldblatt & Manning 2004), and reinterpretation of the type of *F. divaricata* Sweet resulted in plants called *F. divaricata* subsp. *divaricata* and subsp. *australis* M.P.de Vos being referred to a new species, *F. variabilis* Goldblatt & J.C.Manning. Subsp.

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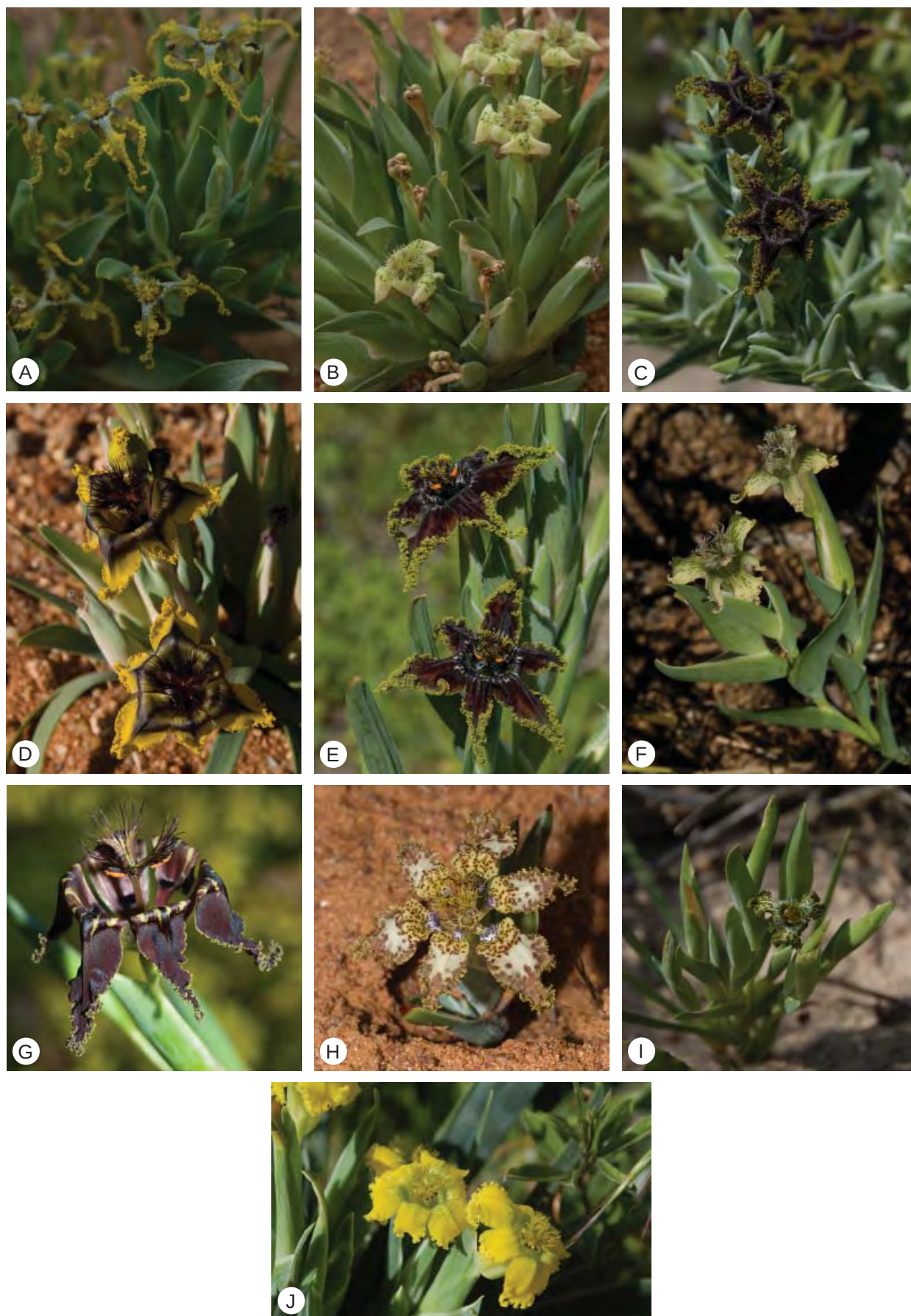


PLATE 1.—*Ferraria*: A, *uncinata* (Clanwilliam, Western Cape) (no. 16); B, *macrochlamys* subsp. *kamiesbergensis* (Kliprand, Northern Cape) (no. 17b); C, *foliosa* (near Elands Bay, Western Cape) (no. 6); D, *variabilis* (Bushmanland, Northern Cape) (no. 14); E, *crispa* (Langebaan, Western Cape) (no. 5); F, *ferrariola* (Bitterfontein, Northern Cape) (no. 11); G, *glutinosa* (northern Namibia) (no. 1); H, *ornata* (near Groen River Mouth, Northern Cape) (no. 10); I, *parva* (Vredenburg, Western Cape) (no. 12); J, *flava* (near Koekenaap, Western Cape) (no. 15).

arenosa of *F. divaricata* is now referred to *F. divaricata* (Goldblatt & Manning 2005) and subsp. *aurea* M.P.de Vos is most likely a synonym of the new *F. flava*.

Our examination of herbarium collections (from BM, BOL, K, LISC, NBG, PRE and SAM), photographs and drawings of the tropical African *Ferraria glutinosa* as circumscribed by De Vos (1979), has convinced us that there are at least four clearly defined sets of populations under this name. Mid- to late summer-blooming populations with brown or dull purple flowers with yellow tepal margins and one or two poorly developed basal leaves match the type of *F. glutinosa*, which is from Angola. We refer plants with a fan of up to eight basal leaves and yellow flowers sometimes marked with brown, also blooming in mid- to late summer, to *F. candelabrum* (Baker) Rendle. Among a series of late spring to early summer-blooming (October to mid-December) populations with smaller, dull yellow to buff flowers and lacking foliage leaves on flowering stems, we recognize *F. spithamea* (Baker) Goldblatt & J.C.Manning for plants lacking fringed style branches and tepal limbs with smooth rather than crisped margins. Plants with tepal limbs with minute brown, red, purple or dull green spotting and well-developed fringed style branches represent a fourth species, the earliest name for which is *F. welwitschii* Baker. We cannot exclude the possibility that additional species occur in tropical Africa, but specimens from there have flowers too poorly preserved to be certain.

These changes render De Vos's 1979 account of *Ferraria* of limited practical use. We provide a revision of the genus in which we recognize 18 species, including three new species, *F. flava*, *F. ornata* and *F. parva*, all from the western coastal belt of South Africa. We also reduce De Vos's *F. kamiesbergensis* to subspecific rank in *F. macrochlamys* and describe subsp. *serpentina* of that species. After briefly outlining the morphology of *Ferraria* and what is known about its phylogeny, we propose a new subgeneric classification. We also review the pollination biology of the genus, show how floral morphology is closely correlated with pollination ecology, and conclude with a key and systematic account of the genus.

GENERIC RELATIONSHIPS AND GEOLOGICAL AGE

Ferraria is a member of the predominantly Old World tribe Irideae (subfam. Iridoideae), which includes the northern hemisphere genus *Iris* L. (± 280 spp.) of Eurasia and North America, the largely sub-Saharan African *Moraea* Mill. (± 200 spp.), the southern African *Bobartia* L. (15 spp.), and *Dietes* Salisb. ex Klatt (6 spp.), also largely sub-Saharan African, but with one species on Lord Howe Island in the southern Pacific (Mathew 1980; Goldblatt 1990). Additional small genera of the tribe are now no longer recognized. *Hermodactylus* Mill. (1 sp.), *Pardanthopsis* (Hance) Lenz (1 sp.), and *Belamcanda* Adans. (1 sp.) have been shown by molecular study to be nested in *Iris* (Tillie *et al.* 2001), whereas *Barnardiella* Goldblatt (1 sp.), *Galaxia* Thunb. (15 spp.), *Gynandriris* Parlatores (9 spp.), *Hexaglottis* Vent. (6 spp.) and *Homeria* Vent. (32 spp.) are now known to be nested in *Moraea* (Goldblatt 1998; Goldblatt *et al.* 2002) and are included in that genus.

Both morphological analysis and molecular DNA sequences of plastid DNA regions show that *Ferraria* is sister to *Moraea* (± 210 species) (Goldblatt 1990; Reeves *et al.* 2001; Goldblatt *et al.* 2002; Goldblatt *et al.* 2008) and this clade is sister to *Dietes/Bobartia*. Using the molecular clock and a combined analysis of four chloroplast DNA regions, preliminary dating estimates showed that *Ferraria* and *Moraea* diverged in the Miocene, ± 25 mya (Goldblatt *et al.* 2002). Subsequent dating using improved molecular clock analysis techniques indicate that the two genera diverged earlier, ± 30 mya, therefore in the late Oligocene (Goldblatt *et al.* 2008). *Moraea* is distinguished from *Ferraria* by its bifacial leaf, single internode corms of axillary corm ontogeny, whereas the leaves of *Ferraria* are unifacial and isobilateral, the ancestral type in Iridaceae, its corm consists of multiple internodes and is of axial origin (De Vos 1977).

MORPHOLOGY

Corm: unmistakable in Iridaceae, relatively large, depressed globose to almost discoid, and lacks tunics when mature. A new corm, produced each season, develops from the base of the flowering stem (De Vos 1977), and is therefore regarded as terminal or axial (sensu Goldblatt *et al.* 2006) in origin. This ontogenetic pattern contrasts with development in the immediately related genus *Moraea*, corms of which are lateral in origin, arising from an axillary bud at the base of the flowering stem (Goldblatt 1976, 1990). Although *Ferraria* corms are described as having tunics, the tunics are membranous and short-lived and are rarely present in mature corms, but in *F. flava* corms carefully removed from the sandy ground have a dark, softly fibrous covering.

Although new corms are produced annually, those of the previous seasons are not completely re-absorbed. Instead, they persist as hard brown discs attached to each other, like a string of large beads behind the current corm. Anatomically, corms lack an organized stele, a feature shared with *Moraea* (De Vos 1977), and as in that genus, new roots emerge from the base of the terminal bud when growth is renewed at the beginning of the wet season. This contrasts with the typical pattern in corm-bearing plants, including Iridaceae subfam. Crocoideae (syn. Ixiodeae), Colchicaceae and Tecophilaeaceae, which have an organized stele and in which the new roots emerge from the base or lower half of the corm (Goldblatt 1990).

Leaves: the lowermost foliar organs sheath the emergent shoot and lack blades and are cataphylls. There are usually three present and they are typically pale and membranous. The cataphylls are distinctive in *Ferraria ferrariola*, where they consistently turn reddish with pale speckling above ground level, and often also in *F. crispa* and *F. densipunctuata*. In *F. ornata* the uppermost cataphyll develops red pigmentation above the ground. The true foliage leaves have a sheathing base and a unifacial, linear to sword-shaped blade with several to many equal, parallel veins or, in *F. crispa*, *F. foliosa* and *F. schaeferi*, there is a relatively prominent central vein, the pseudomidrib, consisting of a pair of large, opposed, vascular traces (De Vos 1979). Even *F. glutinosa* has, at least anatomically, a

pair of larger vascular traces in the centre of the leaf, but this is not evident in live plants or pressed specimens. Foliage leaves are lacking on the flowering shoots of *F. spithamea* and *F. welwitschii*, and leaves are evidently not normally produced by the flowering stems even after flowering and fruiting are completed. Non-flowering and juvenile individuals produce one large, narrowly sword-shaped leaf and one or two smaller ones on a new shoot produced from the base of the fruiting stalk as capsules mature. *Ferraria glutinosa* may also have a reduced or vestigial basal leaf, but cauline leaves are always present.

The basal leaves (or the juvenile leaves produced by immature plants) differ sharply from the cauline leaves in *Ferraria densespunctulata*, *F. ferrariola*, *F. ornata* and *F. ovata*. In the last-named species the short, bifacial, broadly ovate cauline leaves contrast with the unifacial, linear basal leaves. In *F. ornata*, juvenile and non-flowering plants produce 3–5 centric, subterete leaves, round to oval in cross section and up to 100 mm long, whereas flowering individuals have shorter falcate-lanceolate and channelled to concave leaves up to 40 mm long, with short or vestigial unifacial tips.

In *Ferraria foliosa* and *F. schaeferi* the basal leaves are thickest in the midline and have the central vein internal to the thickest part of the blade (De Vos 1979). The leaf blade (the unifacial portion of the leaf) of *F. brevifolia* is considerably shorter than the prominent sheaths which together form a tight fan. *Ferraria spithamea* lacks unifacial foliage leaves except in non-flowering individuals; flowering plants bear relatively large sheathing leaves at the base and in axils of the flowering stems, the tips of which are sometimes extended as short, unifacial blades.

Leaf margins may be undifferentiated or are moderately to prominently thickened and hyaline. The hyaline appearance is the result of the thickening of the strand of sclerenchyma, present below the marginal epidermis in leaves of all species. Thickened margins are particularly prominent in *Ferraria macrochlamys* subsp. *macrochlamys* and *F. uncinata*. In *F. uncinata* the margins are also usually moderately to strongly crisped and the marginal thickenings may be slightly irregularly serrate to crenulate. The leaf tips are often slightly hooked, the feature for which *F. uncinata* was named, but the hook is only weakly developed and is not restricted to that species. In *F. macrochlamys* subsp. *macrochlamys* the marginal thickenings are often slightly and minutely pilose (visible under 10× magnification) and usually crisped or at least crenulate. The blades of the basal leaves of *F. macrochlamys* subsp. *serpentina* are slightly curved back on themselves in loose concertina fashion and the margins are not thickened. In contrast, the leaves of *F. macrochlamys* subsp. *kamiesbergensis* all curve gently to the same side, and in some populations, the curvature is particularly pronounced, forming almost a half circle.

Leaf blades of the *Ferraria glutinosa* and *F. crispa* groups have a visible central vein but in *F. divaricata*, *F. ornata*, *F. variabilis* and the *F. ferrariola* and *F. uncinata* groups, the leaves show no external evidence of an enlarged central vein and leaf sections show all vascular traces to be ± the same size in these species (De Vos 1979).

Flowering stem and inflorescence: the stem of all species is ± erect, terete and, in well-grown plants, often branched. There are three distinct growth patterns. In subgen. *Glutinosae* (the *Ferraria glutinosa* group), the stem bears well-developed branches and the internodes are sheathed only near their bases. Most other species, e.g. *F. crispa*, *F. ferrariola*, have short, suberect branches crowded in the upper half of the stem, and the internodes are usually enclosed by large leaf sheaths. The cauline leaves may be held ± in two opposed, vertical ranks, or are strongly curved outward in a spirally 2-ranked arrangement in *F. foliosa* and *F. schaeferi*. In subgen. *Glutinosae* the upper nodes and distal portions of the internodes are sticky. In a third growth form, typical of a few species including *F. macrochlamys* and *F. variabilis*, the above-ground part of the stem and internodes are short, and the few branches produced are usually subequal in length and crowded close to the ground, giving the plants a somewhat tufted appearance. *Ferraria ornata* is acaulescent, with the stem entirely underground and the rhipidia are borne at ground level.

The main axis and each branch terminates in a cluster of flowers, a rhipidium, the basic inflorescence unit of all Iridaceae subfam. Iridoideae. This is a laterally compressed monochasial cyme with the main axis collapsed and the flowers enclosed by a pair of opposed, large, ± leaf-like bracts called spathes (Goldblatt 1990). The flowers are borne serially on short pedicels that elongate at flowering so that the flower bud is raised out of the sheathing spathes. Within the rhipidium, each flower, except the first one, is enclosed in a large submembranous bract, which in *Ferraria* can usually be seen to have a pair of weakly defined keels, each often greenish and with a central vascular trace. In subgen. *Glutinosae* the rhipidia usually have at least three and in *F. glutinosa* up to six flowers. All members of subgen. *Ferraria* have just two flowers in each rhipidium. The inner of the two spathes is longer than the outer and is partly to entirely sheathed by the outer spathe. The spathe tips are often slightly hooked and curved inward, a feature weakly developed in most species. A feature of several species, notably *F. crispa* and *F. foliosa*, is the elongation of the inner spathe as the capsules ripen. The enlarging capsule therefore remains enclosed in protective leafy spathe tissue until the aerial parts wither and dry.

Perianth: specialized in the family, the *Ferraria* flower embodies several derived features. The inferior ovary is either ovoid and borne on a long pedicel that reaches the tips of the spathes (subgen. *Glutinosae*), or the pedicel reaches to about the middle of the spathes and the ovary is ellipsoid (*F. crispa*, *F. foliosa*, *F. ornata*, *F. ovata*), or fusiform and with a sterile, tubular upper half or beak (*F. schaeferi* and sect. *Macroscyphae* of subgen. *Ferraria*). The ovules are then restricted to the lower part of the ovary. The six tepals are subequal or those of the inner whorl are somewhat smaller. The tepals are clawed and the claws may be relatively short, broad, and slightly ascending to suberect. The claws typically overlap each other and together form a wide to narrow floral cup, whereas the tepal limbs spread horizontally or are slightly reflexed. In *F. ferrariola*, *F. parva* and the *F. uncinata* group, the tepal claws are relatively narrow, comparatively long, and suberect, and then form a narrow cup or

gullet, while the limbs may be distally recurved or the inner tepal limbs may be fully reflexed. In *F. ornata* the lower third of the tepal claws are narrowed with the result that the floral cup has wide gaps or windows alternating with the bases of the claws. The tepal limbs are lanceolate-attenuate and have tightly crisped margins, except *F. spithamea*, in which the margins are plane.

Perianth colour is variable across the genus and is even, within limits, in species. Colours are typically relatively dull, and the margins of the tepal limbs often have a contrasting lighter or darker pigmentation. Because of intraspecific variation it is hard to generalize about colour. *Ferraria glutinosa* has predominantly dark brown (chocolate-coloured) to dull purple tepals (also described as violet), the limbs of which have yellow margins and sometimes yellow markings at the bases of the limbs. *F. welwitschii* has dull yellow to buff tepals with tiny, dark red, brown or dull green spots but the tepal limb margins lack contrasting colour. *F. macrochlamys* and the closely allied *F. brevifolia* consistently have pale, watery yellow tepal limbs with slightly darker margins. Populations of these species differ, if at all, in the colour intensity of the few small spots toward the limb bases. *Ferraria uncinata* usually has deep blue-violet tepal limbs, but populations in the north of its range often have light brown limbs with dark blue spots.

The tepals of *Ferraria crispa*, *F. foliosa*, *F. ornata* and *F. schaeferi* are usually irregularly mottled with dark brown to dull maroon on a paler ground colour. But at least in *F. crispa* and *F. glutinosa* there are individuals with almost uniformly dark brownish tepals with pale, almost golden margins (see figure in Manning *et al.* 2002: 157). Flowers of *F. divaricata* are also dark-coloured, but are not blotched with darker pigment; instead they have dark brown limbs, described in the type description as chocolate-brown, with light brown margins and a pale cup, usually longitudinally streaked with brownish purple or with a single broad longitudinal streak. The series of populations that De Vos (1979) called subsp. *aurea* have flowers with yellow tepals very faintly marked with contrasting colour. *Ferraria variabilis* shows a range of distinctive perianth patterning across its range. In the north, in Namaqualand and southern Namibia, flowers have tepal limbs with a darker band toward the base and are pale brown distally and the margins are the same pale brown. The claws are pale greenish cream with a narrow darker band running down the midline. In the western Karoo flower pigmentation is more variable, with shades of brown or yellow predominating but individual variation is often striking. In the southern Cape and southern Karoo *F. variabilis* has greenish yellow or light to middle brown tepal limbs, usually darker in the midline, and with small or medium-sized spots in the lower third, or when brown, then often with spots irregularly scattered across the limb and the margins sometimes slightly darker coloured. The claws are pale, usually with a darker streak in the midline. Perianth colour can vary as much within a population as across the entire southern Cape and western Karoo.

Perhaps most striking in floral pigmentation, *Ferraria ovata* has yellow tepals with dark brown at the base of the tepal limbs and along the margins and mid-

line (Figure 7). In *F. ferrariola* the tepal limbs range from pale yellow to grey-blue or light turquoise usually with a pale yellow zone toward the base of the outer tepal limbs bearing small dark dots, while the particularly prominent, feathery style branches are grey-blue to pale purple. The smaller, less conspicuous inner tepals are unmarked, often a darker colour, and the limbs are $\pm$ reflexed, in contrast to the horizontally extended outer tepal limbs.

Each tepal claw bears a nectary, which takes the form of small dark zones or larger shallow depressions covering one third to almost half the claw. Nectaries are largest and most conspicuous in the tropical African species and in those southern African species with a shallow floral cup, as in *Ferraria crispa*, *F. foliosa* and *F. schaeferi* the nectary is paler than the rest of the claw. In contrast, the nectaries of *F. glutinosa* and *F. welwitschii* are dark brown and often wider than high. *F. densepunctulata* and *F. ovata* have small, pale, bilobed or paired nectaries above the tepal bases. In *F. ornata* the nectaries are $\pm$ white with violet spots and the distal edges are raised into an irregularly lobed crest. Smaller nectaries located close to the tepal base are often not easy to identify, particularly in species with a deep, narrow floral cup. In those species with large nectaries, small droplets of intensely sweet nectar, in excess of 50 % sucrose equivalents, are scattered over the surface, which may coalesce in a pool in the base of the floral cup when the air is moist or after light rain. Nectar of remarkably low sugar concentration, in the range of 5–9 % sucrose equivalents, accumulates in a pool in the relatively deep floral cups of *F. divaricata* and *F. variabilis*. The size and position of nectaries is usually constant, but we have encountered populations of *F. variabilis* with large bilobed nectaries forming pockets in the middle of the outer tepal claws (e.g. Goldblatt & Porter 12977 from the Tankwa Karoo) although the species usually has small dark nectaries close to or at the base of the claws (De Vos 1979).

Androecium and gynoecium: the three stamens have filaments united for most of their length in a slender, smooth or rarely puberulous column that reaches to the apex of the floral cup. The upper 1.5–3.0 mm of the filaments are free and diverging. The anthers are either oblong with conventional, parallel thecae (sects. *Glutinosae* and *Ferraria*), or the thecae are held together only at their tips and diverge from the apex after anthesis, usually becoming widely divergent (sect. *Macroscyphae*). The filaments are inserted in a small pocket in the connective $\pm$ a third of the anther length above the base or, in sect. *Macroscyphae* a short distance below the anther apex.

Pollen is bright orange-red in most species, or occasionally yellow, but *Ferraria flava* consistently has yellow pollen. Pollen of *F. welwitschii* has been described as orange-yellow (Milne-Redhead 2664) or is yellow in photographs we have examined. Anthers shrink a surprising amount, at least a third and up to half their length, after pollen is shed. De Vos (1979) described the pollen grains in some detail: they are always monosulcate with reticulate exine but exhibit no features of taxonomic significance within the genus.

The ovary is borne on a well-developed (subgen. *Glutinosae*) or short pedicel that elongates just before anthesis, thus raising the flower bud above the sheathing inflorescence spathes. The ovary is either narrowly ovate-truncate (subgen. *Glutinosae*) to $\pm$ fusiform (sect. *Ferraria* except *F. schaeferi*) or in all members of sect. *Macroscyphae* and *F. schaeferi* elongate-fusiform, tapering distally into a slender, sterile tube, the rostrum or beak. Only the middle portion of the wider, lower portion of the ovary then contains ovules. The ovary remains included in the spathes except in subgen. *Glutinosae* and is then held either just below the apex of the inner spathe, or when the ovary is beaked, well within the spathes.

The slender style, held within the filament column, divides at its apex into three tangentially flattened branches, each divided for more than half its length into a pair of conduplicate lobes or arms that curve outward. The arms consist of an adaxial surface, nearly always deeply and irregularly fringed, and an abaxial surface that arches over the anthers and bears the stigma. The fringes of *Ferraria glutinosa* can be seen under at least 20 $\times$ magnification to be minutely papillate, a feature not or barely developed in other species. In *F. spithamea* the style branches lack the fringes that characterize the rest of the genus.

In subgen. *Glutinosae* and sect. *Ferraria* of subgen. *Ferraria*, the stigma is minute and located at the apex of each stylar arm (see illustrations by De Vos 1979). In sect. *Macroscyphae* (subgen. *Ferraria*) the stigmatic surface consists of an expanded and channelled fold of tissue below the tip of each style arm. The stigmatic surface is unusually large in *F. ferrariola* and arches over the adjacent anther lobe, partly concealing it.

Capsules and seeds: capsule shape largely mirrors that of the ovary. Thus, in subgen. *Ferraria* the capsule is $\pm$ globose-truncate closely resembling that in the related *Bobartia*, the less specialized species of *Dietes* (e.g. *D. bicolor*) and many species of *Moraea*. In *F. crispa*, *F. densepunctulata* and *F. foliosa*, which have a fusiform ovary, capsules are ovoid with a rounded to pointed apex. In those species with a beaked ovary, the beak persists in fruit as a firm extension at the tip of the large, ovoid, seed-bearing portion of the fruit. The capsules are enclosed in the spathes throughout their development in subgen. *Ferraria* but remain exerted in subgen. *Glutinosae* as they ripen.

The relatively large seeds are unique in Irideae in their size, multifaceted shape and distinctive smooth, glossy surface. In most species, seeds are five- or six-sided with the facets separated by raised, somewhat undulate ridges and the individual facets have a $\pm$ plane to slightly undulate or somewhat wrinkled surface. These seeds are, to some extent, variable in size, even in the same capsules, and $\pm$ 2.5–3.4 mm wide and 3–4 mm at the longest axis. Seed colour ranges from pale to dark brown, with the ridges separating the facets often lighter yellow-brown. The entire seed surface is smooth and glossy without raised cell outlines. De Vos (1979) noted that *F. divaricata* (as subsp. *arenosa*) stands out in having matte, dull brown, globose seeds with a slightly wrinkled, $\pm$ ruminate sculpturing (called reticulate by De Vos) and fove-

ate epidermal cells, which we have confirmed for one population.

CHROMOSOME CYTOLOGY

The basic chromosome number in *Ferraria* (Table 1) is $\times = 10$ and diploid numbers range from $2n = 20$ to 60 (Goldblatt 1971; De Vos 1979; Goldblatt & Takei 1997). Most species are paleodiploid but *F. crispa* and *F. schaeferi* have tetraploid and hexaploid populations ($2n = 40$ and 60) (Table 1). Largely on the basis of their tetraploid chromosome number, $2n = 40$, but also a slightly smaller flower, De Vos (1979) segregated the northern populations of *F. crispa* as subsp. *nortieri*. The southern and eastern populations of the species are hexaploid, $2n = 60$. The single count for *F. glutinosa* (from Namibia) is tetraploid and *F. variabilis* has diploid and tetraploid populations, the latter in the southern part of its range (and were assigned by De Vos to a separate subsp. *australis* of *F. divaricata*). The southern African *F. flava*, *F. ovata*, *F. ornata*, *F. parva* and the tropical *F. candelabrum* and *F. spithamea* are uncounted.

TABLE 1.—Chromosome numbers of *Ferraria*. Data from Goldblatt (1971), De Vos (1979), and Goldblatt & Takei (1997). *Ferraria candelabrum*, *F. parva*, *F. ornata*, *F. ovata*, *F. spithamea* and *F. macrochlamys* subsp. *serpentina* are uncounted

Species	Diploid chromosome no. $2n$
<i>divaricata</i> (as subspp. <i>aurea</i> and <i>arenosa</i>)	20
<i>crispa</i> (also as subsp. <i>crispa</i> and <i>F. undulata</i>)	60
<i>crispa</i> (as subsp. <i>nortieri</i>)	40
<i>densepunctulata</i>	20
<i>variabilis</i> (as <i>F. divaricata</i> subsp. <i>divaricata</i>)	20
<i>variabilis</i> (as <i>F. divaricata</i> subsp. <i>australis</i>)	40
<i>ferrariola</i> (also as <i>F. longa</i>)	20
<i>flava</i> (as <i>F. divaricata</i> subsp. <i>aurea</i>)	20
<i>foliosa</i>	20
<i>glutinosa</i>	40
<i>kamiesbergensis</i>	20
<i>longifolia</i>	20
<i>macrochlamys</i> subsp. <i>macrochlamys</i>	20
<i>macrochlamys</i> subsp. <i>kamiesbergensis</i>	20
<i>schaeferi</i>	40, 60
<i>uncinata</i>	20
<i>welwitschii</i> (as <i>F. glutinosa</i>)	20

Chromosomes are large, as they are in most genera of subfam. Iridoideae (Goldblatt 1971). The basic karyotype consists of nine acrocentric and one metacentric chromosome pair, reported for *Ferraria welwitschii* (De Vos 1979, as *F. glutinosa*). The southern African species have, in contrast, a derived karyotype of $10 \pm$ acrocentric chromosomes, some of the smaller pairs tending to metacentric. Within Iridoideae, the karyotype of *F. welwitschii* with its metacentric chromosome pair, most closely resembles that of *Moraea* species that have $\times = 10$, the ancestral base number in that genus. Both *Bobartia* and *Dietes*, the two genera immediately related to the *Ferraria*–*Moraea* clade also have $\times = 10$ (Goldblatt 1971; Goldblatt & Takei 1997) and a karyotype with both acro- and metacentric chromosomes.

POLLINATION BIOLOGY

Somewhat surprisingly for a small genus with superficially similar flowers, pollination of *Ferraria* is relatively diverse (Goldblatt *et al.* 2009). As was long suspected, the flowers of several species are adapted for pollination by muscid flies, calliphorid flies, flesh flies and other families of Diptera. Vogel (1954), in his seminal survey of pollination systems in the southern African flora, regarded *Ferraria* as a genus adapted for pollination by flies. The basis for this contention appears to have been the reports by Scott Elliot (1891) of visits to *F. crispa* (as *F. undulata*) by two Diptera, the flesh fly *Scathophaga hottentotta* (now *S. stercoraria*) (Sarcophagidae) and the blowfly *Chrysomya regalis* (Calliphoridae). These insects are evidently attracted to the strong, molasses or burnt sugar odour of the flowers (sometimes loosely described as putrid or decaying), combined with a dull, mottled perianth coloration, reminiscent of the flowers of *Orbea* and *Stapelia* species (Apocynaceae). Two populations sampled respectively by R. Raguso (pers. comm. 2009) and R. Kaiser (pers. comm. 2009) both yielded significant amounts of guaiacol, a phenylpropionoid, which has a strong molasses odour. The reward offered is concentrated sugary nectar retained as tiny droplets on the surface of large perigonal nectaries within the floral cup.

Ferraria densepunctulata, *F. foliosa*, *F. ovata*, and *F. schaeferi* (all sect. *Ferraria*) share this pollination system, often termed sapromyiophily (Faegri & van der Pijl 1979) and according to the definition, associated with a dull-coloured and often mottled perianth, odours of rotting protein, but without a reward. Clearly, flies are attracted by the appearance and odour of the flowers but in *Ferraria* they are rewarded by concentrated nectar. Four families of Diptera: Calliphoridae (*Chrysomya*), Tachinidae (genus undetermined), Sarcophagidae (*Scathophaga*), and Muscidae (several genera) have now been recorded visiting flowers of this group of species (Goldblatt *et al.* 2009). In fair to warm weather, flowers of these species are rarely without one or more fly visitors, usually carrying dense loads of bright orange pollen covering the dorsal parts of the head and thorax and sometimes the abdomen. The $\pm$ bitter or aminoid scents produced by the flowers of *F. crispa*, *F. foliosa*, and *F. ovata* are typical of flowers visited by these flies. In contrast, *F. densepunctulata* and *F. schaeferi* flowers have faint, and to the human nose, pleasant floral odours, and visits by the same suite of fly species are as frequent as those to *F. crispa* and *F. foliosa*.

Not all *Ferraria* flowers have this floral presentation and pollination system. Flowers of *F. ferrariola* are specialized in the genus in having a narrow floral cup, 17–20 mm deep, a pale blue-grey or yellow perianth with only the outer tepals bearing nectar guides, nectar of elevated sugar concentration, and typically a faint sweet scent recalling violets mixed with a spicy odour, in some populations recalling vanilla or, in others, bitter almonds. Flowers of some populations appear to be unscented. The flowers are pollinated only by bees, including honey bees, *Apis mellifera*, and long-tongued anthophorines, including *Anthophora praecox* (Goldblatt *et al.* 2009). Observations on the pollination of other bee-pollinated Iridaceae show that anthophorine bees of

several species may visit and successfully pollinate species of *Babiana* and *Gladiolus* (Goldblatt *et al.* 1998, 2001; Goldblatt & Manning 2006) across their ranges, and we conclude that different *Anthophora* species probably visit *F. ferrariola* at other sites across its wide range. Bees climb into the narrow floral cup, evidently in search of nectar and, in doing so, they passively accumulate loads of orange pollen on the dorsal part of the thorax. Visits to a second flower result in the deposition of pollen on the exposed stigmatic surfaces of the style branches.

Ferraria divaricata and *F. variabilis*, either have dull-coloured flowers, either uniformly pale to dark brown, speckled or banded with purple, brown or green on a cream to dull yellow background, or in *F. macrochlamys* pale, watery yellow. Floral odour seems to be absent, or is slightly unpleasant, but indefinable. The flowers produce large amounts of nectar of exceptionally low sugar concentration, mostly 3–10 % sucrose equivalents, which accumulates in a pool in the base of a wide, fairly deep floral cup. Flowers of both species are visited by medium-sized to large potter wasps, *Delta* and *Allepipona erythrospina* (Eumenidae) or female masarine wasps (Masarinae), *Jugurtia koeroegabensis* recorded on *F. variabilis* (as *F. divaricata*) and *Ceramius* on *F. macrochlamys* subsp. *kamiesbergensis* in Namaqualand (Gess 1997, reported as *F. divaricata*, now *F. variabilis*). Other potential insect visitors including bees and flies of several families common nearby are not attracted to these flowers. The eumenid wasps, seen only infrequently, display a constant foraging pattern, alighting on flowers of one plant after another. In doing so they become densely covered in pollen on the dorsal part of the head and thorax. Microscopic examination of pollen from captured male and female individuals of *Allepipona* and female *Delta caffer* shows that the only type of pollen they carry is that of *Ferraria*. The reason for visits by wasps is unknown but may simply be for the water content of the nectar rather than the dissolved sugar, although the possible presence of amino acids in the nectar has not been assessed.

One last pollination system in the genus is that reported in *Ferraria uncinata*, which is visited only by small herbivorous beetles, *Iselma planidorsus* (Meloidea), and an unnamed genus of Melyridae (Goldblatt *et al.* 2009). We assume that nectar of moderate sugar concentration is the reward for these insects. We are hesitant to accept these beetles as the legitimate pollinators but these fairly common flower visitors are almost invariably seen on flowers of *F. uncinata*.

Pollen carried by flies, bees, and wasps was always deposited on the dorsal part of an insect's thorax as it enters the floral cup in search of nectar. To date, no insect visitors capable of accomplishing pollen transfer have been recorded on the small, pale, watery, yellow flowers of *Ferraria brevifolia* but we assume the species has the same pollinator as *F. macrochlamys*. The flowers of these species have faintly scented flowers with a narrow floral cup containing dilute nectar, 6–12 % sucrose equivalent. All these species require insect-mediated pollen transfer and our lack of success in locating pollinators remains puzzling.

Nectar sugar chemistry, examined for individuals of four species shows that *Ferraria* species secrete hexose-dominant nectar (Goldblatt *et al.* 2009). This is consistent with nectar sugars of the sister genus *Moraea* (Goldblatt & Bernhardt 1999) and contrasts with nectar sugars of Iridaceae subfam. Crocoideae which are sucrose-rich or sucrose dominant except in a few species adapted to butterfly or sunbird pollinators (Goldblatt *et al.* 1999, 2001; Goldblatt & Manning 2006).

HISTORY

The first record of *Ferraria* in the literature is the illustration of *F. crispa* in the celebrated volume, *Flora seu de florum cultura* (Flora of cultivated plants) by the 17th century artist, Giovanni Battista Ferrari (1633). Interestingly the illustration was made from a plant grown in Italy. Ferrari called it ‘*flos indicus e violaceo fuscus radice tuberosa*’ and, unfortunately, did not record the source of his plant. The genus appears in the botanical literature again in Robert Morison’s (1680) *Plantarum historiae universalis* as *Gladiolus indicus e violaceo fuscus* and in Olof Rudbeck’s (1701) *Reliquiae rudbeckianae* as *Narcissus indicus flore saturate purpureo* but the illustrations in both works appear merely to have been copied from Ferrari’s original. *Ferraria* was formally described by Philip Miller (1759a, b), who attributed the name to the Dutch botanist, Johannes Burman. Evidently Burman communicated to Miller his intention to name the genus *Ferraria*, of course, honouring Giovanni Ferrari. Burman’s own paper was published two years later (Burman 1761) and included not only an extended botanical description, but woodcut illustrations of two plants, *F. crispa*, and what he called *F. fimbriata*, the identity of which is uncertain. The illustrations are in fact the types of the two species and adequate for the identification of *F. crispa* but not for *F. fimbriata*. We agree with De Vos (1979) that the latter is not *F. crispa*. Our best guess is that the illustration represents what is now *F. divaricata*.

Linnaeus (1759) accepted the genus without citing Miller or Burman, but listed one species, *Ferraria undata*, without description. Later in *Species plantarum* edn 2, Linnaeus (1763) admitted one species, *F. undulata*, thus overlooking Burman’s earlier epithet, *F. crispa*, although citing Burman’s paper. Linnaeus’s *F. undulata* was based on Miller’s 1759 illustration and was the name used for the species until the late 20th century when Moore (1974) noted that *F. crispa* has nomenclatural priority.

The distinctive and most unusual looking *Ferraria crispa* was grown in Paris and Vienna in the later 18th century and was illustrated by Jacquin (1770) and Redouté (1802), amongst others. Thunberg (1787) collected *F. crispa* himself and realized it was Linnaeus’s *F. undulata*. However, he transferred the species to *Moraea*, which then included such diverse genera as *Bobartia* and *Aristea* (typical *Moraea* species were at the time included in *Iris*). Only two other species of the genus, *F. ferrariola* and *F. ovata*, are known to have been recorded before 1800. Jacquin described *Moraea ferrariola* in 1790, thus following Thunberg’s circumscription of that genus. Jacquin’s description was based on a plant grown in Vienna, and very likely provided by

Franz Boos and Georg Schol, who collected plants for Jacquin at the Cape in the years 1786 to 1788 (Gunn & Codd 1981). Then, in the 1890s, most likely 1893, Francis Masson, plant collector for the Royal Botanic Gardens, Kew, discovered what we now know to be *Ferraria ovata* in western South Africa. His collection, a dried specimen lacking preserved flowers or corms, was described as *Moraea ovata* by Thunberg (1800).

We owe the restoration of *Ferraria* to Willdenow (1800) for in edn 4 of *Species plantarum* he included *F. undulata* and *F. ferrariola* in the genus, as well as two American species, the superficially similar *F. pavonia*, now *Tigridia pavonia*, and *F. ixioides*, now *Libertia ixioides*. Thunberg’s *Moraea ovata* was not included in Willdenow’s account (perhaps because of their contemporary publication) and *M. ovata* remained a puzzling species until 1995 when vegetative plants were collected near the Skilpad Reserve in Namaqualand by botanist, Annelise le Roux. Flowering specimens were obtained soon thereafter and the species was found to have a *Ferraria*-like flower. *M. ovata* was transferred to *Ferraria* by Goldblatt & Manning (2002). Salisbury (1796), always a maverick, also recognized *Ferraria* but expanded its circumscription to include species of what are today *Moraea* and *Sisyrinchium* as well as *Iris domestica* (syn. *Belamcanda chinensis*). Ker Gawler (1804, 1827) followed Willdenow in maintaining *Ferraria* but *Tigridia pavonia* and a few of its American allies in the tribes Tigridieae and Trimezieae (species of *Cypella*, *Eleutherine*, *Gelasine*, and *Trimezia*) were sometimes included in *Ferraria*. *Tigridia* had actually been described for Linnaeus fil.’s *Ferraria pavonia* in 1789 (Jussieu 1789) although the species itself was only formally transferred to that genus some years later (De Candolle in Redouté 1802). The separation of *Tigridia* from *Ferraria*, or for that matter *Moraea*, was not universally accepted until late in the 19th century (Molseed 1970).

The early 19th century saw the addition of two new *Ferraria* species: *F. uncinata* (Sweet 1826a) and *F. divaricata* (Sweet 1827) were both grown in England from corms or seeds collected by Walter Synnot, landdrost (magistrate) at Clanwilliam from 1821 to 1825. Four more species were described in the latter half of the 19th century by J.G. Baker (1878), notably *Ferraria glutinosa* and its allies, *F. candelabrum* and *F. spithamea*, all from Angola and based on collections by the Austrian Friedrich Welwitsch in the years 1855–1861, and all were initially referred to *Moraea* by Baker who evidently did not see their resemblance to the southern African *Ferraria* species (Baker 1877, 1896). This error was most likely due to the condition of the specimens, the flowers of which are poorly preserved. In 1892, Baker described another Angolan species, *F. welwitschii*, this time as referred to the genus. Based not on herbarium material but on an illustration of a plant grown in England, the drawing with some parts painted in watercolour, showed clearly the hallmarks of *Ferraria*, fringed style crests, a floral cup and crisped and undulate tepal limb margins. It was left to J.B. Rendle (1899) to transfer to *Ferraria*, Baker’s other tropical species. Baker (1876) also described what is now *F. macrochlamys* but included it in *Lapeirousia*. The species was based on a poor herbar-

ium specimen in the Kew Herbarium, originally owned by William Forsyth and probably collected by William Paterson in the 1780s, though this is no more than surmise.

Several more species were added in the later 19th and early 20th centuries but most are synonyms of those already described. In 1920, Kurt Dinter added *Ferraria schaeferi* based on collections from southern Namibia $\pm$ 1912–1913, unaware that the species had first been recorded by J.-F. Drège in 1820. G.J. Lewis added *Ferraria brevifolia* and *F. foliosa* in 1954 and M.P. de Vos, in her revision of the genus, added *F. densepunctulata* and *F. kamiesbergensis*. De Vos recognized just 10 species and four subspecies (14 taxa). De Vos unfortunately misunderstood the tropical African species and included the four we recognize here in *F. glutinosa*, following Carter's (1963) lead. Our revision reverses this action, and we now admit 18 species and two subspecies (20 taxa) in *Ferraria* assigned to two subgenera and three sections.

PHYLOGENY AND EVOLUTION

De Vos (1979) considered the morphologically and geographically isolated *Ferraria glutinosa* (in which she included all four tropical African species we recognize), the least specialized member of the genus in the light of its open branching growth form, cluster of basal leaves differentiated from the bract-like cauline leaves, multi-flowered inflorescences, and globose, truncate ovary. These features seem intuitively to be ancestral, recalling species of the related genus *Moraea*. Molecular studies of the genera of the Iridaceae using plastid DNA sequences confirm that *Ferraria* and *Moraea* are immediately related (Goldblatt *et al.* 2002, 2008). The genera share apomorphic astelic corms that produce roots from the base of the terminal bud, unique in the Iridaceae, and also have flowers with the filaments partly united, whereas other African genera of Irideae and *Iris* itself, have free filaments as their ancestral condition.

DNA sequences of 12 *Ferraria* species, using the plastid DNA regions *trnL-F* and *rbcL* (unpublished data), confirm our intuitive hypothesis about relationships within the genus. *Ferraria glutinosa* is sister to the remaining species in the data set, which did not include any other tropical African species. The relationships among these species is largely unresolved, leaving us with the conclusion that *F. glutinosa* (and presumably the morphologically similar tropical species) are taxonomically and geographically isolated species that evolved before the establishment of the present southern African winter rainfall climate. This in turn is consistent with the most recent molecular clock estimates of the divergence of *Moraea* and *Ferraria* $\pm$ 30 mya (Goldblatt *et al.* 2008), during the later Oligocene, when the African climate become increasingly dry and seasonal, but with summer precipitation. This period coincides with the establishment of circum-Antarctic oceanic circulation and the strengthening of the cold Benguela current along the southwestern African coast. Although still under a summer rainfall regime, seasonal aridity is believed to have caused the reduction of forest in favour of open grass-dominated habitats (Raven & Axelrod 1974; Coetzee 1993). Such a regime would have encour-

aged the evolution of geophytic plants, which survive periods of drought using underground storage organs that enable them to rapidly sprout and flower when suitable growing conditions return.

The onset of a winter rainfall regime in southern Africa probably dates from the beginning of the Pliocene, $\pm$ 6 mya, and this is when we assume that a recent burst of radiation occurred in *Ferraria* in the south, associated with summer drought and cool, wet, winter conditions. We infer that the resulting species we see today are too recent to have accumulated sufficient DNA sequence diversity to be successfully resolved in phylogenetic studies of two chloroplast DNA regions we utilized for our molecular study.

For the present, except for the position of *Ferraria glutinosa* (and we infer, the other tropical species) as sister to the remaining species confirmed by DNA sequence studies, we are left with morphology as a guide to the phylogeny of the genus. Outgroup comparison reveals two major specializations in the *Ferraria* species of the southern African winter rainfall zone: an ovary with a sterile tubular tip, the beak (and associated beaked capsule); and divergent anther lobes. The first of these is present in the species of sect. *Macroscyphae* (subgen. *Ferraria*) of De Vos plus *F. schaeferi*, and divergent anther lobes are restricted to that section, although the expression of the character is delayed in *F. ferrariola* and *F. parva*, in which it is expressed in older flowers, after dehiscence of the anther lobes and sometimes only on the second day of anthesis.

We propose a revised infrageneric classification of *Ferraria* based first on the molecular data, supplemented by the morphological variation evident in the ovary and anthers. Thus we recognize two subgenera, subgen. *Glutinosae*, for the tropical species and subgen. *Ferraria* for the remaining species, all of winter rainfall southern Africa. We endorse De Vos's two sections, *Ferraria* and *Macroscyphae*, the first for species with parallel anther lobes, broad, spreading tepal claws and a relatively wide floral cup, and except for *F. schaeferi*, a subacute capsule apex lacking a beak. Sect. *Macroscyphae* always has anther lobes joined only at the tips and usually widely divergent (rarely sub-parallel), a beaked ovary, and except in *F. divaricata* and *F. variabilis*, suberect tepal claws that form a narrow floral cup. In sect. *Macroscyphae* we recognize three informal series, *Macroscyphae*, *Subdivaricatae* and *Uncinatae*.

SYSTEMATICS

***Ferraria* Burm. ex Mill.**, Figures of plants, vol. 2: 187, t. 280 (1759a) and The gardeners dictionary, edn 7 (1759b); De Vos: 327–375 (1979). Type species: *Ferraria foliis lanceolatis* ... (= *F. crispa* Burm.).

Named for the 17th century artist, Giovanni Ferrari, whose illustrated works were much celebrated by contemporaries; his *Flora seu de florum cultura* (Flora of cultivated plants) included the first illustration of *Ferraria*, *F. crispa*, drawn from plants grown in Italy.

Revisionary accounts: De Vos in Journal of South African Botany 45: 295–375 (1979).

Small to medium-sized seasonal perennials. *Corm* depressed-globose, consisting of several internodes, producing roots from terminal bud, lacking tunics when mature. *Leaves* several, lower 3 or 4 lacking blades, thus cataphylls, foliage leaves with isobilateral, sword-shaped to linear, unifacial blades, sometimes not produced on flowering stem, basal one or more and largest, progressively smaller above, becoming bract-like at distal nodes. *Flowering stem* aerial or largely to entirely underground, usually branched, branches often short and crowded distally. *Inflorescence* a 2- or several-flowered rhpidium; spathes green, often leafy, enclosing flower buds, inner always longer than outer, margins free to base. *Flowers* radially symmetric, fugaceous or lasting 2 days, often dull-coloured, usually cream-coloured to buff or brownish, sometimes yellow, rarely blue-violet, spotted and blotched dark brown, green or purple, without scent or scented with sweet, spicy or rotting odours; tepals free, clawed, those of outer whorl slightly to significantly larger than inner, claws forming a wide or narrow cup or shallow basin, limbs spreading to slightly reflexed, margins crisped, the tips attenuate and twisted, producing nectar from nectaries at base or middle of claws, distal edges of nectaries lobed in *F. ornata*. *Stamens* symmetrically arranged; filaments united in lower

± two thirds in a smooth column, free and diverging in upper third or quarter; anthers appressed to style branches, lobes joined to connective but not to each other, parallel and ± contiguous or widely diverging, rarely subparallel but not contiguous. *Ovary* included or exerted from spathes, often with sterile beak; style enclosed by filament column, dividing at column apex into short branches, each forked into flattened, diverging, conduplicate arms, each usually prominently fringed on adaxial margin, rarely fringes vestigial or absent (*F. spithamea*), stigmatic surface terminal on style branches or on grooved lobe below tip of abaxial margin. *Capsules* globose-truncate, ovoid or ellipsoid, then often beaked. *Seeds* angular, mostly 5- or 6-sided, facets separated by winged angles, facets ± smooth or wrinkled, in one species ± globose and reticulate. *Basic chromosome number* $\times = 10$.

Species: 18, dry parts of central and southwestern Africa, with a centre along the southern African west coast and near interior, and four species extending from interior southern Africa through Namibia to Angola, Congo, Zambia, Zimbabwe and Malawi in dry grassland, generally favouring sandy soils, occasionally rocky habitats or seasonally wet sites.

Key to species

- 1a Anthers with filament insertion in lower third and lobes parallel and usually contiguous above filament insertion when fully dehiscent; capsules globose- to ovoid-truncate or acute or beaked in one species; perianth with tepal claws usually forming a shallow cup and bearing prominent nectaries $\frac{1}{3}$ to $\frac{1}{2}$ as long as claw; stigmas minute, terminal on apices of style branch arms (subgen. *Glutinosae* and sect. *Ferraria*):
 - 2a Upper internodes below flower clusters with sticky exudate; ovary ovoid, short, < 10 mm long; capsules ovoid to globose and truncate (subgen. *Glutinosae*):
 - 3a Leaves several (up to 8) in basal fan; rhpidia with outer spathe $\frac{1}{3}$ to $\frac{1}{4}$ as long as inner 2. *F. candelabrum*
 - 3b Leaves absent at base of flowering stem or 1–4 basal; rhpidia with outer spathe $\frac{1}{3}$ to slightly more than $\frac{1}{2}$ as long as inner:
 - 4a Flowers brown or dark purple, sometimes marked with yellow near tepal limb bases; tepal limbs often with buff to yellow margins; flowering plants usually with 1–4 basal foliage leaves, or foliage leaves reduced; filament column 8–11 mm long; flowering (Dec.–)Jan.–Mar.–(May) 1. *F. glutinosa*
 - 4b Flowers yellow to buff, limbs sometimes speckled with brown, dark red, purple or dull green spots; tepal limb margins not contrasting in colour; flowering plants lacking foliage leaves at base and branches subtended by sheathing leaves without blades; filament column 5.0–7.5 mm long; flowering (Sept.–)Oct. to Dec.–(early Jan.):
 - 5a Tepal limbs speckled with dark colour and margins obviously crisped; style branch arms prominently fringed 4. *F. welwitschii*
 - 5b Tepal limbs uniformly yellow and margins plane or slightly undulate; style branch arms entire (not fringed) and arching outward 3. *F. spithamea*
 - 2b Plants ± acaulescent or stem aerial, then upper internodes below flower clusters not sticky; ovary ± fusiform, > 10 mm long; capsules usually ovoid, rounded at apex or with short sterile beak (sect. *Ferraria*):
 - 6a Stem aerial, slender with internodes partly exposed; basal leaves linear to falcate, with blades usually < 5 mm wide:
 - 7a Plants ± acaulescent; tepal claws narrow in lower third, thus forming a windowed cup; nectaries concave, at apex of narrow part of claw and with raised and lobed to fringed distal edge 10. *F. ornata*
 - 7b Plants with aerial stems; tepal claws broad and not abruptly narrowed in lower part, cup not windowed; nectaries relatively large, in centre of tepal claws and without raised distal edges:
 - 8a Cauline leaves lanceolate-attenuate; flowers grey or blue-green with minute brown, maroon or violet speckling; nectaries yellowish green 9. *F. densepunctulata*
 - 8b Cauline leaves ovate-cucullate; flowers yellow with brown margins and a few conspicuous spots; nectaries cream-coloured streaked maroon 8. *F. ovata*
 - 6b Stem stout, mostly covered by leaf bases; leaves sword-shaped to falcate, with blades > 5 mm wide:
 - 9a Ovary with short tapering beak, ± 8 mm long; tepals 22–25(–30) mm long, pale yellow with dark brown margins and blotches, often coalescing in outer quarter; flowers sweetly scented 7. *F. schaeferi*
 - 9b Ovary fusiform, without tapering beak; tepals 25–35 mm long; flowers variously coloured, usually dark maroon or purple with paler margins or cream-coloured to pale yellow and variously striped and blotched, with an unpleasant, burnt-sugar or putrid scent:
 - 10a Blades of basal leaves with slightly thickened zone in middle and prominent central vein; leaves 2-ranked 5. *F. crispa*
 - 10b Blades of basal leaves much thickened in middle but with weakly developed central vein; leaves spirally 2-ranked 6. *F. foliosa*
 - 1b Anthers with filament insertion in upper third and lobes held together only at tips, usually widely divergent when fully dehiscent, rarely sub-parallel but not contiguous (not always so in freshly opened flowers); capsules always prominently beaked; perianth with tepal claws forming deep, narrow or wide cup; stigmas consisting of groove below tips of style branch arms (sect. *Macroscyphae*):
 - 11a Floral cup widening substantially toward apex, rim ± as wide or wider than depth of cup:
 - 12a Flowers small, sweetly, slightly clove-scented; floral cup ± 8 mm deep, ± 7 mm wide at rim; outer tepals 18–22 mm long; filament column ± 6 mm long 12. *F. parva*
 - 12b Flower relatively large, unscented or faintly unpleasantly scented; floral cup 12–15 mm deep, 13–20 mm wide at rim; outer tepals 30–45 mm long; filament column 8–13 mm long:

- 13a Plants usually subcaulescent and stem mostly covered by sheathing parts of leaves; flowers lasting 2 days; seeds (4)5(6)-sided, facets separated by raised angles, surface smooth 14. *F. variabilis*
 13b Plants with aerial stem and branching only distally; flowers lasting a single day; seeds $\pm$ globose, surface matte 13. *F. divaricata*
 11b Flowers with narrow cup, sides $\pm$ erect (rim of cup $\frac{1}{2}$ to $\frac{2}{3}$ as wide as depth of cup):
 14a Stem produced well above ground; basal leaves sharply distinct from cauline leaves and with internodes partly exposed; flowers with floral cup 17–20 mm deep; outer tepals 30–40 mm long 11. *F. ferrariola*
 14b Stem not or only shortly extended above ground (unless growing in shade); basal leaves often hardly distinct from cauline leaves (or from spathes enclosing flower clusters); floral cup 10–12 mm deep; outer tepals 25–35 mm long:
 15a Basal leaves broad, leathery-succulent, 8–20 mm wide, cauline leaves and spathes different from basal leaves; flowers lasting a single day, deep yellow; anthers and pollen yellow 15. *F. flava*
 15b Basal leaves hardly distinct from cauline leaves, rarely exceeding 12 mm wide, flowers lasting two days, watery yellow, blue or shades of beige to cream-coloured dotted with blue spots; anthers and pollen usually orange to $\pm$ red:
 16a Flowers usually predominantly blue to violet with dull yellow-green to khaki margins, occasionally tepal limbs pale bluish or cream-coloured, then speckled dark blue; margins of at least lowermost leaves conspicuously thickened, hyaline and partly crisped and undulate; marginal thickenings smooth 16. *F. uncinata*
 16b Flower pale watery yellow with darker yellow to buff or khaki margins; leaf margins either thickened then lower leaves with margins plane or serrulate to crenate, or sometimes slightly crisped or unthickened and margins plane; marginal thickenings when present often shortly velvety:
 17a Basal leaves with extended, lanceolate to linear blades longer than sheaths 17. *F. macrochlamys*
 17b Leaves with short, oblique, ovate blades less than half as long as sheaths 18. *F. brevifolia*

A. Subgen. **Glutinosae** (M.P.de Vos) Goldblatt & J.C.Manning, subgen. & comb. nov. Sect. *Glutinosae* M.P.de Vos: 329 (1979). Type: *Ferraria glutinosa* (Baker) Rendle.

Plants with open, aerial branching system and stem sticky below nodes. *Rhipidia* with > 2 and up to 6 flowers each. Flowers with tepal claws forming a wide cup, bearing prominent nectaries with dry nectar; filaments inserted in lower third of anthers; anther lobes parallel and contiguous above filament insertion when fully dehiscent. Ovary exserted, ovoid; stigmas minute, terminal on apices of style branch arms. Capsules globose- to ovoid-truncate.

1. *Ferraria glutinosa* (Baker) Rendle, in W.P.Hiern, Catalogue of the African plants collected by Dr. Friedrich in 1853–61, vol. 1,2: 27 (1899); De Vos: 329 (1979); Goldblatt: 11 (1993). *Moraea glutinosa* Baker: 271 (1878). Type: Angola, Huila, near Lopollo, Ferrão da Sola, February and April 1860, Welwitsch 1543 (BM, holo.!; K!, LISU, P!, iso.).

F. bechuanica Baker: 344 (1898). Type: Bechuanaland [Botswana], Ngamiland, Kalahari Desert near Manumwe, 'flowers chocolate with yellow fringe', 26 Feb. 1897, Lugard 237 (K, holo.!).

Moraea randii Rendle in Rand: 144 (1898). *Ferraria randii* (Rendle) Rendle: 54 (1905). Type: Southern Rhodesia [Zimbabwe], Bulawayo, Jan. 1898, Rand 223 (BM, lecto.! here designated; BR, iso.).

F. viscaria Schinz: 77 (1900). Type: South West Africa [Namibia], Omupanda, Wulforst 45 (Z, holo.).

?*Moraea malangensis* Baker: 862 (1901). Type: Angola, Malange, without date, Expedition von Mechow 386 (B, holo., no longer extant, R. Vogt pers. comm.).

Plants mostly 400–600 mm high. Stem exposed above sheaths of lower leaves, with 1(2) branches from upper nodes, branches rarely also branched; distal 5–6 mm of upper internodes sticky, often with sand adhering. Leaves at base solitary or up to 4, sometimes basal leaf poorly developed; blades linear, straight, 4–6(–10) mm wide, with visible central vein, cauline leaves moderately well developed, often longer than basal leaf, progressively reduced above and then largely sheathing. *Rhipidia* 4–6-flowered; inner spathe 30–42 mm long, outer entirely sheathing, usually $\pm \frac{1}{2}$ to $\frac{1}{3}$ as long as inner. Flowers on pedicels slightly longer than spathes, lasting a single day, usually dark brown to dull purple or maroon; tepal limbs with pale yellow to gold margins,

sometimes limbs marked or sparsely spotted yellow near base or with large irregular brown blotches on pale background; claws brown or yellow streaked with purple or brown, odourless; tepals diverging, claws forming wide basin $\pm$ 10 mm deep, 15–18 mm wide at rim, limbs spreading $\pm$ horizontally to reflexed; margins crisped; nectaries dark brown, 1.5 $\times$ 2.0 mm, 3–4 mm above claw bases; outer tepals 23–33 $\times$ $\pm$ 10 mm, claws usually slightly longer and $\pm$ as wide as limbs; inner tepals slightly smaller, claws tapering to narrow base. Stamens with filaments united in a minutely puberulous column 8–11 mm long, free in upper 1.5–2.0 mm; anther thecae diverging below, parallel above filament insertion, 5–6 mm long before anthesis, 3–4 mm long after anthesis, dark brown; pollen orange. Ovary narrowly ovoid, usually exserted, 5–7 mm long; style branches 2 mm long, dividing into diverging, prominently fringed arms 2–3 mm long, fringes smooth or minutely papillate, 4–5 mm long; stigmas terminal on tips of style arms. Capsules ovoid- to globose-truncate, mostly 12–18 mm long. Seeds glossy, brown, 4–5 mm at longest axis, $\pm$ 5-sided, facets separated by raised ridges, facet surfaces wrinkled. Flowering time: mostly Jan.–Mar., occasionally later. Figure 1; Plate 1G.

Distribution and biology: *Ferraria glutinosa* occurs across a wide belt of summer rainfall southern and central Africa; it is relatively common across Botswana and northern Namibia from where it extends northward to southern Angola, and westward to the North-West Province of South Africa and western Zimbabwe, but with an isolated record from Malawi (Figure 2). We have seen no collections from Zambia, where it is likely to occur. *F. glutinosa* is usually found in sandy ground with the corms deeply buried, but sometimes in rocky places. Several collections specifically mention white sand habitats and others red sand.

Diagnosis and relationships: *Ferraria* species in tropical Africa and summer rainfall southern Africa differ from all species of the southern African winter rainfall zone in their open-branching habit, stems with sticky exudate below the nodes, rhipidia with several (usually 4–6) flowers, and subglobose, flat-topped capsules. The genus in tropical Africa is, nevertheless, unusually variable as regards plant height, presence or absence of foliage leaves on the flowering stem, proportions of the

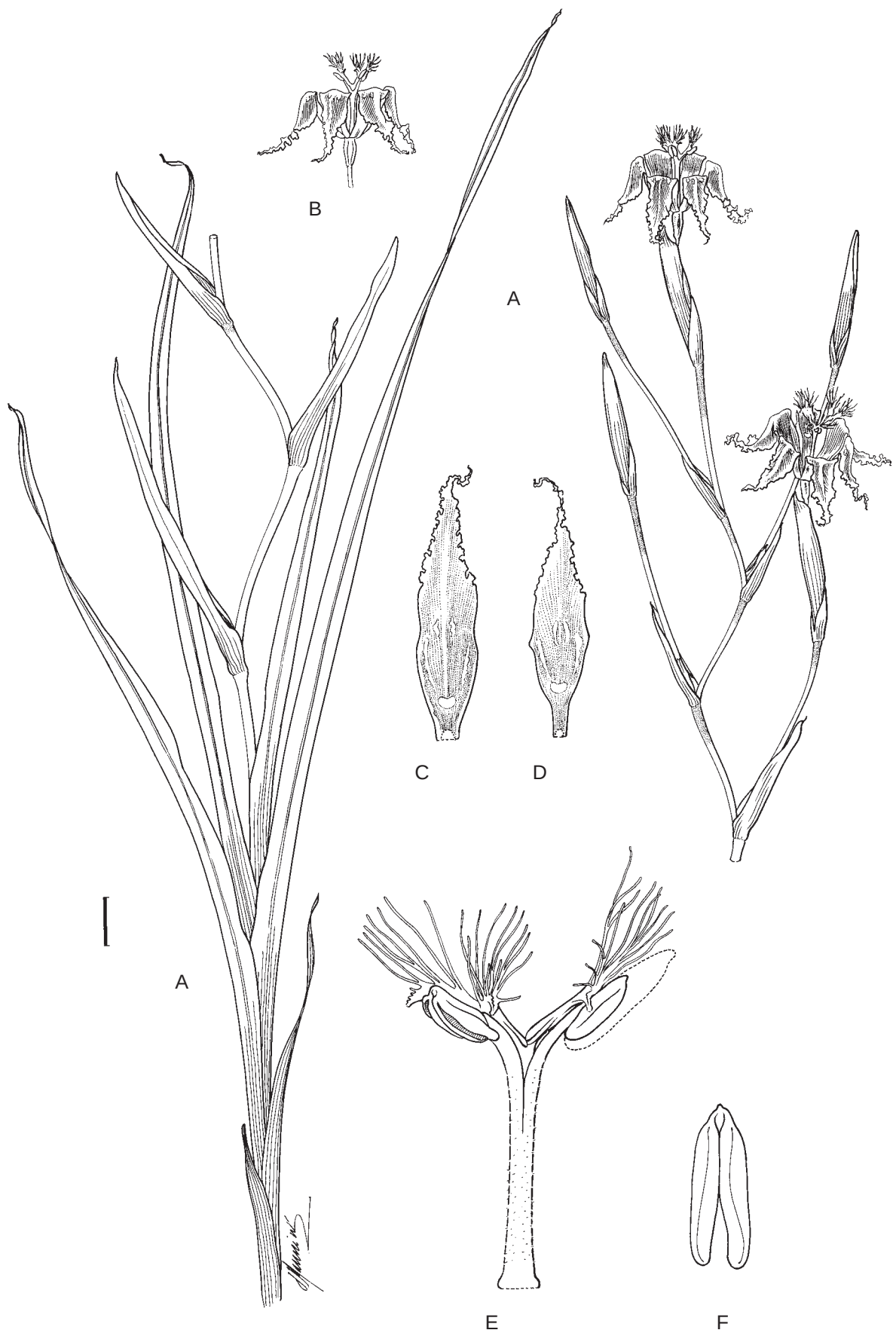


FIGURE 1.—*Ferraria glutinosa*. A, flowering stem; B, flower, side view; C, outer tepal; D, inner tepal; E, staminal column and style, undeveloped anther indicated by broken line; F, anther. Scale bar: A, B, 10 mm; C, D, 5 mm; E, F, 1.5 mm. Artist: John Manning.

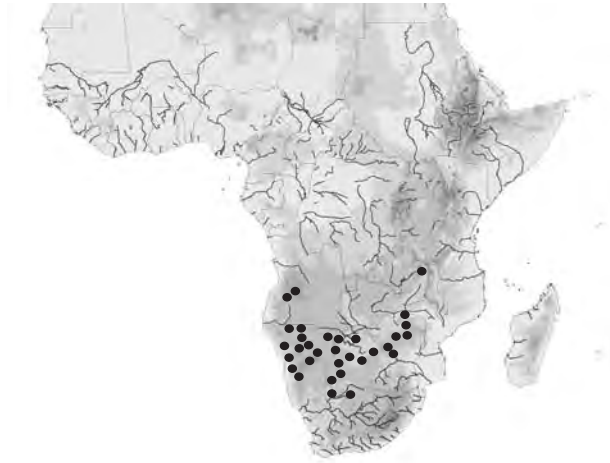


FIGURE 2.—Known distribution of *Ferraria glutinosa*.

inner and outer rhipidial spathes, and flower colour and patterning. It is not altogether surprising then, that 12 species have been described for the area between North-West Province of South Africa and western Angola, southern Congo and Zimbabwe. *Ferraria glutinosa*, based on *Moraea glutinosa*, one of the first four of these named species, was first collected by Friedrich Welwitsch in western Angola in the years 1855–1861, and is the name used until now for all populations of *Ferraria* in tropical Africa (De Vos 1979; Goldblatt 1993).

Three other Welwitsch collections of *Ferraria* from Angola formed the basis for *Moraea andongensis*, *M. candelabrum* and *M. spithamea*, named by J.G. Baker (1878) at the same time as *F. glutinosa*. Five more species were subsequently described by Baker (1892, 1901), four from Angola and one from Botswana (then Bechuanaland); one more species was described from Namibia (Schinz 1900); one from Zimbabwe (Rendle in Rand 1898); and one from Congo (Bolos 1932a). Five of these were placed in the synonymy of *Ferraria glutinosa* by Carter (1963), who suggested that the Namibian *F. viscaria* was probably also conspecific. Following Carter's lead, De Vos (1979) treated all 12 named species from tropical Africa as synonyms of *F. glutinosa*. Her taxonomy was uncritically accepted by Goldblatt (1993) for *Flora zambesiaca* and by Geerinck (2005) for *Flore d'Afrique Centrale*.

We have examined most of the available herbarium collections of tropical African *Ferraria* and conclude that recognition of a single tropical species does not reflect the extent of the variation among *Ferraria* populations there. Most importantly, there are two major vegetative types, one with only short sheathing leaves produced by the flowering stem in plants flowering mainly in October to mid-December, and another with at least one and up to eight well-developed basal leaves with unifacial blades and a relatively prominent central vein in plants flowering in (December) January to March. In the light of the variation, which is closely correlated with flower size and colouring, tepal patterning, relative proportions of the inner and outer inflorescence spathes, flowering time, and partly with geography, we propose an alternative taxonomy, recognizing four species, thus to a large extent validating Baker's (1878) original interpretation of *Ferraria* in tropical Africa.

Ferraria glutinosa, largest-flowered of the tropical species, is distinguished by the presence of several foliage leaves with well-developed blades, at least one of which is basal, and dark brown to purple flowers. Several specimens have the basal leaf virtually vestigial, but longer cauline leaves (e.g. Eyles 8543). Also exceptional are collections from Gweru [Gwelo] and Lomagundi in Zimbabwe (Holland s.n.; Rutherford-Smith 593), which respectively have three or six basal leaves. The inner inflorescence spathes are (30–)35–42 mm long, with the outer half or sometimes only one third as long. The brown to dark purple (also described as brown-violet, bright mauve or dark maroon) flowers have tepal limbs edged with yellow, sometimes also marked with yellow, and are produced mainly from January to March. The plants described as *F. bechuanica* from Botswana by Baker (1898), *Moraea randii* by Rendle (in Rand 1898) from Zimbabwe, and *F. viscaria* from Namibia by Schinz (1900) are the same species, but we note that the flowers of the last-named, *F. viscaria*, were described as yellow. We also provisionally include *F. malangensis* (Baker 1901) in *F. glutinosa* because its flowers were described as violet, but details of the leaves and flowering time, essential for confident identification, are not known. The type at the Berlin Herbarium is evidently lost (R. Vogt pers. comm. 2008).

Like the other species of *Ferraria* from tropical Africa, *F. glutinosa* is remarkable in having sticky internodes, a feature absent in the southern African winter rainfall species of the genus, but present in a few species of related genera of the southern African *Moraea* (only subgen. *Visciramosa*) and two species of *Bobartia* (Strid 1974; Goldblatt 1986). Rand (1898) noted that ants are trapped in the sticky exudate and suggested that this was a defence against these insects, which we assume might consume nectar, the reward for legitimate pollinators.

The fairly open branching pattern of the tropical species is also quite different from the crowded, short branches of other species of *Ferraria* and this, as well as the ovoid-truncate capsule and several-flowered rhipidia suggest an ancestral position in the genus. The morphological indicators of its unspecialized status are confirmed by molecular analysis using plastid DNA sequences, which places *F. glutinosa* as sister to the winter rainfall southern African species of the genus that were included in a preliminary analysis.

Both the common tropical African *Ferraria welwitschii* and the related but rare *F. spithamea* are smaller plants, notable for lacking foliage leaves on flowering plants. They also have flowers somewhat smaller than in *F. glutinosa*, with yellow to buff tepals (in *F. welwitschii* with the limbs marked throughout with small brown to dark red spots, more densely so on the claws), and large dark brown nectaries $\pm$ in the middle of the claws (illustrated in Geerinck 2005: plates 9A, B, as *F. glutinosa*). The rhipidia typically have the outer spathe slightly more than half to two thirds as long as the inner. Both these species bloom mainly in November to mid-December, but have been recorded in flowering as early as October.

The corms of *Ferraria glutinosa* are eaten raw or roasted by the Kwanyama Ovambo, according to the

ethnobotanist Robert Rodin (1985). Except for its value as an occasional ornamental in the garden or in containers, we know of no other human use of this or any other *Ferraria* species. It is noteworthy in the context of Rodin's statement about the edibility of corms, that Mannheim *et al.* (2008) report that *Ferraria glutinosa* is poisonous to stock, with symptoms including anorexia, increased heart rate, rapid respiration, diarrhoea and apathy. Post mortem signs are cyanosis, hyperaemia of the lung, and bloody inflammatory areas of the stomach and intestine. No southern African species is known to be toxic and we have seen cattle grazing on *F. divaricata*, but evidently not relishing it, for animals rarely took more than a mouthful before moving on.

Representative specimens

ANGOLA.—Huila: without precise locality or date, *Dekindt* 493 (LISC) [specimen incomplete and without base]. Huambo: Chianga, $\pm 1\ 700$ m, 3 Nov. 1962, *Teixeira & Andrada* 6525 (LISC). Cunene: Cuvelai, 11 Dec. 1972, *Menezes* 4270 (LISC).

BOTSWANA.—1825 (Panda-ma-Tenga): 13 km toward Jolies Pan, flowers yellow, (–DC), 23 Dec. 1996, *Bruyns* 6972 (NBG). 2033 (Chibabava): near Kwebe Hills, (–CA), Dec. 1898, *Lugard* 282 (K). 2121 (Ghanzi): Groot Laagte (East) fossil river valley, (–AD), 16 Mar. 1980, *Smith* 3176 (MO, PRE, SRGH). 2322 (Kang): Phudukhudu, (–DD), 12 Dec. 1989, *Barnard* 499 (PRE). 2421 (Tshane): Kalahari Park, SW of Ritchie's Pan, white sand savanna, (–AC), Mar. 1979, *Van der Walt* 5807 (PRE).

MALAWI.—Northern: ± 10 km north of Mpherembe, sand at edge of thicket, brown with yellow centre, 1 180 m, 7 Feb. 1987, *La Croix* 957 (MO).

NAMIBIA.—1915 (Okakuejo): Ovamboland, Oshikango, brown-purple with yellow spots, 1 May 1973, *Rodin* 9360 (MO, WIND). 1917 (Tsumeb): Tsumeb, 25 Jan. 1911, *Dinter* 1840 (SAM). 1920 (Tsumkwe): 6 km east of Tsumkwe along Botswana border, white sand, (–DA), 13 Jan. 1971, *Giess, Watt & Snyman* 11027 (PRE); 157 miles [251 km] east of Grootfontein, Simkue, (–DA), 16 Jan. 1958, *Story* 6156B (PRE, with colour slides). 2017 (Waterberg): Otjiwarongo, turn-off to Waterberg, (–DA), 24 Mar. 1987, *Maggs* 83 (WIND). 2115 (Karibib): Donkerhuk 91, sandy ground, (–DD), 2 Mar. 1965, *Barnard* 79 (PRE); Erongo Siding, deep Kalahari sand, (–DB), 22 Apr. (fr.), *Bean, Vlok & Viviers* 1837 (BOL, MO); Namibrand, Altenbronn, (–DD), 10 Mar. 1964, *Seydel* 264 (B). 2117 (Otjosondou): Waterberg, Quickborn, (–AA), 30 Mar. 1930, *Bradfield* 146 (PRE). 2118 (Steinhausen): 15 km along Kapps Farm road, Steinhausen to Windhoek, sandy plain, (–CC), Mar. 1988, *Goldblatt & Manning* 8805 (MO). 2216 (Otjimbingwe): dry rocky slopes of Kupferberg Pass, SW of Windhoek, (–DB), 21 Mar. 1988, *Goldblatt & Manning* 8843 (MO, WIND). 2217 (Windhoek): Farm Frauenstein, (–AD), 18 Jan. 1976, *Giess* 13901 (WIND); Goreangab Dam near Windhoek, (–CA), 21 Feb. 1965, *Giess* 8395 (NBG); Lichtenstein, (–CC), 20 Jan. 1923, *Dinter* 4311 (B). 2219 (Sandfontein): east of Gobabis, farm road between Farm Isabella and Farm Etna, (–AD), 8 Mar. 2002, *Bartsch* 503 (WIND). 2316 (Nauchas): Khomas, Farm Lichtenstein North, rock outcrop, (–DD), 3 Mar. 2002, *Mannheimer* 1732B (WIND). 2317 (Rehoboth): Rehoboth, (–AC), 13 Apr. 1911, *Dinter* s.n. (SAM).

ZIMBABWE.—Mazoe, Umvukwes, 5000 ft [1 525 m], Ruorka Ranch, 17 Dec. 1952, *Wild* 3911 (MO, K, PRE, SRGH). Lomagundi, Dyke near Rod Camp Mine, flowers yellow, spotted purple, 22 Feb. 1961, *Rutherford-Smith* 593 (K). Mangula Township, 17 Dec. 1961, *Jacobsen* 1990 (PRE). Plumtree, Jan. 1936, *Eyles* 8543 (K) [without basal foliage leaves]. Gwelo, 29 Dec. 1929 (cultivated at Kirstenbosch), *Holland* s.n. (BOL as *National Botanic Gardens* 92/28, K). Matobo, Farm Besna Kobila, grassland, Dec. 1955, *Miller* 3215 (PRE).

NORTHERN CAPE.—2723 (Kuruman): Kuruman, Esperanza, (–AD), Apr. 1940, *Esterhuysen* 2219 (BOL); Kormutsethla, (–BB), 2 Feb. 1934, *Cross* 1088 (PRE).

2. *Ferraria candelabrum* (Baker) Rendle, Catalogue of the African plants collected by Dr. Friedrich in 1853–61, vol. 1, 2: 27 (1899). *Moraea candelabrum* Baker: 271 (1878). Type: Angola, Huila, Morro de

Lopollo, Apr. 1860, *Welwitsch* 1544 (BM, lecto.), designated by De Vos, 1979: 331; K!, LISU, iso.).

?*Moraea andongensis* Baker: 271 (1878). *F. andongensis* (Baker) Rendle: 27 (1899). Type: Angola, Pungo Andongo, Mutollo near Pedras de Guinga, marshy, low grassland, Jan. (fr. Mar.), *Welwitsch* 1532 (BM, lecto.), designated by De Vos: 331 (1979); K!, LISU, iso.).

M. kitambensis Baker: 575 (1898). Type: Angola, Bangala, Kitamba, on Cuango River, in swamp, 1880, *Buchner* 679 (B, holo., no longer extant (R. Vogt pers. comm); K, iso!, fragment and drawing of B specimen).

Plants mostly 600–800 mm high. *Stem* enclosed below by overlapping leaf bases, exposed above, branched from upper nodes, branches sometimes 2(3) per node, and primary branches themselves often 1(2)-branched; upper nodes and distal parts of internodes sticky, often with sand adhering. *Leaves* at base 5–8, $\pm$ narrowly sword-shaped-linear, straight, 8–10 mm wide, with visible central vein; margins not thickened; cauline leaves well developed, shorter than basal, progressively reduced above and becoming largely sheathing and bract-like. *Rhipidia* at least 3- or 4-flowered; inner spathe 28–32 mm long, outer entirely sheathing, usually $\pm \frac{1}{3}$ ($-\frac{1}{4}$) as long as inner. *Flowers* on pedicels slightly longer than spathes, ?lasting a single day, brown with yellow markings or pale yellow, evidently odourless; tepals ascending with claws forming a cup 11–12 mm deep, ± 9 mm wide at rim, limbs $\pm$ spreading, ± 10 mm long, margins crisped; nectaries not evident; outer tepals 20–25 mm long, claws 11–13 mm long, inner tepals slightly smaller, claws tapering to narrow base. *Stamens* with filaments united in a column ± 11 mm long, free in upper ± 1.5 mm; anther thecae $\pm$ parallel, ± 3 mm long, shorter after anthesis. *Ovary* usually exserted, narrowly ovoid, ± 3 mm long; style branches ± 1.5 mm long, dividing into diverging, prominently fringed arms ± 2 mm long; stigmas terminal on tips of style arms. *Capsules* globose-truncate, ± 8 mm long. *Seeds* unknown. *Flowering time*: Feb.–Apr., possibly also in Jan.

Distribution and biology: known to us from just four collections, none with well-preserved flowers, *Ferraria candelabrum* is recorded from central Angola and adjacent western Zambia (Figure 3). Plants grow in rocky, well-drained sites. Collections usually mention hilly places, but the type of the synonym, *Moraea kitambensis*



FIGURE 3.—Known distribution of *Ferraria spithamea*, ○; *F. candelabrum*, ●.

sis, is said to be from a swampy place (which seems unlikely). The type of *Moraea andongensis*, provisionally assigned here, is from marshy, low grassland.

Diagnosis and relationships: none of the collections of *Ferraria candelabrum* has well-preserved flowers but the colour was described as yellow in the type collection, brownish in one other, and buff with dark brown stripes and spots in a third. Despite the lack of precise floral details, the vegetative habit is unique among the tropical African species. Plants stand up to 800 mm high, and have a basal fan of several (up to 8) long, relatively soft-textured leaves. The stem is branched repeatedly, the branches terminating in unusually slender rhipidia about 30 mm long. Notably the outer of the two rhipidial sheaths is $\frac{1}{3}$ – $\frac{1}{4}$ as long as the inner, giving the plants a distinctive appearance. *Ferraria candelabrum* is no doubt closely allied to the widespread subtropical African *F. glutinosa* and was included in that species by De Vos (1979). The unusually narrow rhipidia and short outer spathe makes the species easy to recognize. Unlike *F. candelabrum*, *F. glutinosa* has a single or rarely up to three basal leaves, sometimes poorly developed at flowering, a stem usually with the primary branches themselves only occasionally branched and large capsules 12–18 mm long, compared to capsules $\pm$ 8 mm long, known only from the somewhat atypical collection from Lubango in Angola (De Menezes 1661).

We provisionally place *Ferraria andongensis* in the synonymy of *F. candelabrum*. Although flowering in January and fruiting in March, plants of the type collection are much less robust, at most only 300 mm tall, and have only one basal leaf and a second, well-developed cauline leaf, both with narrow blades, $\pm$ 2.5 mm wide. The outer inflorescence spathes are short, about a third as long as the inner, and this as well as the small capsules are consistent with *F. candelabrum*. Welwitsch, in his notes, described the flowers as dull sulphur-yellow. The anthers are short, $\pm$ 2 mm long. Little more can be deduced from the type material.

Representative specimens

ANGOLA.—Huila: Lubango, on plateau of Ponta do Lubango, 11 Apr. 1965, De Menezes 1661 (LISC).

Also known from Angola from the types of the species cited above.

ZAMBIA.—Northwestern: Mwinilunga District: Ikelenge, Milomba Hill, among rocks, 1 440 m, 22 Feb. 1995, Zimba *et al.* 632 (MO, PRE); Mwinilunga, base of Kalene Hill, 1 400 m, sandy bank, flowers buff with dark brown stripes and spots, 22 Feb. 1975, Hooper & Townsend 327 (K).

3. *Ferraria spithamea* (Baker) Goldblatt & J.C.Manning, comb. nov.

Moraea spithamea Baker in Transactions of the Linnean Society, London, ser. 2, Botany 1: 271 (1878). Type: Angola, sandy places about Humpata and Lopollo, Oct. 1859 (fl. and fr.), Welwitsch 1547 (BM, lecto., designated by De Vos: 331 (1979); K, iso.).

Plants mostly 100–160 mm high. Stem exposed above sheaths of cauline leaves; upper nodes and distal parts of internodes sticky, often with sand adhering, 2 or 3 internodes long, with a branch at each node, thus 2- or 3-branched. Leaves of flowering plants absent at base, borne at aerial nodes, partly sheathing, channelled throughout, 20–40 mm long; leaves of vegetative plants unknown. Rhipidia at least 3-flowered; inner spathe

25–30 mm long, outer entirely sheathing, $\pm$ half as long as inner. Flowers on pedicels as long or slightly longer than spathes, ?lasting a single day, yellow, marked with brown spots toward base of tepals, tepals ascending, claws forming a cup, $\pm$ 8 mm deep, $\pm$ 7.5 mm wide at rim, limbs spreading, margins slightly undulate (not crisped); nectaries $\pm$ 1.5 mm diam., in lower third of outer tepal claws, in middle of inner tepal claws, colour unknown; outer tepals $\pm$ 20 mm long, inner $\pm$ 18 mm long. Stamens with filaments united in column $\pm$ 8 mm long, free in upper $\pm$ 1 mm; anther thecae parallel or diverging basally, $\pm$ 3 mm long. Ovary oblong to narrowly ovoid, $\pm$ 3 mm long, included or exerted 2–3 mm at anthesis; style branches $\pm$ 1.3 mm long, dividing into two divergent, entire arms $\pm$ 2 mm long; stigmas terminal on style arms. Capsules globose-truncate, $\pm$ 5 mm long, exerted from spathes, smooth. Seeds unknown. Flowering time: Oct.–Dec.

Distribution and biology: *Ferraria spithamea* is a narrow endemic of the highlands of southwestern Angola (Figure 3). Its habitat is described as thorny thicket in sand, or among rocks.

Diagnosis and relationships: poorly understood, *Ferraria spithamea* is known to us from just two collections, the type and one other, both from southwestern Angola. The species is recognized primarily by the entire, arching style arms, without the fringes characteristic of other species of the genus, but also by the pale yellow flowers with the tepal limbs at best undulate, and not crisped as they are in other species. Plants lack foliage leaves at flowering and we assume the foliage leaves are developed later in the season from separate shoots. The growth form is thus exactly as in the fairly widespread tropical African *F. welwitschii* but that species differs in the slightly smaller flowers, also yellow to buff, but with the tepal limbs and distal parts of the claws liberally scattered with minute dark spots. Normally a taller plant, *F. welwitschii* may reach 350 mm, therefore about twice as tall as *F. spithamea* and, typical of *Ferraria*, it has crisped tepal limb margins and prominently fringed style arms. We have relied in part for the description of the flowers of *F. spithamea* on Welwitsch's notes which describe the yellow tepal colour (*flava*) marked from the middle to the base with small dark marks (*parvis nigris picta*).

The lack of style branch fringing and tepal limbs without crisped margins are anomalous in *Ferraria* but the vegetative form, distally sticky internodes and distinctive corm, leave us in no doubt that the species is correctly assigned to the genus.

Representative specimen

ANGOLA.—Huila: Sa de Bandeira, Bata-Bata, 6 Dec. 1961, Santos 657 (LISC).

4. *Ferraria welwitschii* Baker, Handbook of the Irideae 74 (1892). Type: Angola, locality unknown, cultivated in England (Hort. Saunders), Welwitsch s.n. (K, holo.! drawing only with tepal painted in watercolour).

?*Moraea viscosa* R.C.Foster: 48 (1936), as a new name for *M. aurantiaca* Baker: 575 (1898), nom. illegit. non A. Dietrich: 485 (1832). Type: Angola, Malange, Oct. 1879, Expedition von Mechow 303 (B, holo.! (fragment), K, drawing!).

Moraea aurantiaca Baker: 575 (1898). Type: Angola, Malange, October 1879, *Expedition von Mechow 303* (B, holo.! (fragment), K, drawing!).

F. hirschbergii L.Bolus: 57 (1932a). Type: Congo, [Shaba], near Lubumbashi (Elisabethville), von *Hirschberg s.n.*, cultivated at National Botanic Gardens, Kirstenbosch, 615/29 (BOL, holo.!; K (two sheets)!, SAM, iso.!).

Plants (120–)180–350 mm high. *Stem* exposed above sheaths of lower leaves; upper nodes and distal parts of internodes sticky, often with sand adhering. *Leaves* of flowering plants sheathing, occasionally with short blades shorter than sheaths; of vegetative plants (1)2, narrowly sword-shaped, straight or falcate, 1.5–3.0 mm wide, with visible main vein. *Rhipidia* 4- or 5-flowered; inner spathe 20–34 mm long, outer entirely sheathing, mostly $\frac{1}{2}$ to $\pm \frac{2}{3}$ as long as inner, 10–17 mm. *Flowers* on pedicels $\pm$ as long as spathes, lasting a single day, pale to dull yellow to buff (?also orange) with brown to dark red or dull green spots on limbs and distal part of claws, evidently odourless, tepals ascending, claws forming a cup, 7–9 mm deep, $\pm$ 7 mm wide at rim, limbs spreading to reflexed up to 40°, margins crisped; nectaries dark brown, $\pm$ 1.5 $\times$ 2 mm, $\pm$ in centre of claws; outer tepals 15–20 $\times$ $\pm$ 5 mm, inner 14–20 mm long. *Stamens* with filaments united in a column 5.0–7.5 mm long, free in upper 1.0–1.5 mm; anther thecae parallel or diverging basally, 1.5–2.5 mm long, slightly shorter after anthesis. *Ovary* usually exserted, oblong to narrowly ovoid, 2–3 mm long; style branches 1.5–2.0 mm long, dividing into diverging, fringed arms; stigmas terminal on style arms. *Capsules* globose-truncate, mostly 5–7 mm long, exserted from spathes, smooth or minutely warty (Mendes 1957). *Seeds* angular, $\pm$ prismatic, 3 mm long, glossy, brown with pale, raised angles, $\pm$ 5-sided, facet surfaces undulate to wrinkled. *Flowering time*: mostly Oct. to early Dec.(early Jan.).

Distribution and biology: *Ferraria welwitschii* occurs across a wide belt in central Africa from the Malange highlands in west-central Angola, across Zambia to southern Congo and Zimbabwe (Figure 4). Records indicate that plants grow on the margins of open woodland, often in rocky ground and in fairly moist habitats, including riverbanks and dambos.



FIGURE 4.—Known distribution of *Ferraria welwitschii*.

Diagnosis and relationships: the type collection of *Ferraria welwitschii* is a pencil drawing of a plant cultivated in Britain, with one of the tepals coloured. The plant evidently stood $\pm$ 300 mm high, lacked developed basal foliage leaves and had flowers with reflexed, dull yellow tepal limbs covered with fine, dark brown spots. Friedrich Welwitsch is believed to have collected the plant but the original locality is not recorded. Plants matching this collection, although not always as tall, have been recorded widely across Angola, Zambia, Congo and parts of Zimbabwe, always flowering early in the wet season, October to mid-December, and consistently lacking well-developed foliage leaves. Even those specimens in fruit (e.g. *Cruse s.n.* from Zambia collected in late December) lack foliage leaves; other collections (e.g. *Mendes 1957* from Angola in fruit in January) have short, narrow foliage leaves emerging at the base, evidently representing late-developing foliage leaves on a shoot lateral to the main axis. It is clear that flowering plants do not produce leaves later in the season but rely on the stems and sheathing leaves for photosynthesis and production of storage carbohydrates for the new corms developed after flowering. This pattern recalls tropical African *Gladiolus unguiculatus* Baker; flowering and fruiting specimens of this species have short or vestigial foliage leaves but plants remain green even after the capsules have ripened and the seeds are shed in December (Goldblatt 1996). Corms of both species eventually produce new foliage leaves from shoots lateral to the fruiting axis, after the capsules have ripened. Vegetative specimens of *F. spithamea* have one or more well-developed leaves and one or two smaller leaves in a basal tuft.

Evidently the closely allied *Ferraria spithamea* from southwestern Angola has a similar growth form, but the yellow tepals lack the characteristic small dark spots, have at best undulate margins (never crisped), and the style branches lack the feathery fringes of all other *Ferraria* species.

The inclusion of *Ferraria welwitschii*, and for that matter *F. spithamea*, in the larger-flowered *F. glutinosa* (e.g. Carter 1963; De Vos 1979; Geerinck 2005), a taller, more robust plant with brown or purple (to maroon) or sometimes partly yellow flowers, and often bears one or more foliage leaves and well-developed cauline leaves on flowering individuals, now seems mistaken. The flowers of *F. glutinosa* have tepal limbs edged in yellow and bloom mainly from January to March, rarely in late November or December. Colour photographs in *Flore d'Afrique Centrale* (Geerinck 2005) show the flower form, colour and patterning of *F. welwitschii* clearly and they contrast starkly with photographs of *F. glutinosa* (e.g. *Story 6165B PRE*; Mannheimer *et al.* 2008) and our illustration of the species (Figure 1). We include *F. hirschbergii* in the synonymy of *F. welwitschii*, the type of which closely matches that species. We provisionally also include a second heterotypic synonym, *Moraea aurantiaca*, in *F. welwitschii*. The type, at the Berlin Herbarium, is fragmentary, but consists of an apparently leafless plant without flowers, but with small rounded capsules. We assume the species was called *aurantiaca* because the flowers were orange (or thought to be so) but the basis for this is not evident to us. Duplicates of

the type collection, if they exist, may help establish the identity of this name. The flowering time, October, and absence of leaves are consistent with our provisional assignment to *F. welwitschii*.

Representative specimens

ANGOLA.—Huila: Ganguelas, Vila Artur de Paiva, banks of the Cubango, 1 450 m, 4 Jan. 1960, *Mendes* 1957 (fr.), (LISC, MO); Huambo, outskirts of Nova Lisboa, 1 750 m, 8 Nov. 1970, *da Silva* 3340 (K, LISC, PRE); Caala to Cuima, 26 Nov. 1959, *Stopp* 122 (K). Lubango, Hoque, on road to Dinde, 5 km, 9 Nov. 1962, *De Menezes* 340 (K, LISC, PRE). Cuanza Sul: Cela-Cassamba, $\pm$ 1 350 m, 28 Sept. 1963, *Texeira & All* 7396 (LISC).

CONGO.—Shaba: Lubumbashi, woodland and savanna, 1 300 m, 6 Dec. 1968, *Lewalle s.n.* (MO); near Lubumbashi, banks of the Nat-webo, 25 Oct. 1970, *Lisowski* 108 (B, BR, K); Lubumbashi, Paturage de la Karavia, Nov. 1933, *Quarré* 3633 (BR).

ZAMBIA.—Northwestern: Mwinilunga: Kalenda Ridge, W of Matonchi Farm, stony ground, 8 Oct. 1937 (fr. 16 Dec. 1937), *Milne-Redhead* 2664 (K).

ZAMBIA.—Western: Luano Forest Reserve, Chingola, in granite rocks, 19 Nov. 1961, *Linley* 218 (K, MO, PRE, SRGH).

ZAMBIA.—Copperbelt: Kitwe, dambo margin, 13 Dec. 1959, *Fanshawe* 5314 (K, NDO); Mufulira, dambo, 10 Nov. 1947, *Cruse* 92 (K), late Dec. 1947 (fr.), *Cruse s.n.* (K); Kawambwa Dist., 900 m, by M'bereshi River, 2 Dec. 1961, *Richards* 15485 (K); Mazabuka, Ridge-way road, 2 Dec. 1931, *Central research station* 541 (K, PRE). Mumbwa Dist., 30 miles [48 km] west of Kafue Hoek pontoon on road to Mankoya, 21 Nov. 1959, *Drummond & Cookson* 6734 (K, MO, PRE, SRGH).

ZIMBABWE.—Bulawayo, 25 Dec., 'brown flowers', *Norman* R44 (K); Matobo, Paddocks, black land, Dec. 1931, *Rattray* 440 (K); Farm Shumbashaba, among rocks, Dec. 1954, *Miller* 2569 (K); Gokwe, Charama road fly gate 4 miles [6 km] north of Gokwe, 2 Jan. 1963, *Bingham* 393 (PRE).

B. Subgen. *Ferraria*

Plants acaulescent or with aerial stems with relatively short branches enclosed by leaf sheaths. *Stem* not sticky below nodes. *Rhipidia* with only 2 flowers each. *Flowers* with tepal claws widely diverging, forming a shallow cup, with large nectaries with non-fluid nectar, or forming a deep, wide to narrow cup with small nectaries and with fluid nectar; filaments inserted in lower third or near apex of anthers; anther lobes parallel and usually contiguous above filament insertion or lobes not contiguous and usually widely diverging when fully dehiscent. *Ovary* included, ellipsoid, with or without sterile beak; stigmas minute, terminal on apices of style branch arms, or larger, on lobes below style arm tips. *Capsules* ovoid-oblong and obtuse or with prominent beak.

B1. Sect. 1. *Ferraria*

Flowers with tepal claws widely diverging, forming a shallow cup, with large nectaries with non-fluid nectar; filaments inserted in lower third of anthers; anther lobes parallel and contiguous above filament insertion. *Ovary* ellipsoid, sometimes with sterile beak; stigmas minute, terminal on apices of style branch arms. *Capsules* ovoid-oblong and obtuse or with prominent beak.

5. *Ferraria crispa* *Burm.* in *Nova acta physico-medico Academiae Caesareae Leopoldino-Carolinae germanicae naturae curiosorum* 2: 199 (1761); *De Vos*: 338 (1979). Type: South Africa, without precise locality, illustration in *Burman*, *Nova acta physico-medico*

Academiae Caesareae Leopoldino-Carolinae germanicae naturae curiosorum 2: 199, t. 3, fig. 1 (1761).

F. undulata L.: 1353 (1763), nom. illegit. superfl. pro *M. crispa* *Burm.f.* *Moraea undulata* (L.) *Thunb.*: no. 14 (1787). Type: South Africa, without locality or collector, illustration in *Miller*: 187, t. 280 (1759a), lecto., here designated.

F. ensiformis *Mill.* (1768), nom. superfl. pro *F. crispa* *Burm.* Type: not designated.

F. obtusifolia *Sweet*: t. 148 (1826b). Type: illustration in *Sweet*, l.c. (1826b).

F. major *Eckl.*: 18 (1827), nom. nud.

F. vandermerwei *L.Bolus*: 276, fig. D (1932b). Type: South Africa, [Western Cape], near Swellendam, cultivated in Cape Town, Sept.–Oct. 1932, *Van der Merwe s.n.* *BOL20168* (BOL, holo.).

F. crispa subsp. *nortieri* *M.P.de Vos*: 338 (1979), syn. nov. Type: South Africa, [Western Cape], heights north of Verlorenvlei, 28 Aug. 1976, *De Vos* 2366 (NBG, holo.).

See *De Vos* (1979: 338) for additional synonymy.

Plants usually robust, (300–)450–1 500 mm high. *Stem* much branched in upper half, sheathed by leaf bases below; cataphylls and bases of leaf sheaths often speckled pale on red background. *Leaves* several, linear to sword-shaped, (4–)6–12 mm wide, basal leaves longest, with visible main vein. *Rhipidia* 2-flowered; spathes green with membranous margins, inner 45–65 mm long, outer $\pm$ half as long, usually entirely sheathing. *Flowers* on pedicels 40–60 mm long, lasting a single day, variously pale yellow to beige with brown to dull purple mottling and brown margins to predominantly brown with pale yellow margins, strongly scented, odour reminiscent of caramel or molasses, tepals widely diverging, forming a shallow bowl 6–8 mm deep, 13–18 mm wide at mouth, nectary $\pm$ $\frac{1}{2}$ length of claw, sometimes slightly longer, limbs spreading horizontally; outer tepals 28–35 mm long, claws 8–12 mm long, limbs to 25 mm long, inner tepals slightly shorter and narrower. *Stamens* with filaments united in smooth column $\pm$ 6 mm long, free in upper 3 mm; anthers $\pm$ 3 mm long, thecae parallel, shortly apiculate; pollen orange. *Ovary* spindle-shaped, not beaked, included in spathes, 12–20 mm long; style branches $\pm$ 4 mm long, forked in upper half, divided into diverging arms; 4–5 mm long, prominently fringed; stigmas terminal on style arms. *Capsules* ovoid to oblong, 15–25 mm long, obtuse or pointed at apex. *Seeds* angular, mostly 5-sided, $\pm$ 4 mm long, facets slightly wrinkled. *Flowering time*: Aug.–Oct. Plate 1E.

Distribution and habitat: *Ferraria crispa* is best known as a coastal species and it is common along the Western Cape coast in rocky sites from Lambert's Bay to Hermanus; it also occurs sporadically further east along the coast at least to Herold's Bay near George (Figure 5). Showing a striking ecological shift, it also grows in montane habitats, sometimes along streams in deep, coarse sand, or on seasonally moist south-facing slopes, from Pakhuis Pass in the north through the Witteberg and Swartberg to Georgida in the Baviaanskloof Mtns of Eastern Cape. Usually fairly robust in stature, plants of montane populations can reach a remarkable 1.5 m in height, more than has been recorded in any coastal population of the species. Unlike the coastal populations which flower annually, the montane populations of *F. crispa* flower well only in late spring following a wild fire the previous summer.

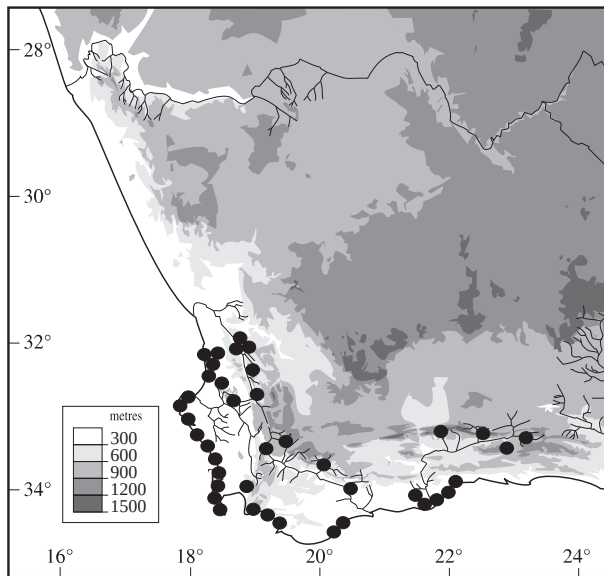


FIGURE 5.—Known distribution of *Ferraria crispa*.

Long known by the later synonym, *Ferraria undulata* L., dating from 1763 (e.g. Baker 1892, 1896), the species was first described by Johannes Burman in 1761 as *F. crispa*. It is the most well-known species of the genus and the name *F. crispa* (or *F. undulata*) is often carelessly applied to other members of the genus. The species is best recognized by the habit, with stems produced well above the ground and bearing numerous branches crowded in the upper half of the stem, combined with a flower with a wide, shallow cup and an ovoid capsule lacking a beak. The sword-shaped lower leaves and the shorter cauline leaves have a definite main vein and form two-opposed vertical ranks. The strongly scented flowers have tepals speckled or blotched dark brown to dull purple on a cream-coloured to pale yellowish background, or occasionally predominantly dark brown, but whatever the dominant colour, the crisped margins are a pale colour, sometimes almost golden when the tepals are otherwise brown. More important than their colour and patterning, which is quite variable, the tepals form a wide, fairly shallow cup and each claw has a large nectary, often covering almost half the surface. The nectaries produce minute droplets of concentrated nectar scattered over the entire surface.

De Vos (1979) recognized the northern populations of *Ferraria crispa* as subsp. *nortieri* because of their pale green rather than slightly glaucous leaves, slightly smaller flowers, the perianth with a cup ± 8 mm deep and ± 10 mm wide at the rim, and the ovary less than 20 mm long. The inner tepals are also slightly narrower, ± 6.5 mm wide versus ± 10 mm wide in the typical subspecies. The distinction is less clear than De Vos indicated and we prefer not to recognize these northern populations formally. Notably, all plants of subsp. *nortieri* for which chromosome numbers are available, are tetraploid, $2n = 40$, whereas populations assigned to subsp. *crispa* to the south and in the southern Cape mountains are hexaploid, $2n = 60$. The smaller flower dimensions, and smaller pollen grain size noted by De Vos, seem directly correlated with the lower ploidy level in these northern populations.

The ecological range of *Ferraria crispa*, as noted above is remarkable. We have looked in vain for differences between the coastal populations that favour rocky outcrops and those from montane sandy slopes and in the absence of any morphological distinction, apart from greater height in the latter plants, they remain the same taxon.

Representative specimens

WESTERN CAPE.—3218 (Clanwilliam): 2 km from Lambert's Bay to Vredendal, (–AB), 5 Sept. 1976, *De Vos* 2374 (NBG); Pakhuis Pass, road to Klein Kliphuis, (–BB), 4 Sept. 1976, *De Vos* 2368 (NBG). 3317 (Saldanha): Bobbejaankop, Saldanha, (–BB), 2 Sept. 1974, *De Vos* 2323 (NBG). 3318 (Cape Town): entrance to West Coast National Park, calcareous slope, (–AA), 4 Aug. 2001, *Goldblatt & Manning* 11665 (MO); Dassen Island, (–AC), Jan. 1926 (fr.), *Lang sub Marloth* 6696 (PRE); Robben Island, (–CC), *Walgate* 496 (NBG); Spieka near Klipheuwel, (–DA), 10 Sept. 1975, *Thompson* 2617 (NBG). 3319 (Worcester): Hex River Pass, (–BD), 26 Sept. 1951, *Barker* 7454 (NBG). 3320 (Montagu): Montagu Baths, (–CC), Oct. 1921, *Page* 74 (PRE). 3321 (Ladismith): Swartberg Mtns, road to Gamkakloof, deep sand along stream, burned last summer, (–BD), *Goldblatt & Porter* 11858 (MO, NBG); Gamkaberg Nature Reserve, (–CB), 15 Aug. 1983, *Cattell & Cattell* 298 (NBG). 3322 (Oudtshoorn): Swartberg Mtns, Meiringspoort, (–BC), *Loubser sub De Vos* 2351 (NBG). 3418 (Simonstown): Strandfontein, (–AB), 18 Sept. 1942, *Compton* 13705 (NBG). 3419 (Caledon): Kleinmond, (–AC), *De Vos* 2360 (NBG); Hermanus, (–AC), Nov. 1921 (fr.), *Rogers* 22619 (PRE); Fernkloof Nature Reserve, (–AD), 2 Oct. 1984, *Drewe* 154 (MO). 3420 (Bredasdorp): De Hoop, (–AD), 13 Sept. 1979, *Burgers* 2217 (NBG). 3421 (Riversdale): Stilbaai, hill near tennis courts, (–AD), 23 Nov. 1978 (fr.), *Bohnen* 4651 (NBG, PRE); 1 mile [1.6 km] N of Gouritz River mouth, (BD), 18 Sept. 1968, *Mauve* 4755 (PRE).

EASTERN CAPE.—3323 (Willowmore): Georgida, (–AD), Oct. 1930, *Fourcade* 4411 (NBG).

6. *Ferraria foliosa* G.J.Lewis in *Annals of the South African Museum* 40: 117 (1954); *De Vos*: 366 (1979). Type: South Africa, [Western Cape], near Elandsbaai [Elands Bay], 12 Sept. 1955, *Lewis* 2301 (SAM60809, holo.!; SAM (two sheets)!, STE!, PRE!, iso.).

Plants 300–800 mm high. *Stem* leafy and much-branched, branches rotated in clockwise fashion. *Leaves*: basal (and juvenile) with linear blades diamond-shaped in cross section, thickened in midline, ± 8 –10 mm wide, main vein hardly evident below thickened midline; cauline leaves falcate, channelled below, distally horizontal, main vein often not evident, arranged in a two-ranked spiral. *Rhipidia* 2-flowered; inner spathe 48–50 mm long, often prominently inflated, outer 28–30 mm long, sheathing below, diverging in upper half, hooked at tips. *Flowers* on pedicels 17–20 mm long, lasting a single day, dull maroon to purple or dark brown, usually with darker purple-maroon blotches, margins pale brown, claws usually maroon speckled with white, putrid- or molasses-smelling, tepal claws broad, forming a wide cup, 7.5–8.0 mm deep, 13–18 mm wide at rim, nectaries pale green, heart-shaped, prominent, $\frac{1}{3}$ to $\frac{1}{2}$ as long as claw, limbs $\pm$ spreading; outer tepals 33–40 mm long, inner tepals 28–35 mm long, claws of both whorls 9–10 mm long. *Stamens* with filaments united in a column 8–11 mm long, free in upper 1.5–2.5 mm; anthers ± 3.5 mm long before anthesis, thecae parallel; pollen orange. *Ovary* spindle-shaped, not beaked, included, 15–20 mm long; style branches ± 4.5 mm long, diverging, with prominently fringed arms; stigmas terminal on style arms. *Capsules* ellipsoid, 28–35 mm long, round

at apex. *Seeds* angular, $\pm$ 5-sided, $\pm$ 3 mm long, facets slightly wrinkled, light brown, shiny. *Flowering time*: late Aug.–Oct. Plate 1C.

Distribution and biology: the vegetatively distinctive *Ferraria foliosa* is restricted to dunes and sandy beaches along the Atlantic coast of Northern and Western Cape of South Africa (Figure 6). Plants have been recorded from near Hondeklip Bay in the north to near Velddrif in the south, where it overlaps the range of *F. crispa*. The latter favours rocky sites in contrast to the deep sands, mostly in strandveld close to the sea shore in which *F. foliosa* grows. The dull purple-brown flowers have a strong unpleasant, molasses-like or putrid odour and attract numerous flies which successfully accomplish cross pollination.

Vegetatively, *Ferraria foliosa* can be recognized by the long, linear basal leaves much thickened in the midline, thus diamond-shaped in cross section (see De Vos 1979), and sometimes dry by flowering time. The basal leaves differ markedly from the shorter, wider cauline leaves, the blades of which are also thickened in the middle and arch outward, ultimately spreading horizontally. Successive leaves are opposed but collectively the leaves have a spirally two-ranked arrangement. This is also reflected in the short lateral branches, which are crowded in the upper half of the stem, the successive ones rotated slightly in a clockwise direction. The flowers differ little from those of closely related *F. crispa* in their darkly mottled pigmentation, broad tepal claws with large nectaries, and wide, shallow floral cup. Whereas the flowers of *F. crispa* are usually shades of dull yellow, buff and brown, those of *F. foliosa* are mottled dull purplish, or brownish maroon on a paler grey-purple background.

In her key to the species, De Vos (1979) distinguished *Ferraria foliosa* and *F. schaeferi* from *F. crispa* by the leaf blades having numerous parallel veins rather than a single prominent vein. That distinction seems to us to poorly reflect their morphology, for the blades of *F. foli-*

osa are so thickened and leathery that no veins are evident except for the main vein in the centre of the thickened blade. *Ferraria foliosa* is better distinguished from *F. crispa* by the spirally rotated leaves and branches, and secondarily by the duller flower coloration, the background tinged with purple and the mottling a maroon to dull purple in *F. foliosa* that contrasts with the dark brownish or dull yellow colouring on a pale cream-coloured background, or brown with yellow margins in *F. crispa*. The cream-coloured perianth covered with dark speckles and prominently beaked ovary, immediately separate *F. schaeferi* from *F. foliosa*. The species appears to have first been collected by Harry Bolus near Velddrif in 1892, but that specimen was overlooked by Lewis and was referred to *F. crispa* by De Vos in her account of *Ferraria*.

Representative specimens

NORTHERN CAPE.—3017 (Hondeklipbaai): Farm Avontuur, 3 km E of Hondeklipbaai [Hondeklip Bay], (–AD), 25 Aug. 1986, *Le Roux & Lloyd* 260 (NBG); sandy slopes above lighthouse at Groen River Mouth, (–DC), 25 Aug. 2002, *Goldblatt & Porter* 12113 (MO); Groen River Mouth, above highwater mark, (–DC), 29 Aug. 1977, *De Vos* 2396 (PRE).

WESTERN CAPE.—3117 (Lepelfontein): Brand-se-Baai, (–BD), 23 Aug. 1993, *De Villiers* 121 (PRE). 3118 (Vanrhynsdorp): Olifants River, dunes at river mouth, (–CA), 8 Oct. 1983, *O’Callaghan* 649 (NBG). 3218 (Clanwilliam): Otterdam, Lambert’s Bay, (–AB), 6 Sept. 1953, *Compton* 24162 (NBG); sandy slope south of Leipoldville, Elandsbaai [Elands Bay] road, (–AD), 15 Sept. 2001, *Goldblatt & Porter* 11886 (MO, NBG); sandy flats along coast between Nuwedam and Soutkloof, S of Elandsbaai [Elands Bay], (–AD), 5 Oct. 2004, *Goldblatt & Porter* 12619 (MO, NBG); Elands Bay, sand below Bobbejaankop, (–AD), 28 Aug. 1976, *De Vos* 2365 (NBG); Dwarskersbos, strandveld, (–CA), 7 Oct. 2004, *Goldblatt & Porter* 12636 (NBG); dunes at mouth of Berg River, (–CC), Oct. 1892, *Bolus* 6301 (BOL, NBG, PRE).

7. *Ferraria schaeferi* Dinter in Repertorium Novae Species Regni Vegetabilium 16: 339 (1920); De Vos: 344 (1979). Type: South West Africa [Namibia], Klinghardt Mtns, Dreikugelberg, 14 Aug. 1913, *Schäfer* 562 (B, neo.), designated by De Vos 1979: 344).

Plants 200–500 mm high. *Stem* sheathed by leaf bases, branching repeatedly in upper axils, branches rotated in clockwise spiral; with corm bearing long runners from base, each terminating in a small corm. *Leaves* with overlapping sheaths; blades thick and leathery, thickened in midline and main vein usually evident, arranged in a two-ranked spiral, spreading horizontally above, 12–20 mm wide. *Rhipidia* 2-flowered; spathes firm, leafy in texture, with translucent membranous upper margins, inner 50–60 mm long, outer somewhat shorter, sheathing only near base, arching outward in upper half. *Flowers* on pedicels 40–50 mm long, lasting a single day, creamy yellow with small to large brown spots, margins dark brown, usually sweetly scented (of violets), tepal claws broad, forming a wide cup, $\pm$ 8 mm deep, 12–15 mm wide at rim, with brownish purple, heart-shaped nectaries in lower half, $\pm$ $\frac{1}{2}$ as long as claw; outer tepals $\pm$ 25 mm long, inner tepals 22–24 mm long, claws of both whorls $\pm$ 8 mm long. *Stamens* with filaments united in a column $\pm$ 7.5 mm long, free in upper 2 mm; anther thecae parallel, $\pm$ 5 mm long at anthesis, later shrinking; pollen dull brown to orange. *Ovary* spindle-shaped, 20–25 mm long, tapering to a slender beak, $\pm$ 8 mm long, included; style branches $\pm$

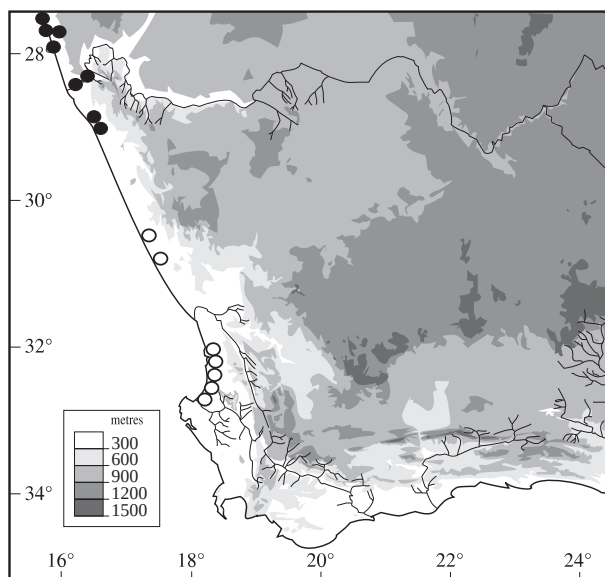


FIGURE 6.—Known distribution of *Ferraria foliosa*, O; *F. schaeferi*, ●.

2 mm long, diverging into prominently fringed arms $\pm$ 2 mm long; stigmas terminal on style arms. *Capsules* $\pm$ ellipsoid, 20–25 mm long, excluding beak. *Seeds* light brown, glossy, 5- or 6-angled, facets $\pm$ smooth. *Flowering time*: mid-Jul.–Sept.

Distribution and biology: favouring deep sands, mainly along the coast, or a short distance inland, *Ferraria schaeferi* extends from near Lüderitz Bay in south-western Namibia in the north, to the coast at Grootmis in Northern Cape, South Africa in the south (Figure 6). The type locality, the Klinghardt Mtns of southwestern Namibia, lies some 40 km inland, which is somewhat unusual but we have also seen *F. schaeferi* growing near Brandkaros east of Alexander Bay, some 30 km inland, along the Orange River. There is also an early record of the species at Arrisdrif (Marloth 12391), even further inland, so *F. schaeferi* is not restricted to near-coastal habitats. The inland stations benefit from coastal fog, the additional precipitation allowing this otherwise coastal species to extend into the interior.

Unlike the flowers of the related species, *Ferraria crispa* and *F. foliosa*, those of *F. schaeferi* sometimes have, at least to the human nose, a pleasant, sweet scent reminiscent of violets, but with a slightly sour undertone. We have noted in cultivated plants that some have sweeter-scented flowers at cool temperatures, whereas others smell putrid both at cooler and warm temperatures. Whatever the scent, the flowers of *F. schaeferi* are visited exclusively by a range of small and large fly species, mostly of the families Muscidae and Calliphoridae that forage on the droplets of sweet nectar on the nectaries.

Diagnosis and relationships: with a basic floral morphology very much like that of *Ferraria crispa* and *F. foliosa*, *F. schaeferi* has widely spreading tepals, the broad claws of which form a shallow cup, $\pm$ 8 mm deep and some 12 mm wide at the rim. The tepal claws bear large heart-shaped nectaries, while the limbs have a creamy pale yellow ground colour speckled with small dark brown spots, the same colour as the crisped margins. In vegetative form, *Ferraria schaeferi* most closely resembles *F. foliosa* which also has the leaves and branches arranged in a two-ranked spiral, and the leaf blades are similarly thick and leathery with a weakly defined central vein. In addition to the differently coloured perianth, the ovary and capsule have a pronounced beak up to 8 mm long, that readily separates *F. schaeferi* from *F. foliosa*. In its normally sandy habitat, plants spread vegetatively on long runners produced from the base of the stem that can extend below the ground a metre or more from the parent plant, each terminating in a corm.

Although first collected in October 1830 on the south side of the Orange River by the important early plant explorer in South Africa, J.F. Drège (*Drège s.n.*, P), *Ferraria schaeferi* is based on an early 20th century collection made about 1912 to 1913 by the medical doctor, Fritz Schäfer, who worked on the Lüderitz Bay–Keetmanshoop railway in the then German colony of South West Africa (Gunn & Codd 1981), now Namibia. Schäfer made two collections in the Klinghardt Mtns in the Namib Desert south of Lüderitz Bay, and these specimens formed the basis for Dinter's description of *F. schaeferi*. The broad similarity of the plant to *F. crispa*

led 19th century botanists to overlook the Drège collection, which lacks flowers, but has the characteristic beaked capsules that mark *F. schaeferi* unmistakably.

Representative specimens

NAMIBIA.—2615 (Lüderitz): Kosisberge, (–AA), 8 Sept. 1929, Dinter 6689 (B); Lüderitzbucht, (–AC), Sept. 1917, Knobel s.n. (SAM12783); Kowis Mtns, east of Lüderitz, 644 m, (–AA), 15 Aug. 2001, Smook 11394 (PRE); east of Grosse Bucht, wind farm site, (–CC), 21 Sept. 2001, Mannheimer & Burke 1703 (WIND). 2715 (Bogenfels): south Namib opposite Possession Is., (–AA), 10 Oct. 1976, De Vos 2379 (NBG); Granietberg near Bogenfels, (–AA), Aug. 1911, Schaefer 14 (sub Marloth 5249) (PRE); Buchubergen, (–DD), 9 Aug. 1929, Dinter 6584 (B). 2816 (Oranjemund): rocky outcrop before Schakel Mtn among quartzite stones, (–BA), 31 Jul. 1977, Muller 752 (WIND).

NORTHERN CAPE.—2816 (Oranjemund): Beauvallon, sanddune, (–DA), 22 Aug. 2001, Goldblatt & Porter 11739 (MO); 19 Jul. 2002, Manning 2746 (NBG). 2817 (Vioolsdrif): stony gravel flats near Arrisdrif, banks of Orange River, (–AC), 31 Aug. 1925, Marloth 12391 (PRE). 2916 (Port Nolloth): 5 km E of Port Nolloth, (–BC), 22 Aug. 2001, Goldblatt & Porter 11734A (MO). 2917 (Springbok): Grootmis, sanddune, (–CA), Oct. 1977, De Vos 2391 (NBG).

8. *Ferraria ovata* (Thunb.) Goldblatt & J.C.Manning in Novon 12: 461 (2002). *Moraea ovata* Thunb.: 186 (1800). Type: South Africa, [Northern Cape,] Namaqualand, near Kooksfontein [as Koksfontein, also Cocksfonteyn], (now Soebatsfontein), without date, probably in 1793, Masson s.n. UPS-THUNB1225 (UPS-THUNB, holo.).

Plants often small, (40–)100–200 mm high. *Stem* erect, unbranched, lower half partly exposed. *Leaves*: basal and juvenile with short, linear blades, up to 45 $\times$ 2 mm; cauline entirely bifacial, broadly ovate to rotund, amplexicaul, 15–18 mm long, spreading, concave; margins membranous, often reddish. *Rhipidia* 2-flowered; spathes leafy, green, often brown at tips, inner 18–20 mm long, outer 12–20 mm long, sheathing in lower half, arching outward above. *Flowers* on pedicels 7–12 mm long, lasting a single day, pale yellow with brown spots in midline and base of limbs, margins closely crisped, dark brown, acrid-smelling, tepal claws broad, 7–8 mm long, forming a cup $\pm$ 7 mm deep, $\pm$ 8 mm wide at rim, nectaries $\pm$ 2 mm long, above base of claws, $\pm$ 2 $\times$ 2 mm, paired or bilobed, greenish, tepal limbs spreading; outer tepals 17–20 mm long, limbs 8–12 mm long, inner slightly smaller than outer. *Stamens* with filaments united in a column 7–8 mm long, free in upper 1 mm; anther thecae parallel, $\pm$ 2 mm long; pollen orange. *Ovary* included, spindle-shaped, $\pm$ 6 mm long, without beak; style branches $\pm$ 2 mm long, diverging into prominently fringed arms; stigmas terminal on style arms. *Capsules* ovoid (mature capsules and seeds unknown). *Flowering time*: Jun.–Jul. Figure 7A–E.

Distribution and biology: found on granitic slopes and clay-loam flats, *Ferraria ovata* is restricted to central Namaqualand, South Africa, where it has been recorded from a few isolated sites from Soebatsfontein in the north to the low hills of the southern Kamiesberg between Kliprand and Bitterfontein (Figure 8). Plants typically grow in gritty granitic gravel among rocks that protect the corms from predation. Like those of other species of sect. *Ferraria*, the flowers of *F. ovata* seem adapted for pollination by muscid and blowflies.

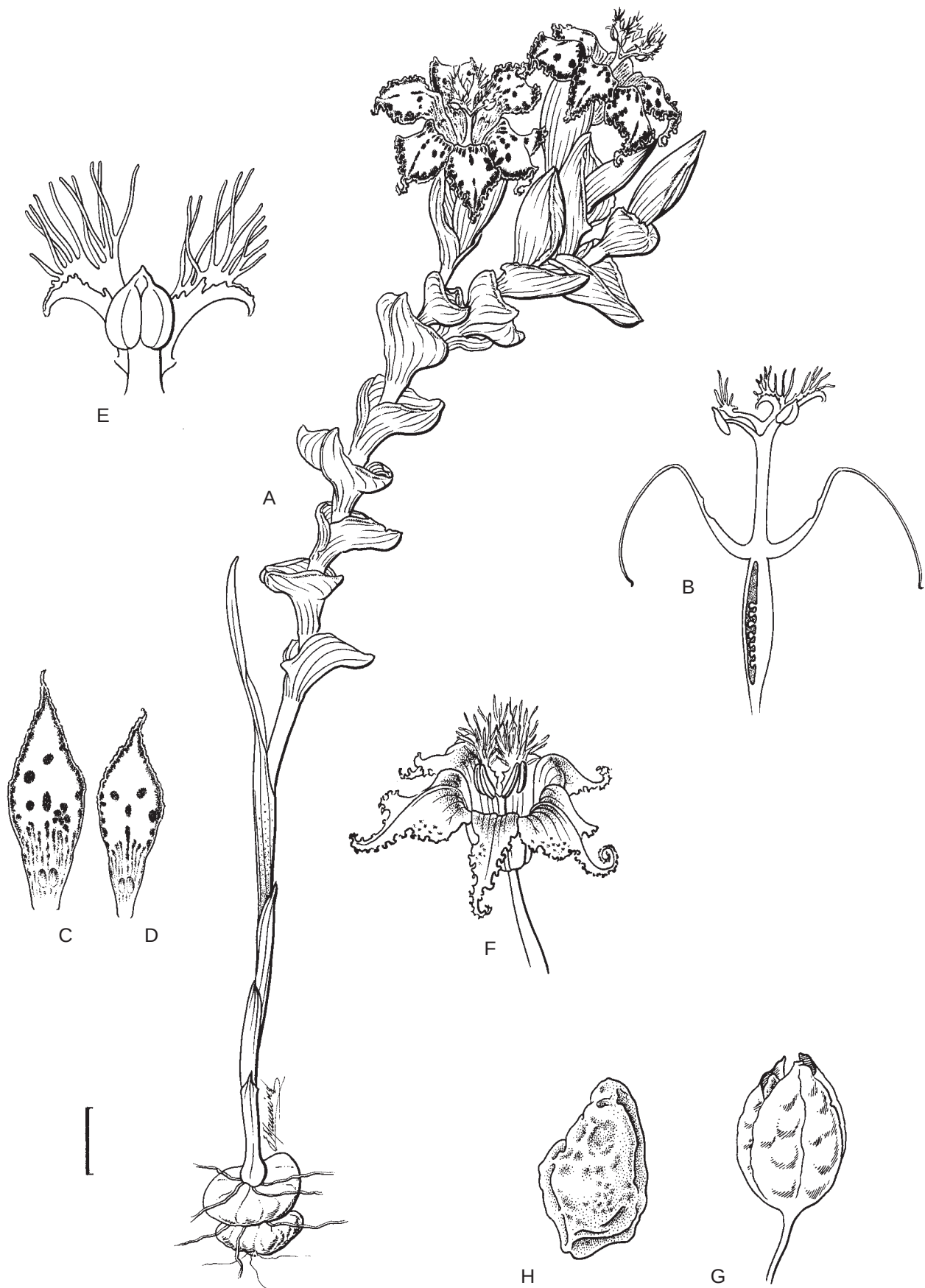


FIGURE 7.—A–E, *Ferraria ovata*: A, whole plant; B, half-flower; C, outer tepal; D, inner tepal; E, anther and style branches. F, *Ferraria variabilis*: flower. G, H, *F. densepunctulata*: G, capsule; H, seed. Scale bar: A, C, D, F, G, 10 mm; B, 5 mm; E, 2 mm; H, 1.5 mm. Artist: J.C. Manning.

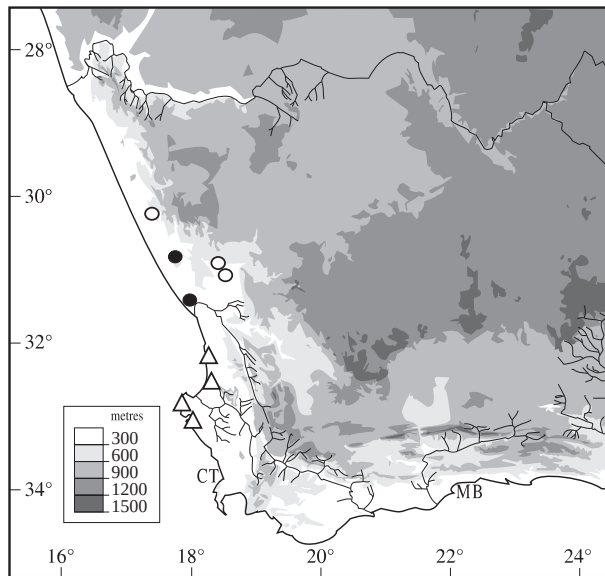


FIGURE 8.—Known distribution of *Ferraria densepunctulata*, △; *F. ovata*, ○; *F. ornata*, ●.

Diagnosis and relationships: the parallel anthers, wide and shallow tepal cup, spindle-shaped ovary without a beak, and stigmas terminal on the style arms, show that *Ferraria ovata* belongs in sect. *Ferraria*. It most closely resembles the coastal species *F. densepunctulata*, which also has dimorphic basal and cauline leaves, a sparsely branched or unbranched stem, and the relatively small bilobed or paired nectaries located well above the base of the tepal claws. It is one of three winter flowering species in the genus, the others being the coastal species, *F. densepunctulata* and *F. ornata*.

History: one of the rarest species of the genus, *Ferraria ovata* was first collected in the 1790s, probably in 1793, by the Royal Botanic Gardens Kew collector, Francis Masson, and not again for over 200 years. The species was described as *Moraea ovata* by Thunberg in 1800, based on Masson's collection, which was in fruit and without corms. Plants were rediscovered in 1995 by botanist, Annelise le Roux, who collected a sterile specimen near Soebatsfontein in central Namaqualand. A later record by P. Desmond and party, also sterile, finally led us to a site with plants in bloom near Kliprand, east of Bitterfontein (Manning 2350), in June 2001, when it became clear that the plants represented an unknown species of *Ferraria* (Goldblatt & Manning 2002).

Representative specimens

NORTHERN CAPE.—3017 (Hondeklipbaai): Namaqualand, Farm Doornfontein 464, Steenkamp Kraal, sandy loam slope, (–BA), 2 Sept. 1995 (sterile), *Le Roux* 4658 (JONK).

WESTERN CAPE.—3018 (Kamiesberg): Farm Gannabos, 25 km from Bitterfontein on road to Kliprand, granite outcrops, (–CD), 10 Aug. 2000 (fr.), *Goldblatt & Manning* 11373 (MO, NBG), 10 Jun. 2001, *Manning* 2350 (MO, NBG); Knersvlakte, Farm Steenbokskraal, (–CD), 20 Aug. 1999 (fr.), *National Geographic-IPC Expedition* 115 (NBG).

9. *Ferraria densepunctulata* M.P.de Vos in *Journal of South African Botany* 45: 346 (1979). Type: South Africa, [Western Cape], Elandsbaai [Elands Bay], 14 Jun. 1974, *Loubser sub De Vos* 2317 (STE, holo.!; PRE, iso.!).

Plants slender, mostly 120–250 mm high. *Stem* several-branched in upper half, lower half of stem partly visible; leaf sheaths and cataphylls often flushed red with pale spotting. *Leaves*: basal with long compressed-cylindrical blades, loosely 2-ranked, 3–5 mm wide, with narrow hyaline to reddish margins; cauline leaves shorter, spreading outward, tips often hooked; juvenile leaves in a 2-ranked cluster, up to 6, terete, hollow, dark green. *Rhipidia* 2-flowered; spathes green with narrow membranous margins either pale or flushed red; inner 40–50 mm long, outer $\pm$ 25 mm long, sheathing below, diverging and hooked distally. *Flowers* on pedicels slightly shorter to $\pm$ as long as spathes, lasting two days, pale greenish to grey-blue, outer tepals densely speckled with small maroon to purple or dark blue spots, inner tepal limbs maroon to purple or dark blue blotch in lower $\frac{1}{2}$, faintly spice-scented, tepal claws forming a shallow cup, $\pm$ 9 mm deep, 15–20 mm wide at rim; nectaries bilobed, above base of outer tepal claws, in midline of inner tepal claws, tepal limbs spreading horizontally, undulate or only slightly crisped; outer tepals $25\text{--}30 \times 11\text{--}13$ mm, inner tepals $20\text{--}23 \times \pm 10$ mm, claws of both whorls ± 10 mm long, inner much narrower than outer. *Stamens* with filaments united in a column 8–10 mm long, free in upper ± 2 mm; anther thecae parallel, ± 4 mm long before anthesis; pollen orange or dull yellow. *Ovary* sometimes exserted, spindle-shaped, 12–15 mm long, without obvious beak but without ovules in upper 3–4 mm; style ± 10 mm long, style branches ± 3 mm long, divided in upper $\frac{1}{3}$ into diverging, fringed arms; stigmas terminal on style arms. *Capsules* ovoid, 15–25 mm long, apex subacute. *Seeds* pale glossy brown, ± 3 mm diam., 5-sided with facets slightly wrinkled. *Flowering time*: May–Jul. Figure 7G, H.

Distribution and biology: *Ferraria densepunctulata* grows in rocky or calcareous sandy sites along the Western Cape coast of South Africa, from Lambert's Bay in the north to Langebaan in the south (Figure 8). At Jacobsbaai near Saldanha, plants grow in limestone pavement. The spice-scented flowers are pollinated by a range of short-tongued flies.

Diagnosis and relationships: early flowering and relatively rare, *Ferraria densepunctulata* was only described in 1979 by M.P. de Vos, and until she began her study of the genus, the species was known from just three collections, the first made by C.L. Leipoldt in June 1941 in the hills at Langebaan, south of Saldanha, still the most southerly record. The species is distinctive in the narrow basal leaves, oval in cross section, and rather different from the shorter, broader cauline leaves, and in the unusually coloured flowers, minutely dark blue to purple spotted on a pale greenish to grey-blue background, but with the limbs of the inner tepals so densely speckled as to appear solidly coloured, either maroon or dark slate blue. The flowers are also unusual in the genus in having the tepal limb margins undulate instead of closely crisped. The small bilobed nectaries are located at the base of the outer tepals but in the midline of the inner tepal claws, the lower halves of which are linear and ± 1 mm wide. Like other members of sect. *Ferraria*, the stigmas are terminal on the arms of the style branches and the ovary is not beaked as in all but *F. schaeferi* of the section. The flowers are unique in the section in last-

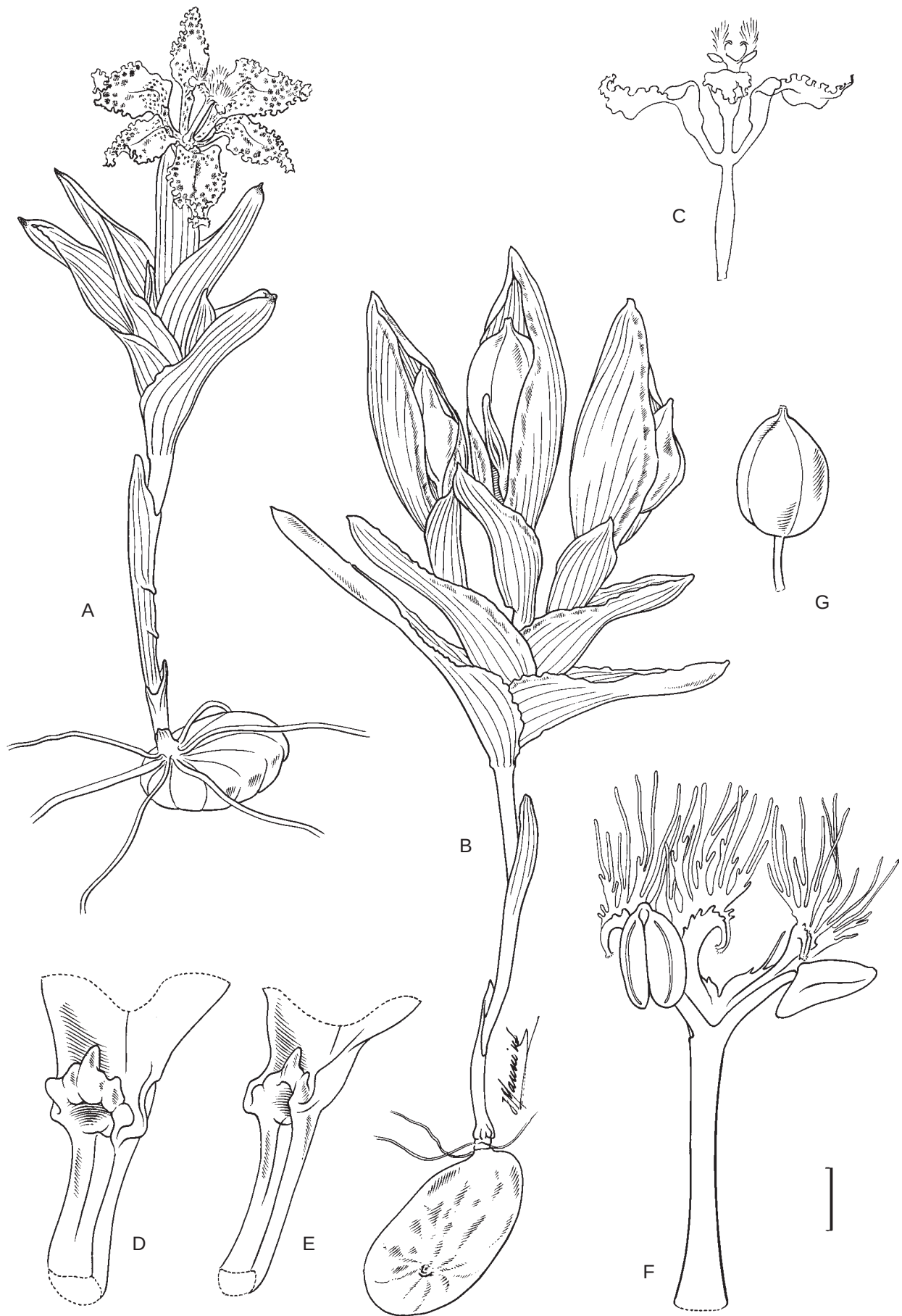


FIGURE 9.—*Ferraria ornata*, Manning 3174. A, flowering plant; B, fruiting plant; C, outline side view of flower; D, claw of outer tepal; E, claw of inner tepal; F, staminal columns and style; G, capsule. Scale bar: A–C, G: 10 mm; D, E, 0.5 mm; F, 1.5 mm. Artist: J.C. Manning.

ing two days instead of a single day. The leaves of non-flowering plants are so strikingly different from those of mature, flowering individuals that they appear to represent a different species. Four to six in number, they are held in a close, 2-ranked fan and the blades are dark green, terete and hollow.

The early flowering habit of *Ferraria densepunctulata* is now known to be matched in the genus by *F. ornata* and *F. ovata*, both of which also have the narrow basal leaves differentiated from the shorter and broader cauline leaves.

Representative specimens

WESTERN CAPE.—3217 (Vredenburg): Jacobsbaai, in limestone pavement, (–DD), Aug. 2007 (fr.), Goldblatt & Manning 12914A (MO); Cape Columbine, hill adjacent to lighthouse, in sand with limestone gravel, (–DD), 8 Sept. 2009, Goldblatt & Porter 13285 (MO, NBG). 3218 (Clanwilliam): Langdam, near Lambert's Bay, (–AB), Jun. 1974, De Vos 2298 (NBG); Elands Bay, near school, (–AB), 17 May 1966, Pamphlett 98 (NBG); Farm St Helenafontein, sandy ground, (–DB), 11 Sept. 2008 (fr.), Goldblatt & Porter 13111 (MO, NBG). 3318 (Cape Town): Langebaan, hills behind hotel, (–AA), Jun. 1941, Leipoldt 3844 (BOL).

10. *Ferraria ornata* Goldblatt & J.C.Manning, sp. nov.

Plantae acaulescentes usitate 50–80 mm altae, foliis 4 vel 5 amplexicaulibus concavo-lanceolatis ad 40×15 mm, lamina folii basalis 5–10 mm longa subtereti ad cylindrica, spathis coriaceis glaucis marginibus translucentibus spatha interna 40–50 mm longa externa 20–30 mm longa extrinsecus arcuata, floribus albis tepalis basi pallide flavis, limbis unguibusque brunneis maculatis inodoris, marginibus undulatis crispisque, nectaribus bilobis in medio unguum marginibus distalibus cristis prominentibus, tepalis inaequalibus externis $\pm 19 \times 10$ mm unguibus ± 8 mm longis ± 2 mm latis ad basem, internis $\pm 13 \times 6$ mm unguibus ± 6.0 longis ± 1.5 mm latis ad basem, columna filamentorum ± 8 –9 mm longa, antheris ± 3 mm longis brunneis lobis paralleli, ovario fusiformi incluso 10–12 mm longo, ramis styli fimbriatis.

TYPE.—Northern Cape, 3017 (Hondeklipbaai): central Namaqualand, sandy slopes 10 km inland from Groen River mouth, Farm Van Zylsrus, 500 m along dirt track N of main road, strandveld in deep sand, (–DC), 2 Jun. 2008, Manning 3174 (NBG, holo.; MO, iso.).

Plants acaulescent, congested, 50–80 mm high. *Stem* 2–4-branched; replacement corms not present at flowering, developing later; cataphylls (usually only uppermost) turning red above ground. *Leaves* 4 or 5, amplexicaul, lanceolate-concave, up to 40×15 mm, glaucous with purple tips; margins reddish membranous, finely crisped, basal leaf with blades only 5–10 mm long, subterete to cylindrical, obtuse-apiculate, 3–4 mm diam.; non-flowering plants with 1–3(–5) leaves; blades suberect or falcate, subterete or cylindrical, $\pm$ quadrangular to round in section, 60–80 $\times$ 2–4 mm, obtuse-apiculate, glaucous with purple apex and sheath, sheath margins and veins abaxially minutely hairy. *Rhipidia* 2-flowered; spathes leathery, glaucous, with translucent, membranous margins, inner 40–50 mm long, outer much smaller, 20–30 mm long, sheathing in lower half, arching outward. *Flowers* on pedicels 30–40 mm long,

lasting a single day, white with base of tepal limbs yellow, limbs finely brown-spotted basally and with fewer, larger brown spots distally, margins finely crisped, yellow and brown, claws streaked with brown, unscented, with bilobed, concave nectaries in middle of claws, distal nectary margin prominently crested, pale lilac with purple streaks, tepal claws narrowed below, forming a windowed cup 7–8 mm deep and ± 10 mm wide at rim, limbs spreading or slightly reflexed; tepals unequal, outer $\pm 19 \times 10$ mm with claws ascending, ± 8 mm long, narrowed below and ± 2 mm wide, inner $\pm 13 \times 6$ mm with claws ± 6 mm long, narrow proximal part ± 1.5 mm wide. *Stamens* with filaments united in column 8–9 mm long, free in upper ± 2 mm; anthers diverging, thecae parallel, ± 3 mm long, brown; pollen orange. *Ovary* included, spindle-shaped, 10–12 mm long; style branches diverging, deeply divided into diverging, fringed arms; stigmas terminal on style arms. *Capsules* broadly ovoid, 14–18 mm long, tapering to acute tip. *Seeds* irregularly 5(6)-sided, $\pm 3 \times 2$ mm, facets separated by pale straw-coloured, wavy ridges, facet surfaces usually $\pm$ plane and dark brown. *Flowering time*: May to early Jun. Figure 9, Plate 1H.

Distribution and biology: *Ferraria ornata* is known from two extended populations, one on slopes above the lower Groen River in central Namaqualand and the other west of Koekenaap in southern Namaqualand, some 120 km to the south. It occurs on sandy ground in sandveld (Figure 8). At its northern site on the northern bank of the Groen River, ± 10 km inland from the Atlantic coast, plants occur in localized colonies in deep, gritty, sandy soil in Namaqualand Strandveld vegetation among succulent shrubs, including *Othonna cylindrica* and *O. coronopifolia*. The plants appear to be habitat specific and were not located in patches of Namaqualand Coastal Fynbos that interdigitate with the strandveld. Plants flower early in the season, after the first rains, in May or June, and last a single day, opening $\pm 08:00$ and collapsing $\pm 16:00$. Branches are produced in the upper one or two leaf axils, which extend the flowering period for some weeks, possibly into early July in years of favourable rainfall. Juvenile and non-flowering plants produce a tuft of cylindrical leaves quite different from those on flowering individuals. Replacement corms of flowering individuals are absent at flowering and develop later as the capsules ripen.

The species was discovered by Cape Town ecologist, Rupert Koopman, who collected a fruiting specimen in spring 2007. The locality was visited in the following winter in a year of poor rainfall but we were able to locate a single flowering individual for description and illustration.

Diagnosis and relationships: stemless, and with the tepal claws unusually narrow in the lower part, thus forming a windowed cup, *Ferraria ornata* is easily recognized by its small size, flowering individuals standing only 50–80 mm high. The flowers are unique in the fleshy crests bordering the distal margins of the nectaries, which are situated in the middle of the tepal claws, and which secrete miniscule quantities of sticky, sweet nectar. The flowers appear scentless to the human nose. The short, concave cauline leaves of flowering plants stand in marked contrast to the long, centric leaves of

non-flowering individuals. Both the early flowering and unusual, concave cauline leaves of flowering plants suggest it is most closely allied to *F. ovata*, which has a similar growth strategy of early flowering and small, concave cauline leaves on a taller flowering stem.

Additional specimens

NORTHERN CAPE.—3017 (Hondeklipbaai): same locality as type collection, Aug. 2007 (fr. and sterile), *Koopman s.n.* (NBG).

WESTERN CAPE.—3118 (Vanrhynsdorp): Farm Kommandokraal west of Koekenaap, sandveld, ± 80 m, (–CA), 9 Sept. 2008 (fr.), *Goldblatt & Porter 13098* (K, MO, NBG, PRE).

B2. Sect. **Macroscyphae** Baker in Journal of the Linnean Society 16: 106 (1877); De Vos: 349 (1979). Type species: *Ferraria divaricata* Sweet (lectotype designated by De Vos 1979: 350).

Flowers with tepal claws forming a deep, wide or narrow cup containing fluid nectar; filaments inserted near apex of anthers; anther lobes when fully dehiscent usually widely divergent, rarely parallel but never contiguous. Ovary always with sterile beak; stigmas on lobes below apices of style branch arms. Capsules with prominent beak.

Series Subdivaricatae

11. ***Ferraria ferrariola* (Jacq.) Willd.**, Species plantarum edn 4, 3: 581 (1800); De Vos: 350 (1979). *Moraea ferrariola* Jacq.: (1790). Type: South Africa, without precise locality or collector, illustration in Plantarum rariorum horti caesarei schoenbrunnensis 4: 24, t. 450 (1804).

F. viridiflora Andrews: 285 (1803) [*F. viridis* Ker Gawl. (1804) orth. var.]. Type: South Africa, collected by W. Synnot, without precise locality, illustration in The botanist's repository 4: t. 285 (1803); no preserved material known.

F. longa Barnes: 313 (1930). Type: South Africa, [Northern Cape], Nieuwoudtville, cultivated at Kirstenbosch, Jul. 1930, *P. Ross-Frames s.n.* BOL19720 (BOL, holo.).

Plants slender, mostly 150–250 mm high. Stem sheathed below by mottled cataphylls and leaf sheaths; lower internodes usually partly exposed, usually branched in upper $\frac{1}{2}$. Leaves: basal linear, unifacial, usually slightly longer than stem, mostly 2–3 mm wide, main vein usually well delineated; cauline leaves markedly shorter and broader than basal leaves and resembling spathes. *Rhipidia* 2-flowered; spathes glaucous or pale green, with broad transparent margins, inner 45–60(–70) long, often inflated, outer $\pm \frac{1}{2}$ to $\frac{2}{3}$ as long, sheathing below, diverging in upper half and $\pm$ hooked at tips. Flowers on pedicels 20–30 mm long, lasting two days, greenish blue, grey-blue, or pale watery yellow to pale green, usually with darker spots and streaks on outer tepal limbs, faintly sweet- or spice-scented, sometimes odourless, tepal claws forming a narrow, closed cup, 17–20 mm deep, ± 12 mm wide at mouth; nectaries small, at base of tepals; outer tepals (30–)35–40 mm long, claws fairly narrow, 17–20 mm long, inner slightly shorter and narrower, limbs of outer $\pm$ spreading, inner usually reflexed. Stamens with filaments united in a column 14–19 mm long, free in upper 1–2 mm; anther thecae initially parallel, ± 4 mm long at anthesis, later diverging and shrinking to almost 2 mm. Ovary spindle-shaped, 20–25 mm long, with sterile beak,

(5–)8–12 mm long; style branches ± 2.5 mm long, dividing into diverging, fringed arms, ± 2.5 mm long; stigmas irregularly shaped lobes in middle of style arms, arching over anthers. Capsules ovoid-oblong, 14–20(–25) mm long, beak (5–)8–12 mm long. Seeds mostly 5-sided, $3.0\text{--}3.5 \times 2.5\text{--}3.0$ mm, smooth, shiny, brown, facets separated by prominent, pale wavy ridges, facets light yellow-brown with surfaces smooth or slightly wrinkled. Flowering time: Jun.–Aug. Plate 1F.

Distribution and biology: usually in rocky sites, the relatively common *Ferraria ferrariola* is found on granite and sandstone slopes, or in sandy ground usually not far from rock outcrops. Its range extends from the Richtersveld in northern Namaqualand to the Bokkeveld and Olifants River Mtns as far south as Clanwilliam (Figure 10). The floral cup contains nectar of moderately high sugar concentration. The scented flowers, which last two days, appear attractive to bees, the only recorded floral visitors (Goldblatt *et al.* 2009). These include honey bees, *Apis mellifera*, and *Anthophora* species, which visit the flowers to forage for nectar, and during their visits accomplish pollination.

Diagnosis and relationships: *Ferraria ferrariola* is readily recognized by the linear basal leaves, quite different from the shorter cauline leaves, the stem usually partly exposed, and the red-flushed and white-speckled cataphylls and sheath of the lowermost leaf. The large flowers have a deep and relatively narrow floral cup, 17–20 deep and ± 12 mm wide at the mouth. The flowers are usually shades of turquoise-grey to pale slate-blue with a pale yellow nectar guide lightly speckled with darker colour on the limbs of the outer tepals (Manning *et al.* 2002: 157). The flowers have a faint sweet odour, often with spicy overtones of almond or cinnamon or vanilla, unique in the genus.

The relationships of *Ferraria ferrariola* are evidently with sect. *Macroscyphae* with which it shares the divergent anther lobes and large stigma lobes below the tips of the style arms, as well as a prominently beaked ovary.

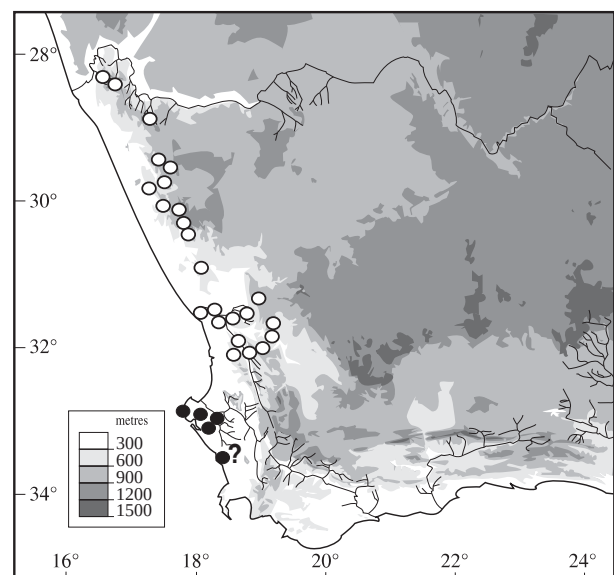


FIGURE 10.—Known distribution of *Ferraria ferrariola*, O; *F. parva*, ●.

The sharp dimorphism between the basal and cauline leaves does not occur in other species of the section, but is found in *F. densepunctulata* and *F. ovata* of sect. *Ferraria*, and in *F. glutinosa* of subgen. *Glutinosae*. These species are, however, otherwise very different in having flowers with the tepal claws forming a wide, shallow cup, anthers with parallel lobes, small stigmatic surfaces terminal on the style arms, and an ovary lacking a beak.

In our Western Cape Wildflower Guide (Manning & Goldblatt 1996: 51) we misidentified as *Ferraria ferrariola* the photograph of a second species, *F. parva*, described here as new. Whereas the two have flowers of similar shape, divaricate anthers, and a narrow floral cup, those of *F. parva* are much smaller, with a floral cup, ± 6 mm deep, and outer tepals 18–22 mm long, compared to (30–)35–40 mm in *F. ferrariola*. The sheaths and cataphylls of *F. parva* also lack the red flush and white speckling so characteristic of *F. ferrariola*.

Representative specimens

NORTHERN CAPE.—2817 (Vioolsdrif): Richtersveld, Kodaspiek, stony clay loam, (–AA), 2 Sept. 1977, *Oliver, Toelken & Venter* 395 (PRE); Armanshoek, moist gorge, (–AC), Aug. 1995, *Williamson & Williamson* 5647 (NBG); stony flats ± 4 km N of Eksteenfontein, (–CD), 23 Aug. 2001 (fr.), *Goldblatt & Porter* 11755 (MO). 2917 (Springbok): granite dome W of Springbok, (–DB), 21 Aug. 2002, *Goldblatt & Porter* 12085 (MO). 3017 (Hondeklipbaai): Kamieskroon, (–BB), 24 Jul. 1941, *Compton* 11110 (NBG); flats east of Karkams on Tweerivieren road, (–BD), 21 Aug. 2001, *Goldblatt & Porter* 11723 (MO). 3119 (Calvinia): Nieuwoudtville Wildflower Reserve, dolerite rocks, (–AC), 11 Aug. 1983, *Perry & Snijman* 2276 (NBG); Botterkloof Pass, (–CA), 12 Aug. 1983, *Van Wyk* 1453 (NBG); top of Botterkloof, (–CC), 28 Jul. 1948, *Lewis* 1992 (SAM).

WESTERN CAPE.—3018 (Kamiesberg): ± 9 km N of Bitterfontein, (–CC), 20 Aug. 2001, *Goldblatt & Porter* 11713A (MO). 3118 (Vanrhynsdorp): Holrivier, stony hills, (–AD), 11 Aug. 1970, *Hall* 3730 (NBG); Farm Kliphoeck, 10 miles [16 km] east of Doringbaai, (–CC), 12 Aug. 1970, *Hall* 3743 (NBG). 3218 (Clanwilliam): Pakhuis Pass, west end, (–BB), 23 Aug. 1966, *Barker* 10454 (NBG); Clanwilliam, 350 ft [106 m], (–BB), 22 Aug. 1896, *Schlechter* 8597 (PRE). 3219 (Wuppertal): between Pakhuis and Botterkloof, 2 km past Bidouw turn-off, (–AA), 4 Sept. 1976 (fr.), *De Vos* 2369 (NBG).

12. *Ferraria parva* Goldblatt & J.C.Manning, sp. nov.

Plantae usitate 80–150 mm altae, foliis unifacialibus, basalibus 2–3 linearibus 3–5 mm latis, caulibus lanceolatis 4–6 mm latis, spathis pallidis viridibus interne 45–65 mm longis, externe $\pm$ dimidio longiore interne, floribus atroflavis ad pallide caeruleo-viridibus atromaculatis, marginibus crispis bubalinis, tepalis exterioribus 18–22 mm longis, columna filamentorum ± 6 mm longis, antheris ± 3 mm longis lobis divaricatis.

TYPE.—Western Cape, 3217 (Vredenburg): sandveld west of Vredenburg, north side of Saldanha highway, opposite cemetery, under shrubs and restios, (–DD), 19 Sept. 2007, *Goldblatt & Manning* 13000 (NBG, holo.; MO, iso.).

Plants mostly 80–150 mm high, not including basal leaves. Stem branched near base and in upper part, lower $\frac{1}{2}$ often partly exposed; cataphylls and sheath of lowermost leaf pale. Leaves unifacial, basal 2 or 3 $\pm$ linear, usually exceeding spathes, 3–5 mm wide, upper leaves subtending branches lanceolate, spreading, shorter and wider than basal, mostly 4–6 mm wide, margins and

main vein not evident when alive; non-flowering plants with 2 or 3 linear leaves, oval in cross section, without differentiated margins or main vein. *Rhipidia* 2-flowered; spathes pale green, apices slightly hooked, inner 45–65 mm long, often inflated with age, margins transparent, outer spathe $\pm \frac{1}{2}$ as long as inner, often diverging in upper $\frac{1}{3}$. Flowers on pedicels 18–20 mm long, lasting 2 days, spotted with dark brown in a dull yellow, light red-brown or pale greenish blue background, margins crisped, buff to khaki, sweetly scented of a mix of jasmine and coconut, tepal claws forming a narrow cup ± 8 mm deep, ± 7 mm wide at rim; outer tepals 18–22 $\times$ 8–10 mm, claws 7–8 mm long with a pouch-like bilobed nectary in lower midline; inner tepal slightly shorter and $\pm \frac{1}{2}$ as wide, limbs slightly reflexed, inner more so than outer. Stamens with filaments united in a column ± 6 mm long, free in upper ± 1.5 mm; anther thecae initially parallel, later divaricate, ± 3 mm long at anthesis, later $\pm \frac{2}{3}$ as long. Ovary fusiform, 12–15 mm long, with a sterile beak up to 7 mm long; style branches ± 2 mm long, forked in upper $\frac{1}{2}$, prominently fringed; stigmas narrow, at lateral ends of style branches, arching forward. Capsules ovoid-oblong, 15–20 mm long, with beak up to 2–7 mm long. Seeds angular, smooth, shiny, golden brown, mostly 5-sided, facets smooth or slightly wrinkled. Flowering time: late Aug.–mid-Sept. Figure 11, Plate 11.

Distribution and biology: *Ferraria parva* is a surprising discovery—plants grow close to Saldanha and Vredenburg, an area believed to be well-explored botanically. Clearly rare, the species is restricted to sandveld and limestone fynbos on the Western Cape coast between Bokbaai and Vredenburg and the Berg River near Langrietvlei (Figure 10). Plants grow in deep sandy ground, sometimes over limestone, or in cracks in limestone or calcrete pavement. The flowers last two days and have a sweet scent reminiscent of a mix of jasmine and coconut or, less often, a somewhat sour, unpleasant odour. The floral cup contains moderately sweet nectar of mean 24.2 % sucrose equivalents. Pollination biology is unknown but, like its closest relative, *F. ferrariola*, the flowers appear adapted for pollination by bees foraging for nectar. At the type site we noticed plants had been well pollinated. Unfortunately, many plants in the small population had been uprooted and the corms eaten, presumably by porcupines. Apart from the type site, incidentally, the only known locality for *Romulea elliptica* M.P.de Vos, just one other record of the species was known before 2007, made in 1940 by W.F. Barker ‘on the road to Ganzekraal’ (probably the farm southwest of Darling near Bokbaai). Collecting in the Saldanha area in 2008 showed the species to be fairly common in the immediate area of Vredenburg and Saldanha, both on limestone and in sandy ground. The single flower of the Ganzekraal collection is poorly preserved but is comparable in size and has the divaricate anthers and general appearance of *F. parva*.

Diagnosis and relationships: we first encountered *Ferraria parva* in 1995 while taking photographs for the *West Coast Wildflower Guide* (Manning & Goldblatt 1996) and included therein a photograph of the species misidentified as *F. ferrariola*. Later, during our study of *Ferraria*, it became clear that this

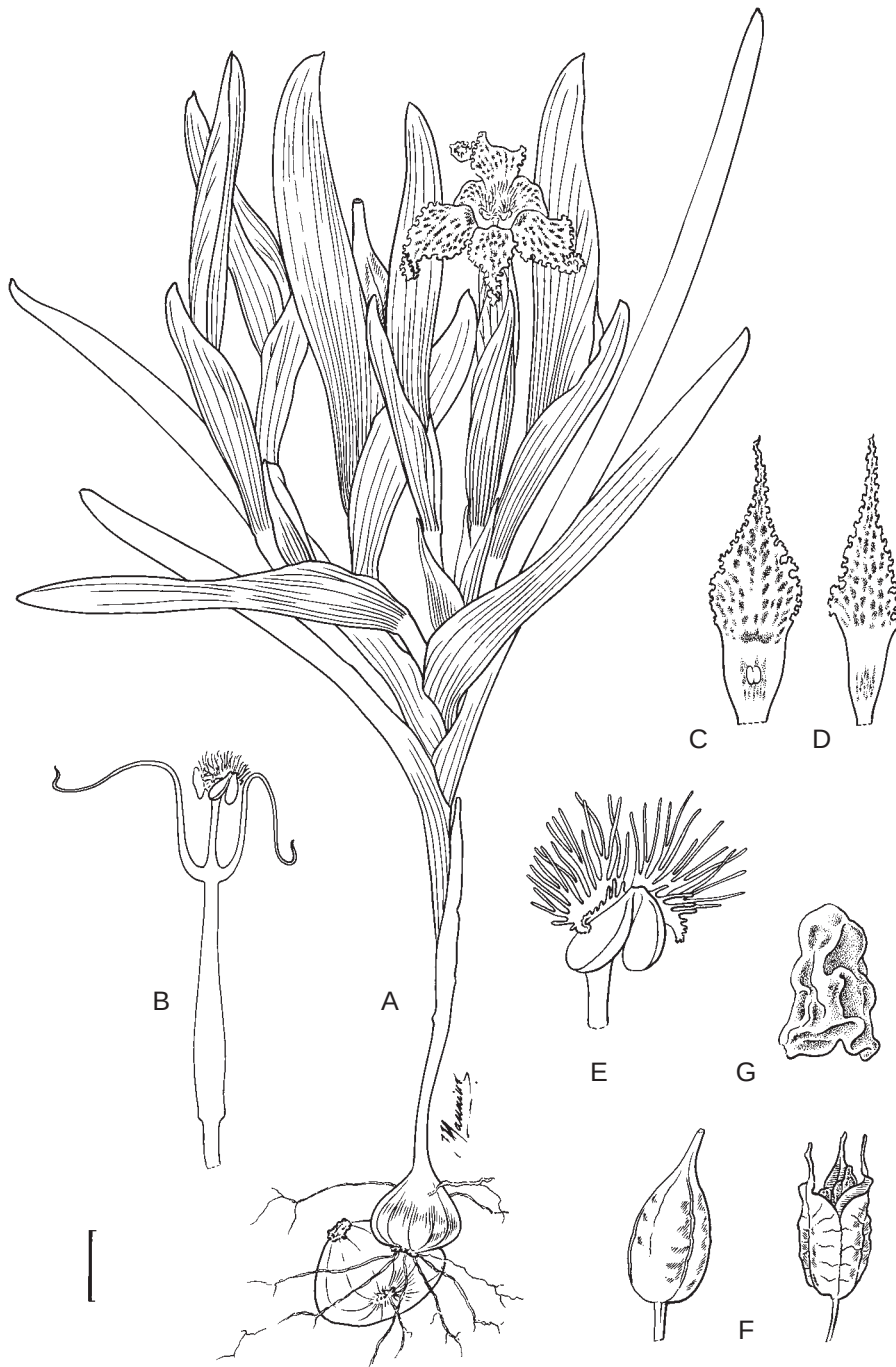


FIGURE 11.—*Ferraria parva*, Goldblatt & Manning 13000. A, flowering plant; B, half flower; C, outer tepal; D, inner tepal; E, anther and single style branch; F, capsules, undehiscent (left) and dehiscent (right); G, seed. Scale bar: A, F, 10 mm; B–D, 5 mm; E, G, 2 mm. Artist: J.C. Manning.

was not *F. ferrariola*, which is a Namaqualand plant that extends south only as far as Clanwilliam, but an unknown species. After repeated searches at the same site, we re-collected the species in September 2007. The flower is similar to *F. ferrariola* in basic structure: it has a narrow floral cup and tepals with slightly reflexed limbs but the flower is less than half the size of those of *F. ferrariola*, the tepals just 18–22 mm long, the floral cup $\pm$ 8 mm deep and filament column $\pm$ 6 mm long, compared with outer tepals (30–)35–40 mm long, a floral cup 17–20 mm deep and a filament column 14–19 mm long of *F. ferrariola*. The cataphylls and sheath of the basal leaf of *F. parva* are uniformly coloured in contrast to the speckled and usually red-flushed cataphylls and sheaths of *F. ferrariola*.

Representative specimens

WESTERN CAPE.—3217 (Vredenburg): sandveld west of Vredenburg, (–DD), 29 Aug. 1995, Goldblatt & Manning 10271 (MO); limestone-topped hill north of Saldanha, (–DD), 13 Sept. 2008, Goldblatt & Porter 13117 (MO, NBG, PRE). 3218 (Clanwilliam): *Eriocephalus*-dominated sandveld on Farm Brakfontein (Nuweland) south of Langrietvlei, (–CC), 6 Sept. 2008, Goldblatt & Porter 13077 (K, MO, NBG, PRE, S); sandveld near Langebaanweg Fossil Park, (–CC), Goldblatt & Porter 13150 (MO, NBG). 3318 (Cape Town): road to Ganzekraal, (–?DB), 15 Sept. 1940, Barker 730 (NBG).

Series *Macroscyphae*

13. *Ferraria divaricata* Sweet in British flower garden: t. 192 (1827); De Vos: 354 (1979). Type: South Africa, without precise locality, collected by W. Synnot, illustration in British flower garden: t. 192 (1827) (no preserved material known).

F. divaricata subsp. *arenosa* M.P.de Vos: 358 (1979). Type: South Africa, [Western Cape], Clanwilliam, Nardouw Pass, Farm de Lille, Oct. 1973, *Van Breda sub De Vos* 2295 (NBG, holo.; PRE, iso.).

Plants (250–)350–500 mm high. *Stem* well developed, much-branched distally. *Leaves* sword-shaped to linear, 6–15 mm wide, often with a slightly raised main vein, glaucous, margins sometimes slightly raised, basal leaves longest, cauline leaves progressively shorter above and becoming spathe-like. *Rhipidia* 2-flowered; spathes glaucous, with broad membranous margins, inner 70–85 mm long, outer $\pm$ half as long as inner, sheathing entirely or in lower two thirds, then often slightly S-shaped. *Flowers* on pedicels 6–15 mm long, lasting one day, variously dark chocolate to golden brown, crisped part of margins concolourous or paler, claws pale, streaked with fine longitudinal lines or with a broad median darker centre, forming a cup, 14–18 mm deep, 15–18 mm wide at rim; outer tepals (30–)35–44 $\times$ 14–16 mm, inner tepals (28–)36–38 $\times$ 8–10 mm, claws of both whorls (13–)16–19 mm long; nectaries at base of claws, $\pm$ black or pale yellow-green, 1.3–4.0 mm long. *Stamens* with filaments united in a column 11–13 mm long, free and arching outward in upper $\pm$ 3 mm; anther thecae usually widely diverging, initially $\pm$ 4 mm long, shrinking after dehiscence; pollen orange. *Ovary* fusiform, 33–42 mm long including beak 15–20 mm long; style branches $\pm$ 2 mm long, dividing into diverging, prominently fringed arms $\pm$ 4 mm long; stigmas on small lobes below tips of style arms, arching over anthers. *Capsules* 15–22 mm long (excluding beak 15–20 mm long). *Seeds* globose, $\pm$ 3 mm diam., pale matte brown, surfaces lightly wrinkled in $\pm$ ruminate pattern, epidermal cells foveate. *Flowering time*: mainly late Sept. to early Nov.

Distribution and biology: *Ferraria divaricata* extends along the west coast and coastal mountains of Northern Cape and Western Cape, South Africa, from near Komaggas in northern Namaqualand southward to the Cape Flats (Figure 12). Plants grow in deep sandy soils, in sandveld or marginal fynbos habitats. The flowers,

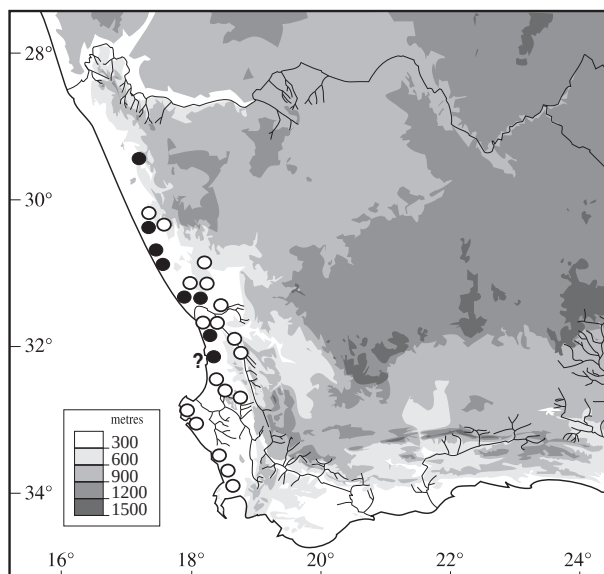


FIGURE 12.—Known distribution of *Ferraria divaricata*, O; *F. flava*, ●.

with a relatively wide, deep floral cup, contain quantities of dilute nectar, seldom more than 8 % sucrose equivalents. This dilute nectar is remarkable as it is an unlikely reward for any potential pollinator. Like its relative, *F. variabilis*, which has a similar floral cup and dilute nectar, the flowers are visited only by vespid and masarine wasps (Eumenidae) (Goldblatt & Manning 2006).

Diagnosis and history: the name *Ferraria divaricata* has been generally applied to the low-growing, usually $\pm$ tufted plant, mostly 100–200 mm tall, now *F. variabilis*, from southwestern Namibia, the Upper Karoo, Namaqualand and Western Cape. This species also has divaricate anthers and pale brown to yellowish tepals with the limbs either speckled or marked with a dark brown to blackish purple band of solid colour at the base and the claws forming a deep floral cup. De Vos (1979) associated the name *F. divaricata* with the northerly populations of *F. variabilis*, which she divided into four subspecies.

Examination of the type, a watercolour illustration in *The British flower garden* led us (Goldblatt & Manning 2004) to question De Vos's interpretation (Goldblatt & Manning 2005) of subsp. *divaricata*. The height, said to be 18 inches (450 mm), the longer basal leaves with a slightly raised central vein and appearing slightly striated when dry as the leaf veins become raised above the surrounding leaf tissue and differentiated from the cauline leaves, plus the exposed stem and uniformly chocolate-brown tepal limbs, seem to us to accord best with the plant De Vos called *F. divaricata* subsp. *arenosa*. This attribution also seems reasonable on circumstantial grounds, for plants depicted in the type illustration were collected (presumably as seed) by Walter Synnot, magistrate (*landdrost*) at Clanwilliam from 1821 to 1825. Synnot collected plants in the Clanwilliam District and nearby (Gunn & Codd 1981), where subsp. *arenosa* is found but there is no evidence that he collected in Namaqualand where subsp. *divaricata sensu* De Vos occurs. This generally tufted plant has flowers with a solid, dark band of colour on the lower half of the tepal limbs. De Vos's two tufted subspecies, subsp. *divaricata* and subsp. *australis*, seem best treated as one species, *F. variabilis*. The fourth subspecies, subsp. *aurea*, is here associated with the new *F. flava*.

The vegetative differences outlined above and the associated different patterns of tepal marking are substantial and are correlated with differences in the seeds. Whereas most *Ferraria* species have brown seeds, compressed by pressure into 5 or 6 smooth, flattened facets separated by thickened ridges, the seeds of plants called subsp. *arenosa* and subsp. *aurea* are globose with reticulate/foveate sculpturing (De Vos 1979). Seeds rarely vary within a species so that differences in seed morphology usually have strong taxonomic significance. Another difference between the last two subspecies is that their flowers last a single day but two days in subsp. *divaricata* and subsp. *australis*.

As here understood, *Ferraria divaricata* is a plant of deep sands or stony sandstone slopes, extending from near Komaggas in northern Namaqualand to the Cape Flats close to Cape Town. Populations extend inland as far as Vanrhynsdorp and the northeastern slopes of the

Piketberg (60–70 km inland). As in most *Ferraria* species, floral pigmentation patterns and colour are variable. The tepal limbs are uniform in colour, except for the margins, and range from light to chocolate-brown with paler margins, or are dull yellow-brown, then with little or no colour difference at the margins. The tepal claws are cream-coloured to palest yellow with fine, dark, longitudinal streaks and usually a dark median stripe.

The Cape Town botanist, H.M.L. Bolus, annotated collections of *Ferraria divaricata* from Langebaan, north of Cape Town, *F. langebaanensis*, but did not publish the name (De Vos 1979).

Representative specimens

NORTHERN CAPE.—3017 (Hondeklipbaai): 1.2 km east of Oubees/Wildepaardehoek boundary, 4.7 km E of Springbok–Soebatsfontein road, (–BA), 15 Oct. 1986, *Le Roux & Lloyd* 664 (NBG); 38 km from Garies to Wallekraal, (–BC), 4 Sept. 1977, *Drijfhout sub De Vos* 2399 (NBG); without precise locality: between Komaggas and Soebatsfontein, 9 Sept. 1950, *Barker* 6740 (NBG).

WESTERN CAPE.—3118 (Vanrhynsdorp): 16 km north of Strandfontein, front of sand dune, (–CA), 12 Sept. 1975, *De Vos* 2356 (NBG); west of Koekenaap, Farm Kommandokraal, (–CA), Sept. 2008, *Goldblatt & Porter* 13188 (NBG); Ratelfontein, Olifants River Mtns, (–DC), 6 Oct. 2004, *Goldblatt & Porter* 12630 (MO). 3218 (Clanwilliam): northeastern slopes of the Piketberg, $\pm$ 28 km north of town, (–DA), 28 Sept. 2001, *Goldblatt & Manning* 11931 (MO, NBG). 3318 (Cape Town): Farm Osfontein east of Saldanha and north of Langebaan, calcareous sand and limestone, (–AA), Nov. 1976, *Boucher s.n.* (PRE); Silwerstroomstrand, (–CA), 20 Nov. 1974, *De Vos* 2339 (NBG); Bellville, University of Western Cape campus, (–DC), 10 Nov. 1976, *De Vos* 2385 (NBG).

14. *Ferraria variabilis* Goldblatt & J.C.Manning in *Bothalia* 35: 73 (2005). Type: South Africa, [Northern Cape,] Nieuwoudtville, Klipkoppies, lower slopes, 15 Sept. 1961, *Barker* 9537 (NBG, holo.!; MO, iso.!).

F. antherosa Ker Gawl.: t. 751 (1804), nom. illegit. superfl. pro *F. viridiflora* [as *F. viridis*] Andrews (= *F. ferrariola* (Jacq.) Willd.). Type: South Africa, without precise locality or collector, illustration in Curtis's Botanical Magazine 19: t. 751 (1804).

F. divaricata subsp. *australis* M.P.de Vos: 359 (1979). Type: South Africa, [Western Cape,] Karoo Garden, Whitehill, 17 Sept. 1945, *Compton* 17412 (NBG, holo.!).

Plants 60–200(–300) mm high. *Stem* often branched just above base, branches crowded and $\pm$ equal in length, often forming small tufts. *Leaves* sword-shaped to linear, usually $\pm$ as long as stem, sometimes up to twice as long, (2–)3–15(–22) mm wide, mostly sub-basal, without visible midrib, often slightly striate, margins often slightly thickened, rarely obscurely crisped, sheaths usually overlapping and concealing stem. *Rhipidia* 2-flowered; spathes glaucous green, inner mostly 60–75 mm long, outer slightly shorter to $\pm$ as $\frac{1}{2}$ as long, entirely sheathing or arching outward in distal third. *Flowers* on pedicels 10–15 mm long, lasting 2 (rarely 3) days, predominantly pale to dull yellowish to pale or middle brown, or dull grey-blue, limbs with solid dark brown to blackish purple at base, or with scattered dark spots, margins darker or paler in colour, claws uniformly pale or with dark longitudinal streaks or with a broad darker median streak, forming a floral cup 12–15 mm deep, 13–15 mm wide at rim, usually slightly putrid smelling, nectaries usually basal, rarely in pouches in centre of claws, pale or dark-coloured; outer tepals 30–40(–45) $\times$ 10–15 mm, claws 10–15 mm long; inner tepals

25–40(–45) $\times$ 8–10 mm. *Stamens* with filaments united in a column 8–13 mm long, free and arching outward in the upper 2–4 mm; anthers 3.5–5.0 mm long before anthesis, shorter after dehiscence, thecae joined only at apices, usually widely diverging but sometimes almost parallel. *Ovary* fusiform, 15–20 mm long, with a sterile beak 5–8 mm long; style branches 2–3 mm long, dividing into diverging, prominently fringed arms, $\pm$ 4 mm long; stigmas on small lobes below tips of style arms and arching over anthers. *Capsules* ellipsoid, 30–50 mm long. *Seeds* rounded, usually angled by pressure, coat dull and slightly wrinkled. *Flowering time*: Aug.–Nov. Figure 7F, Plate 1D.

Distribution and biology: most widespread of the southern African species, *Ferraria variabilis* extends from southern Namibia to Oudtshoorn including Bushmanland and the Great Karoo and as far east as Upington and Britstown, but is absent from the western coastal forelands of Western Cape Province (Figure 13). Plants grow in a variety of habitats including shale flats, granite outcrops, and deep sands. As described in more detail above and elsewhere (Goldblatt & Manning 2006; Goldblatt *et al.* 2009), the flowers are adapted for pollination by mud wasps (Vespidae): the only pollinating insects recorded on *F. variabilis* are species of *Allepipona* and *Delta* (Eumeninae), and *Jugurtia* (Masarinae). A previous report of pollination of *F. variabilis* by the masarine wasp, *Ceramius* (Goldblatt *et al.* 2009), is incorrect: that record is for *F. macrochlamys* subsp. *kamiesbergensis*.

Diagnosis and relationships: *Ferraria variabilis* is morphologically fairly coherent in including plants with relatively few branches crowded near the base, and rarely higher than 200 mm. Plants thus form low tufts unless growing under shrubs when they may be taller. The flowers are fairly large and the broad tepal claws form a deep, relatively wide bowl in which nectar of low sugar concentration accumulates in a pool. The spreading tepal limbs vary considerably in colour and marking. In the north of its range, in Namaqualand and southern Namibia, flowers have light brown tepal limbs with a

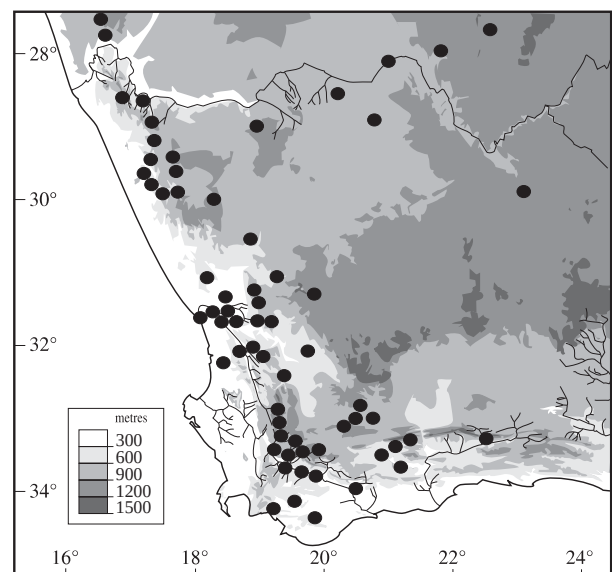


FIGURE 13.—Known distribution of *Ferraria variabilis*.

dark purple longitudinal band toward the base and light brown margins, while the claws are pale greenish cream with a narrow darker band running down the midline. The nectaries in the northern populations are fairly large and green or less often purple-black. In the western and southern Karoo and the southern Cape, populations have greenish yellow or pale to middle brown tepal limbs, usually darker in the midline, and with small or medium-sized spots in the lower third or when brown then often with spots irregularly scattered across the limb and the margins sometimes slightly darker coloured. The claws are pale, usually with a darker streak in the midline and have a small dark nectary at the base or on the inner tepals, shortly above the base. Perianth colour can vary as much within a population as across the entire southern Cape and western Karoo.

Scent is also variable and difficult to describe. In the protologue of *Ferraria antherosa*, an illegitimate, superfluous name but applicable to *F. variabilis*, Ker Gawler (1804) described the scent as reminiscent of green olives, whereas we have noted both a slightly putrid smell or a faint, sweet odour in different populations. Scent characteristics are dependent on temperature and the condition of the plants, so that little can be said with certainty except that odours slightly unpleasing to the human nose are characteristic of the species.

A notable variant of *Ferraria variabilis* occurs in the Olifants River Valley and adjacent mountains, represented by Goldblatt & Porter 12210, and possibly De Vos 2389; leaves are broader and more succulent than those found elsewhere. The best-developed leaves are 20–22 mm wide (versus typically 4–12 mm for most other populations), and the rest of the plant is also larger, thus the outer spathes are 50–70 mm long and the inner may reach 85 mm. Plants form circular mats in stony ground, which suggest spreading by vegetative means. De Vos (1979: 355) found that her collection from the Gifberg, was triploid ($2n = 30$) and she speculated that it was a hybrid between *F. divaricata* subsp. *divaricata* (i.e. the diploid northern form of *F. variabilis* with $2n = 20$) and subsp. *australis* (the southern tetraploid form with $2n = 40$), both of which occur on the lowlands below the Gifberg (and have similarly narrow leaves less than 10 mm wide). Polyploidy and hybrid vigour seem unlikely to explain the gross differences in leaf width and thickness of the plants in question. More likely, they represent a local variant of *F. variabilis* and deserve further investigation. Plants from Boklands-kloof near Lokenburg (Acocks 19736) in the Bokkeveld Mtns have subspathulate leaves with the blades shorter than the sheaths and 15–18 mm at the widest point. The blade margins are also strongly thickened, the thickenings partly wavy to slightly crisped and the apices are hooked. These plants appear vegetatively very unusual; unfortunately the flowers are poorly preserved and colour was not noted on the label. Revisiting Lokenburg in 2008 we found plants with such leaves but the flowers were quite typical of *F. variabilis*.

Some collections of *Ferraria variabilis* from southwestern Namibia, the Richtersveld and Bushmanland have long, narrow leaves exceeding the stems and only 2–3 mm wide (e.g. Mittendorf 43; Mostert 1415), so different from the spathes, that the plants appear to repre-

sent another species. Flowers and other features correspond closely to *F. variabilis* from this, the northwestern and northeastern extremities of its range.

Populations of *Ferraria variabilis* from the Tanqua Basin and nearby (e.g. Goldblatt & Porter 12977, MO, NBG, PRE) stand out in having the nectaries located in prominent pouches in the middle of the tepal claws, rather than at the claw bases. The anthers in the Tanqua Basin populations and others from nearby (e.g. Jackson s.n. NBG, from Wuppertal; Compton 17412, NBG, from Whitehill, incidentally the type of *F. divaricata* var. *australis*) have the anther lobes held $\pm$ parallel, although joined together only at the tips, as they are in plants from other parts of the range that have widely diverging anther lobes.

History: as discussed above under *Ferraria divaricata*, this name was applied in part by De Vos (1979) to what we here call *F. variabilis*. A taller species, *F. divaricata* is based on a painting of a plant about 450 mm high, most likely collected in the Clanwilliam District. It has large flowers with dark brown tepal limbs except for the paler margins, large anthers with widely divaricate lobes, orange pollen, and long basal leaves with a grey bloom. That plant corresponds to what De Vos called *F. divaricata* subsp. *arenosa*, which we considered best treated as a separate species that now bears the name *F. divaricata* (Goldblatt & Manning 2005). The only epithet that can be applied with some degree of certainty to *F. divaricata* subsp. *divaricata sensu* De Vos is the nomenclaturally illegitimate *F. antherosa*, a species based on a plant of uncertain provenance, and painted from a specimen that flowered in England in 1804. The flowers most closely match those of northern populations of low-growing, more or less tufted plants which De Vos distinguished in *F. divaricata* by tepal markings of solid colour and the claws with large green nectaries. The name *F. antherosa* is, however, superfluous because Ker Gawler also cited as a synonym *F. viridis* Andrews, an orthographic variant of *F. viridiflora* (= *F. ferrariola*), published in 1803. *Ferraria divaricata* subsp. *divaricata sensu* De Vos was named *F. variabilis* by Goldblatt & Manning (2005). The epithet reflects the variability in tepal colour and marking across its range, and even within populations. *Ferraria atrata* Loddiges (1828) may be this species but the description, accompanying the illustration, and a fragment at the Kew Herbarium that may be the type, are inadequate to identify the plant. It can even be argued that the species lacks a description, for the text associated with the painting contains no truly descriptive information. It is impossible even to determine whether the anther lobes are parallel or divergent.

Ferraria divaricata subsp. *australis* was described by De Vos (1979) for populations that have tepals speckled and streaked and small dark-coloured nectaries at the tepal bases, contrasting with subsp. *divaricata* (as she understood it), which has tepals with solid patterns of colour and larger, pale greenish nectaries. We find the distinction less clear in the field: plants with some tepal streaking or spots have large nectaries and there seems to be a cline from the northwest to the southeast of the range of plants with increasing degrees of tepal spotting and

decreasing size of the nectaries. Some northern populations with tepals marked with solid bands of colour also have fairly small nectaries. Currently, subsp. *australis* is included in the synonymy of *F. variabilis*.

Representative specimens

NAMIBIA.—2715 (Bogenfels): Klinghardt Mtns, near ephemeral pan, (–BC), 22 Sept. 1996, *Mannheimer & Mannheimer 271* (PRE, WIND). 2716 (Witputz): Sperrgebiet, SE side of Auros Mtns, in red sand, 644 m, (–CB), 11 Aug. 2001, *Smook 11318* (WIND); $\pm$ 40 km N of Rosh Pinah, (–DA), 29 Sept. 1983, *Goldblatt 7018* (MO); Huib Hoch Plateau, between Zebrafontein and Witputs, (–DB), 29 Jun. 1989, *Oliver 9161* (NBG); Namuskluft, (–DD), *Mittendorf 43* (PRE, WIND); 12 Sept. 1973, *Giess 12900* (PRE). 2816 (Oranjemund): Luderitz Dist., gravel plain west of rooi duine, (–BA), 1 Oct. 1996, *Mannheimer & Mannheimer 449* (WIND); Schakel Mtn in sand, (–BA), 1 Aug. 1977, *Muller 775* (WIND).

NORTHERN CAPE.—2816 (Oranjemund): 37 km north of Lekkersing, red sand, (–DB), 10 Oct., 1991, *Germishuizen 5595* (PRE). 2817 (Vioolsdrif): Richtersveld, Rosyntjieberg, dry riverbed, (–AC), 30 Aug. 1977, *Oliver, Tölken & Venter 267* (PRE); 15 km south of Vioolsdrif, (–DC), 7 Aug. 1976, *Giess 14535* (PRE, WIND). 2821 (Upington): Sandveld, Upington, (–AC), 8 Aug. 1961, *Mostert 1415* (PRE). 2917 (Springbok): Richtersveld, road to Eksteenfontein, (–CD), 24 Aug. 1992, *Goldblatt & Manning 9312* (MO); 48 km W of Steinkopf, stony slope, (–BA), 25 Sept. 1974, *Goldblatt 2778* (MO). 2918 (Gamooep): Aggenys, Farm Nooisabes, (–AB), 11 Aug. 2000, *Desmet & Opel 2995* (NBG); Goegab Nature Reserve, (–CA), 10 Oct. 1999, *Zietsman 3869* (PRE). 2919 (Pofadder): 6 km from Pofadder to Springbok, (–AB), 21 Sept. 1975, *Boucher 2886* (NBG). 2921 (Kenhardt): golf course, (–AC), 28 Aug. 1977, *De Vos 2395* (NBG). 3019 (Loeriesfontein): 103 km from Brandvlei to Loeriesfontein, (–DC), Oct. 1975 (fr.), *Arnold 905* (PRE). 3023 (Britstown): Britstown, rock cracks, (–DA), Sept. 1961, *Mauve 4133* (PRE). 3119 (Calvinia): Boklandskloof, Lokenburg, (–CA), 11 Oct. 1958, *Acocks 19736* (PRE); Agterplaas, west of Calvinia, (–BC), 1 Sept. 1990, *Oliver 9615* (NBG).

NORTH-WEST.—2822 (Glen Lyon): Hay Dist., Langberg, (–DD), Jul. 1920, *Hunter 18* (PRE); Hay Dist., Farm Doring Aar, red sand, (–DD), 7 Aug. 1936, *Acocks 571* (PRE).

WESTERN CAPE.—3118 (Vanrhynsdorp): top of Gifberg, (–DB), 25 Sept. 1975, *De Vos 2389* (NBG). 3119 (Calvinia): near Nieuwoudtville, Glen Lyon, rocky hills, (–AC), *Goldblatt & Porter 12216* (MO, NBG). 3218 (Clanwilliam): 12 km N of Clanwilliam on old road to Bulshoek, (–BB), 15 Sept. 2002, *Goldblatt & Porter 12210* (MO); Clanwilliam, 350 ft [106 m], (–BB), 5 Aug. 1896, *Schlechter 964* (PRE). 3219 (Wuppertal): Bidouw Valley, (–AA), 23 Sept. 1952, *Midlemost 1746* (NBG); Farm Jakkalsfontein, 25 km toward Middelpas from Calvinia–Ceres road, (–BD), 31 Aug. 1982, *Snijman 616* (PRE); Tanqua National Park, Maansedam, 10 Sept. 2007, *Goldblatt & Porter 12977* (MO, NBG, PRE). 3220 (Sutherland): $\pm$ 2 km N of Matjiesfontein, Farm Buelhouer, (–BA), 14 Sept. 2004, *Snijman 1925* (NBG). 3319 (Worcester): flats east of Prince Alfred's Hamlet, (–AD). 10 Oct. 1974, *Oliver 5062* (MO, NBG, PRE); Doorn River, 12 miles [19 km] N of Villiersdorp, (–CC), 25 Oct. 1962, *De Villiers s.n.* (NBG). 3320 (Montagu): Tweedside, (–AB), 26 Sept. 1951, *Barker 7463* (NBG). 3419 (Caledon): burned stony slopes on western outskirts of Caledon, (–AB), 29 Sept. 2110, *Goldblatt & Nänni 11939* (MO). 3420 (Bredasdorp): 25 km W of Swellendam, slopes of Bromberg, (–AA), 17 Sept. 1978, *Goldblatt 4882* (MO).

15. *Ferraria flava* Goldblatt & J.C.Manning, sp. nov.

?*F. divaricata* subsp. *aurea* M.P.de Vos: 359 (1979). Type: South Africa, [Western Cape], $\pm$ 9 miles [$\pm$ 13.5 km] north of Lambert's Bay, Farm Langdam, 28 Sept. 1973, *Van Breda sub M.P. de Vos 2297* (STE, holo.!; PRE, iso., two sheets!).

Plantae $\pm$ acaulescentes ad 120 mm altae foliis exclusis, foliis 5–7 ensiformibus ad 300 $\times$ 12–20 mm subrectis glaucis $\pm$ succulentis, rhipidiis 2-floris, spathis viridibus marginibus transparentibus spatha interna usitate 40–55 mm longa externa vaginanti vel supra divergenti apice incurvata, floribus flavis limbis tepalorum caer-

uleo-viridibus maculatis marginibus crispis pallidioribus, tepalis exterioribus $\pm$ 30 $\times$ 10 mm, interioribus $\pm$ 12 $\times$ 5 mm, unguibus $\pm$ 15 mm longis, columna filamentorum 11–12 mm longa, antheris $\pm$ 3.5 mm longis lobis divaricatis, ramis styli $\pm$ 3 mm longis, lobis ramorum prominenter fimbriatis.

TYPE.—Western Cape, 3118 (Vanrhynsdorp): sandveld west of Koekenaap, Farm Kommandokraal, (–AD), 10 Sept. 2008, *Goldblatt & Porter 13105* (NBG, holo.; K, MO, PRE, iso.).

Plants $\pm$ acaulescent, up to 120 mm high excluding leaves. *Stem* with (2–)4 or 5 primary branches produced from below or shortly above ground level, each with several branches, these crowded basally and congested, together bearing up to 50 rhipidia. *Leaves* suberect, 5–7, sword-shaped, up to 300 mm long, lower 3–5 much exceeding spathes and flowers, mostly 12–20 mm wide, glaucous, $\pm$ succulent, without visible main vein. *Rhipidia* 2-flowered, numerous, crowded on short, $\pm$ horizontal or ascending branches; spathes green, margins transparent, inner mostly 40–55 mm long, outer $\pm$ $\frac{2}{3}$ as long as inner, usually entirely sheathing or diverging above, apex curving inward. *Flowers* on pedicels up to 10 mm long, lasting one day, clear yellow, tepal limbs with minute blue-green spots in lower $\frac{1}{3}$, margins slightly paler in colour, claws translucent white inside, forming a floral cup 14–15 mm deep, 8–9 mm wide at rim, tepal limbs spreading, crisped, usually sweet vanilla-smelling, nectaries at tepal bases, pale green; outer tepals $\pm$ 30 $\times$ 10 mm, inner tepal limbs $\pm$ 12 $\times$ 5 mm, claws of both whorls $\pm$ 15 mm long. *Stamens* with filaments united in a column 11–12 mm long, free and arching outward in upper $\pm$ 1 mm; anthers pale yellow with dark purple-brown on the lines of dehiscence, $\pm$ 3.5 mm long before anthesis, $\pm$ 1.5 mm long after dehiscence, horizontal, thecae joined only at apices, widely diverging; pollen pale yellow. *Ovary* fusiform, 20–25 mm long, with a sterile beak, $\pm$ 10 mm long, style branches $\pm$ 3 mm long, dividing into diverging, prominently fringed arms, $\pm$ 5 mm long; stigmas on small lobes below tips of style arms and arching over anthers. *Capsules* and *seeds* unknown. *Flowering time*: early Sept.–late Oct. Figure 14, Plate 1J.

Distribution and habitat: endemic to the sandveld of coastal Western Cape and Namaqualand, *Ferraria flava* extends from the sandy flat country north of Lambert's Bay and Klaver to the Groen River and Komaggas (Figure 12). Plants grow in deep, moderately fine sand among sandveld species such as *Willdenowia* (Restionaceae) and the small, tree-like, willowy *Wiborgia obcordata* (Fabaceae), and occur most often on the slopes of low, stabilized and vegetated dunes. It shares this habitat at some sites with the rare *F. ornata* which blooms in May and June and has ripe capsules when *F. flava* comes into flower in September. Its pollination biology is unknown. The flowers last one day, with the tepals unfolding at $\pm$ 9:00 and collapsing at $\pm$ 16:00. They produce small quantities of watery nectar 6–8 % sucrose equivalents, a feature of *F. divaricata* and its immediate allies (Goldblatt *et al.* 2009). No potential pollinating visitors have been observed.



FIGURE 14.—*Ferraria flava*, Goldblatt & Porter 13105. A, flowering plant; B, flower, side view; C, inner tepal; D, outer tepal; E, staminal column and style; F, anther, undeheisced (above), dehiscent (below). Scale bar: A, B, 10 mm; C, D, 8 mm; E, F, 1.6 mm. Artist: J.C. Manning.

Diagnosis and relationships: *Ferraria flava* is recognized by the yellow, sweetly scented flowers and typically acaulescent habit with well-grown plants bearing 3 or 4 main branches arising below the ground and bearing numerous rhipidia set closely together. Combined with the acaulescent habit are the several broad, firm, almost, rigid leathery leaves up to 300×20 mm. The leaves recall those of *F. divaricata*, which has aerial stems and larger, usually predominantly brown flowers (but sometimes dull yellow) with a wider floral cup. The flowers of *F. flava* recall those of *F. macrochlamys* and its immediate allies in the narrow floral cup but they are somewhat

larger, with tepals $\pm 30 \times 10$ mm and claws ± 15 mm long, and last a single day, unlike those of the *F. macrochlamys* group, which have somewhat smaller tepals with shorter claws, 10–14 mm long, and last two days. We noted that at one site near Koekenaap, *F. divaricata*, with tall stems and brown flowers (Goldblatt & Porter 13188 NBG), occurs together with *F. flava*, but blooms later in the season, coming into flower there in October.

We provisionally include *Ferraria divaricata* var. *aurea* in synonymy here. The type, from near Lambert's Bay, has short, aerial stems but other collections cited by De Vos (1979) under this name are more or less stemless

and do belong here. Flower colour and shape of the type collection with aerial stems are consistent with *F. flava*. We have not been able to locate plants at the type locality and wonder whether subsp. *aurea* is simply a short-stemmed variant of *F. flava*. Living plants from the type locality need to be examined to determine the true identity of subsp. *aurea*.

Representative specimens

NORTHERN CAPE.—2917 (Springbok): Komaggas, (–DC), 6 Oct. 1934, *Herre s.n.* (BOL). 3017 (Hondeklipbaai): Farm Hardevlei, NW of Kotzesrus on road to Groenrivier, sandy flats, bright yellow with greenish dots in V-shaped pattern, sweetly scented, (–DC), 29 Sept. 1987, *Reid 1292* (BOL, MO, PRE).

WESTERN CAPE.—3117 (Lepelfontein): sandy flats and dunes west of Lepelfontein, ± 160 m, (–BB), 10 Sept. 2009 (sterile), *Goldblatt & Porter 13309* (NBG); Brand-se-Baai, sandy slopes inland of coast, (–DD), 15 Sept. 2008, *Goldblatt & Porter 13122* (MO, NBG). 3118 (Vanrhynsdorp): sand dunes 3–4 miles [4.5–6.0 km] north of Klaver station, (–DA), 27 Oct. 1944, *Leipoldt 4166* (BOL).

Series Uncinatae

16. *Ferraria uncinata* Sweet in The British flower garden: t. 161 (1826a); De Vos: 365 (1979), excluding subsp. *macrochlamys*. Type: South Africa, without precise locality, illustration in Sweet l.c. (1826a), originally collected by W. Synnot (no preserved specimen known).

F. framesii L.Bolus: 123 (1931). Type: South Africa, [Western Cape], ± 6 miles [± 9 km] south of Clanwilliam, 22 Oct. 1931, *Ross Frames s.n.* BOL19928 (BOL, holo.!; SAM, iso.!).

Plants 90–200(–300) mm high. *Stem* either $\pm$ subterranean and then few-branched at base, or stem produced above ground and branched from upper nodes. *Leaves* lanceolate, mostly 8–12 mm wide, sheaths usually concealing stem, usually without visible main vein, prominently multi-veined, flat or slightly twisted, apex often hooked, margins thickened, hyaline, smooth, usually crisped and undulate at least proximally. *Rhipidia* 2-flowered; spathes green, usually with hooked tips, inner mostly 40–60 mm long, outer 26–40 mm long ($\pm \frac{1}{2}$ to $\frac{2}{3}$ as long as inner), usually entirely sheathing. *Flowers* on pedicels 12–20 mm long, lasting two days, usually pale to dark blue-violet, or light brown with blue speckling, margins crisped, dull yellow-green to khaki, with a narrow cup, 8–12 mm deep, ± 7 mm wide at rim, often unscented, faintly foetid-smelling, or scented of lemon and cinnamon, nectaries minute, at base of tepals; outer tepals 28–35 $\times$ 7–10 mm, limb at least 1.5 times as long as claw, and up to 3 times as long, often long-attenuate and coiled, claws 8–12 mm long; inner tepals 28–30 mm long, limbs reflexed, claws slender, 7–12 mm long. *Filaments* united in a column 7–11 mm long, free in upper ± 1.5 mm; anthers ± 3 mm long, thecae divergent, shrinking to $\pm \frac{1}{2}$ their length after dehiscence. *Ovary* fusiform, 15–28 mm long, with beak 8–12 mm long; style branches ± 1.5 mm long, dividing into diverging, prominently fringed arms, ± 1.5 mm long; stigmas terminal on small lobes below tips of style arms and arching over anthers. *Capsules* 12–15 mm long, excluding beak. *Seeds* angular, 5- or 6-sided, 3–4 mm long, dark brown, facet surfaces slightly wrinkled. *Flowering time*: late Aug.–Oct. Plate 1A.

Distribution and biology: *Ferraria uncinata* extends from the slopes of the Gifberg near Klaver southward,

through the Olifants River Valley and Piketberg to Malmesbury and Mamre, some 65 km north of Cape Town (Figure 15). Plants are most often found in sandstone outcrops and relatively dry sites, but also sometimes in open ground in coarse, granite-derived gravel or on sandstone slopes in deep sand.

Diagnosis and relationships: as circumscribed here, *Ferraria uncinata* includes plants with a narrow floral cup 8–12 mm deep, tepals either deep blue to violet edged with dull yellow-green or in the north of its range, buff to dull yellow with violet speckles with yellow-brown margins. The leaves have thickened margins with at least the edges of the lower leaves crisped and undulate. The margin surface itself is smooth. The hooked tips of the leaves and spathes, the character for which the species was named (*uncinatus* is Latin for hooked), is frequent, though not constant, not only in *F. uncinata* but in several other species of the genus.

De Vos (1959) included the yellow-flowered central Namaqualand species, *Ferraria macrochlamys* in *F. uncinata* as subsp. *macrochlamys*, but we regard this plant as a separate species (Goldblatt & Manning 2004). It differs not only in the pale yellow flower colour but the leaf margins in those populations with thickened margins resemble those of *F. uncinata* only superficially. In *F. macrochlamys* subsp. *macrochlamys* the marginal thickenings are usually densely ciliate and irregularly serrulate or crenulate, as well as sometimes being slightly crisped. The tepal limbs of *F. uncinata* are at least 1.5 times as long as the claws and up to three times as long in the northern populations, the tepal apices of which are unusually extended. In *F. macrochlamys* the tepal limbs are slightly shorter to ± 1.5 times as long as the claws and are less prominently attenuate.

The type illustration, of a plant with the tepal limbs speckled with dark blue dots on a light brown background, suggests that it was collected between Clanwilliam and Bulshoek in the Olifants River Valley. Elsewhere across its range, *Ferraria uncinata* has blue-violet tepal limbs with somewhat obscure, darker blue spot-

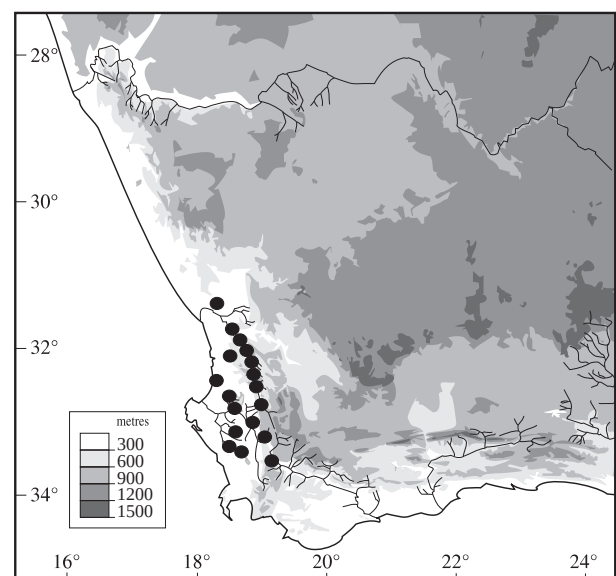


FIGURE 15.—Known distribution of *Ferraria uncinata*.

ting. The northern populations of *F. uncinata* differ not only in colouring, but in the proportions of the flower. Elsewhere, the floral cup is ± 11 – 12 mm deep and the tepal limbs are 16 – 18 mm long. In the northern populations, however, the floral cup is 8 – 9 mm deep and the tepal limbs are 25 – 28 mm long, the extended length due largely to the long, trailing, attenuate tip.

Representative specimens

WESTERN CAPE.—3218 (Clanwilliam): Olifants River Valley, stony slopes at turn-off to Nardouw, (–BB), 26 Aug. 1957, Lewis 5213 (NBG), 15 Sept. 2002, Goldblatt & Porter 12213 (MO, NBG, PRE); Clanwilliam, 5 Aug. 1896, Schlechter 8413 (K, MO, PRE, S); Olifants River Valley, Farm Klawervlei, N-facing slopes at bridge over Olifants River, (–BD), 2 Sept. 1994, Goldblatt & Manning 9959 (MO); hills N of Aurora near Redelinghuis, (–DA), 14 Sept. 2001, Goldblatt & Porter 11882 (MO, NBG). 3219 (Wuppertal): Brandewyn River, (–AA), 26 Aug. 1950, Barker 6572 (NBG); Cedarberg, Algeria Forest Station, (–AC), 10 Sept. 1997, Van Rooyen et al. 729 (NBG). 3318 (Cape Town): Malmesbury, western edge of town in new development, (–BC), 1 Oct. 1998, Goldblatt & Manning 11034 (MO); near Groenekloof (Mamre), (–AD), Nov. (fr.), Ecklon 305 (K, MO, S). 3319 (Worcester): Mostertshoek, Romans River, (–AC), Sept. 1976, De Vos 2338 (NBG).

17. *Ferraria macrochlamys* (Baker) Goldblatt & J.C.Manning in Novon 14: 293 (2004). *Lapeirousia macrochlamys* Baker: 338 (1876). *F. uncinata* subsp. *macrochlamys* (Baker) M.P.de Vos: 369 (1979). Type: South Africa, without precise locality or date, as Herb. Forsyth (K, holo.).

Plants mostly 70 – 100 mm high forming low tufts. *Stem* few- to several-branched (rarely simple), branches crowded close to base; branches and spathes all $\pm$ same length. *Leaves* narrowly sword-shaped to linear, mostly $(2.0\text{--})4.5$ – 7.0 mm wide, $\pm$ straight, or all curving to same side, or serpentine (loosely wavy in concertina fashion), tips oblique or hooked, sometimes densely papillate-ciliate; margins heavily thickened then sometimes velvety, often irregularly serrulate or crenate, sometimes slightly crisped. *Rhipidia* 2-flowered; inner spathes 37 – 62 mm long, abaxial margins sometimes crisped, outer 24 – 50 mm long, usually entirely sheathing, or free distally, often hooked at apex. *Flowers* on pedicels 10 – 23 mm long, lasting two days, pale watery yellow with slightly darker yellow to light brown margins, outer tepal limbs often minutely speckled grey-blue at base, with a narrow cup, 9 – 13 mm deep, 5 – 7 mm wide at rim, with a faint, green apple or slightly sour odour; outer tepals 26 – 32 mm long, limbs spreading to slightly reflexed, inner tepals 26 – 28 mm long, limbs often ultimately $\pm$ reflexed, claws of both whorls 10 – 14 mm long. *Stamens* with filaments united in a column 10 – 12 mm long, free and diverging in upper ± 1 mm; anthers 2.2 – 3.0 mm long, thecae divergent; pollen orange. *Ovary* fusiform, 15 – 20 mm long with beak 7 – 15 mm long; style branches 1.0 – 1.5 mm long, dividing into diverging, prominently fringed arms, 1.0 – 1.5 mm long; stigmas on small lobes below tips of style arms and arching over anthers. *Capsules* 15 – 20 mm long excluding beak. *Seeds* angular, mostly 5- or 6-sided, ± 2.7 – 3.0 mm diam., dark brown, facets slightly wrinkled. *Flowering time*: late Aug. to end of Sept., rarely to mid-Oct. Figures 16–19.

Distribution and biology: an exclusively Namaqualand species, the range of *Ferraria macrochlamys*

extends from Steinkopf in the north to the southern foothills of the Kamiesberg near Bitterfontein in the south and west toward the coast (Figure 17). Plants grow on a variety of soils, subsp. *macrochlamys* and subsp. *kamiesbergensis* in gritty to loamy granite-derived soils, sometimes in granite outcrops, in vegetation dominated by succulent-leaved shrubs and subsp. *serpentina* mostly in quartzitic sand, usually among rocks. As in other members of series *Uncinatae*, the flowers last two days and often have a slightly unpleasant, sour odour, but sometimes they appear to have no scent at all. Pollination biology is known only for subsp. *kamiesbergensis*, the flowers of which are pollinated by the masarine wasp (Vespidae: Masarinae) *Ceramius* (Gess 1997, reported as *F. divaricata*, now *F. variabilis*). So similar are the flowers of all three subspecies that we infer the same pollination strategy for the other two subspecies.

Diagnosis and relationships: De Vos (1979) treated *Ferraria macrochlamys* as a subspecies of the dark blue-flowered *F. uncinata*, a plant of the western half of Western Cape. She considered that the two shared identically specialized leaves with heavily thickened and crisped margins and derived flowers with a narrow floral cup and that they differed only in flower colour, either violet-blue with dull greenish yellow margins in subsp. *uncinata* or pale yellow with yellow to brown margins in subsp. *macrochlamys*. The leaf morphology in the two taxa is, however, not identical: whereas *Ferraria uncinata* has leaf margins crisped and sometimes undulate with the thickened edges smooth, *F. macrochlamys* has more often straight leaf margins but the marginal thickenings, when present, are usually irregularly serrate to crenate, or sometimes crisped, and are also sometimes densely velvety. Only occasionally do the lower leaf blades have undulate or crisped margins. Their flowers differ in size as well as colour. The tepal limbs of *F. uncinata* exceed the claws by at least 1.5 times and are usually at least twice and sometimes up to three times as long, and $(18\text{--})28$ – 35 mm long (with claws 8 – 12 mm long), whereas the tepals limbs of *F. macrochlamys* are 15 – 20 mm long and at most half again as long as the claws, 10 – 18 mm long, and are less strongly attenuate. While *F. macrochlamys* is clearly allied to *F. uncinata*, it seems to us most closely related to *F. brevifolia*, a local endemic of southern Namaqualand. This species has virtually identical flowers to those of *F. macrochlamys* but the broad leaf blades are shorter than the sheaths.

We recognize three subspecies in *Ferraria macrochlamys*, based on differences in leaf morphology and sometimes in habitat. Only subsp. *macrochlamys* has leaves with thickened and crisped to undulate margins and sometimes papillate-ciliate leaf blades. The $\pm$ falcate leaves of subsp. *kamiesbergensis* are all recurved in the same direction and have smooth, unthickened margins. In subsp. *serpentina* the leaf margins are also unthickened but the blades are serpentine, thus loosely wavy in concertina fashion.

History: *Ferraria macrochlamys* was initially described as *Lapeirousia macrochlamys* by J.G. Baker (1876). It remained so poorly understood that in 1931 H.M.L. Bolus, who collected plants at Bowesdorp in central Namaqualand in 1929, described it anew as *F. crispulata*. Goldblatt (1972), in his revision of southern

African *Lapeirousia*, noted that the type of *L. macrochlamys* was a species of *Ferraria* akin to *F. crispulata*, but it remained to M.P. de Vos in her revision (De Vos 1979) to transfer the species to the genus. The species was based on a specimen in the Kew Herbarium, ostensibly collected by W. Forsyth. It is now understood that the specimen was part of a collection purchased in 1835 by George Bentham of the Royal Botanic Gardens, Kew, from the estate of William Forsyth, son of W.F. Forsyth (1737–1804). Forsyth, a distinguished Scottish horticulturist, was one of the founders of the (Royal) Horticultural Society of London and was also associated with the Chelsea Physic Garden (1771–1784). The brief comment about Forsyth by Gunn & Codd (1981) in their history of plant collecting in southern Africa, is thus inaccurate with regard to Forsyth (Nelson 2006). It seems reasonable to suggest that at least some specimens of the Forsyth herbarium were gathered by the Scottish botanist, James Niven, who collected plants at the Cape for British patrons and later the Empress Josephine of France. Niven visited Namaqualand in 1799 and travelled to the Kamiesberg through country where *F. macrochlamys* grows. Another possibility is that *F. macrochlamys* was first collected by William Paterson, who travelled through Namaqualand collecting plant and animal specimens in 1778 and 1779. Paterson was for a time associated with W.F. Forsyth.

Key to subspecies

- 1a Leaf margins thickened, hyaline, and sometimes shortly velvety, at least lower leaves with serrulate to crenulate margins; leaf blades $\pm$ straight or laxly undulate; outer spathes sheathing for most of their length and no more than $\frac{2}{3}$ as long as inner 17a. subsp. *macrochlamys*
- 1b Leaf margins hardly, if at all, thickened, and smooth:
 - 2a Leaf blades in upper $\frac{1}{2}$ inclined to curving to same side; outer spathes not sheathing in distal half and $\pm$ as long as inner; outer tepals 25–35 mm long; filament column $\pm$ 12.5 mm long 17b. subsp. *kamiesbergensis*
 - 2b Leaf blades in upper $\frac{1}{2}$ serpentine, thus loosely folded back on themselves in concertina fashion; outer spathes sheathing for most of their length and $\pm \frac{2}{3}$ as long as inner; outer tepals 25–30 mm long; filament column 10–11 mm long 17c. subsp. *serpentina*

17a. subsp. *macrochlamys*

Ferraria crispulata L.Bolus: 260 (1931). Type: South Africa, [Northern Cape], near Bowesdorp, 27 Aug. 1929, *L. Bolus* s.n. BOL19162 (BOL, holo.; BM, K!, iso.).

Plants with leaves often densely papillate-ciliate; margins heavily thickened, thickenings smooth or densely ciliate, often irregularly serrulate or crenate, sometimes slightly crisped. *Rhipidial spathes*: inner 45–62 mm long, abaxial margins sometimes crisped, outer 30–50 mm long, usually entirely sheathing, or tips free. *Flowers* with narrow cup 11–13 mm deep, $\pm$ 7 mm wide at rim, with faint, green-apple or slightly sour odour; outer tepals 28–32 mm long, limbs spreading to slightly reflexed, inner tepals 26–28 mm long, claws of both whorls (11–)12–14 mm long. *Stamens* with filaments united in column $\pm$ 12 mm long, free and diverging in upper $\pm$ 1 mm; anther thecae $\pm$ 3 mm long before dehiscence. *Ovary* 23–28 mm long with beak 15–18 mm long. *Flowering time*: late Aug.–late Sept. Figure 16.

Distribution and habitat: restricted to central Namaqualand, subsp. *macrochlamys* extends from Steinkopf in the



FIGURE 16.—*Ferraria macrochlamys* subsp. *macrochlamys*, Goldblatt, Manning & Porter 13406 (NBG). Scale bar: 10 mm. Artist: J.C. Manning.

north to Garies in the south and inland to the northern Kamiesberg (Figure 17). Plants grow in gritty to loamy granite-derived soils.

Diagnosis: most distinctive of the three subspecies, subsp. *macrochlamys* stands out in its spreading leaves with thickened margins that are crenate or crisped and sometimes velvety. The flowers often serve to distinguish it from subsp. *serpentina* in their slightly larger size, but that difference is not consistent, hence unreliable. Subsp. *macrochlamys* is always acaulescent, whereas subsp. *serpentina*, in years of ample rainfall, develops an aerial stem rendering it quite different in general appearance.

Representative specimens

NORTHERN CAPE.—2917 (Springbok): 48 km west of Steinkopf, stony slope, (–BA), 25 Sept. 1974, Goldblatt 2778 (PRE); 1 mile [1.6 km] west of Springbok, (–DB), 9 Sept. 1950, Barker 6701 (NBG); Mesklip, (–DD), Lewis 1035 (SAM). 3017 (Hondeklipbaai): road to Soebatsfontein, $\pm$ 1 km from N7, (–BB), 17 Sept. 2002, Goldblatt & Porter 12229 (MO); 1 km south of Kamieskroon, (–BB), 29 Sept. 1981, Hugo 2889 (PRE); top of Garies hill along road to Hondeklipbaai, (–BD), 2 Sept. 2000, Goldblatt & Nänni 11454 (MO, NBG), 4 Sept. 1945, Compton 17179 (NBG). 3018 (Kamiesberg): Kamiesberg, slopes north of Leliefontein, burned previous summer, (–AC), 17 Sept. 2002, Goldblatt & Porter 12228 (MO).

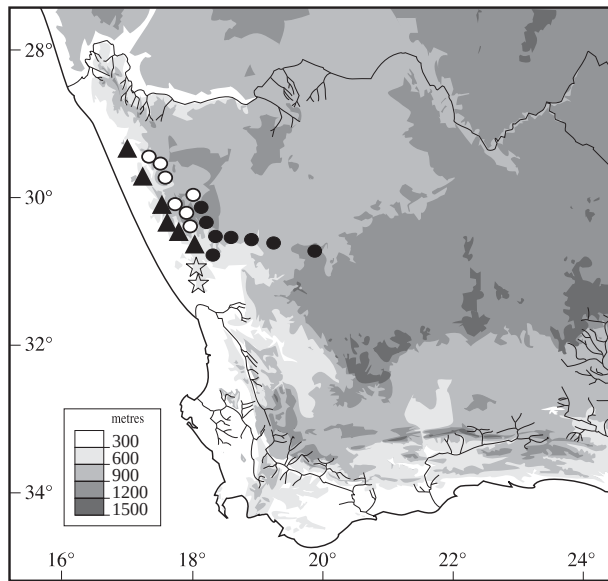


FIGURE 17.—Known distribution of *Ferraria macrochlamys* subsp. *macrochlamys*, ○; subsp. *kamiesbergensis*, ●; subsp. *serpentina*, ▲; and *F. brevifolia*, ☆.

17b. subsp. **kamiesbergensis** (M.P.de Vos) Goldblatt & J.C.Manning, comb. et stat. nov., *Ferraria kamiesbergensis* M.P.de Vos: 362 (1979). Type: South Africa, [Northern Cape], Kamiesberg, Rondefontein, 1 Sept. 1976, Oliver 5970 (NBG, lecto!., designated by Goldblatt & Manning, 2004: 292).

Plants forming low tufts, rarely unbranched. *Leaves* firm, suberect-curved to falcate-incurved, mostly 70–100 × 3–6 mm, all weakly to strongly curving to same side; margins plane, barely or not at all thickened. *Rhipidial spathes*: inner 50–65 mm long, outer 50–57 mm long, sheathing in lower half, arching outward distally. *Flowers* with tepal claws forming narrow cup mostly 12–14 mm deep, ± 7 mm wide at rim, limbs laxly spreading; outer tepals 25–35 mm long, 8–10 mm at widest, limbs 13–20 mm long, slightly exceeding claws, inner tepals 25–30 mm long, claws of both whorls 12–14 mm long. *Stamens* with filaments united in a column 10.5–12.5 mm long, free and diverging in upper 1 mm; anther thecae ± 3 mm long, shorter after anthesis. *Ovary* 18–22 mm long with tubular beak ± 12 mm long; style branches ± 1 mm long, dividing into diverging, prominently fringed arms, ± 2 mm long. *Flowering time*: Sept.–early Oct. Figure 18, Plate 1B.

Distribution and biology: subsp. *kamiesbergensis* is centred in the southern highlands where it extends from Rooiberg in the Kamiesberg to Bitterfontein but isolated populations occur to the east toward Loeriesfontein and the hills northwest of Calvinia in the western Karoo (Figure 17). In the Kamiesberg, plants grow in coarse, gritty soil derived from decomposed granite or in cracks in granite pavement. Soils favoured by *F. kamiesbergensis* in the western Karoo are not recorded and we have not seen the species there ourselves. The flowers last two days and, in the one population we examined for nectar, produced modest quantities of dilute nectar, mean 10.6 % sucrose equivalents. The one record of pollination in subsp. *kamiesbergensis*, by Gess (1997, originally reported as *F. divaricata*) is by the masarine wasp,

Ceramius (Eumenidae). We have seen no potential pollinators on the other subspecies.

Diagnosis and relationships: subsp. *kamiesbergensis* is distinctive only in its vegetative morphology. The leaves are firm and leathery to almost succulent and the blades are often dark green and in the upper half all curve to the same side and the margins are plane, smooth and not at all, or only barely, thickened. Otherwise plants have the tufted habit of subsp. *macrochlamys* and flowers virtually identical to that subspecies. The ranges of subsp. *kamiesbergensis* and subsp. *macrochlamys* do not overlap: populations of the latter are mostly from the highlands west and north of the Kamiesberg and in the Kamiesberg itself are only known from Leliefontein and nearby, which is north of the range of subsp. *kamiesbergensis*.



FIGURE 18.—*Ferraria macrochlamys* subsp. *kamiesbergensis*, Goldblatt & Porter 13176. Scale bar: 10 mm. Artist: J.C. Manning.

Typification of this taxon has proved problematic (Goldblatt & Manning 2004) as the illustration in the protologue (De Vos 1979) is not this species but, at least in leaf, resembles the widespread and common *Ferraria variabilis*. Of the three plants on the type sheet only one, now the lectotype, resembles subsp. *kamiesbergensis*. When seen alive, the flowers of the true *F. kamiesbergensis* and *F. variabilis* are quite different but in specimens with poorly pressed flowers, they are remarkably similar. Because of lingering confusion over the identity and circumscription of *F. kamiesbergensis* (now subsp. *kamiesbergensis*) we list all specimens of the subspecies that we have seen below, including our own recent collections.

Representative specimens

NORTHERN CAPE.—3018 (Kamiesberg): Farm Karas, Die Kom, (–CA), Oct. 1940, *Leipoldt* 3563 (BOL); Wilgehout Ravine, (–CA), Sept. 1911, *Pearson* 6812 (K); Farm Rondefontein, south of Karas, in fallow field on SE-trending slope, (–CA), 17 Sept. 2002, *Goldblatt & Porter* 12223 (MO, NBG); NE slopes of Rooiberg, (–CA), 17 Sept. 1987, *Davidse* 33353 (MO); southern Kamiesberg, between Farms Doringkraal and Gembokkloof, (–CA), 25 Sept. 2008, *Goldblatt & Porter* 13176 (MO, NBG). 3019 (Loeriesfontein): between Kliprand and Loeriesfontein, Farm Onderste Camdini, (–CD), 11 Sept. 1976, *Thompson* 2882 (NBG). 3119 (Calvinia): near Hantams River, 30 miles (± 45 km) NW of Calvinia on Loeriesfontein road, (–BB), 26 Sept. 1952, *Lewis* 2534 (SAM); 32 miles (± 48 km) from Calvinia to Loeriesfontein, (–BB), 27 Sept. 1952, *Johnson* 603 (NBG).

WESTERN CAPE.—3018 (Kamiesberg): ± 10 km north of Bitterfontein, sandy slope, (–CC), 2 Sept. 2002, *Goldblatt & Porter* 12146 (MO).

17c. subsp. ***serpentina*** Goldblatt & J.C.Manning, subsp. nov.

Ferrariae macrochlamydi subsp. *macrochlamydi* similis sed foliis linearibus usitate 3–4 mm latis laminis undulatis marginibus non incrassatis, spathis interioribus 37–45 mm longis, exterioribus 24–38 mm longis, floribus cupulo florali 9–11 mm profundo munitis, limbis tepalorum exteriorum 16–18 mm longis interiorum ± 16 mm longis, ovario 15–28 mm longo.

TYPE.—Northern Cape, NE of Kotzesrus on road to Garies, 16 Sept. 2001, *Goldblatt & Porter* 11900 (NBG, holo.; K, MO, PRE, iso.).

Plants like subsp. *macrochlamys* with branches crowded close to base or branching above ground, thus forming rounded plants. *Leaves* in a loose fan, linear, (2–)3–4 mm wide, without a central vein, blades serpentine (loosely wavy in concertina fashion, sometimes appearing coiled when pressed); margins plane, not thickened. *Rhipidial spathes*: inner 37–45 mm long, outer 24–38 mm long, sheathing in lower two thirds. *Flowers* on pedicels 10–15 mm long, with tepal claws forming a narrow cup, 9–11 mm deep, ± 5 mm wide at rim; outer tepal limbs 16–18 mm long, tips attenuate and twisted, inner tepal limbs ± 16 mm long, slightly reflexed, claws of both whorls 10–12 mm long. *Stamens* with united filaments in a column 10–11 mm long, free in upper 1 mm; anther thecae ± 2.2 mm long. *Ovary* 15–28 mm long, with a beak 7–18 mm long; style branches diverging, with style arms ± 1 mm long. *Flowering time*: late Aug. and Sept., rarely to mid-Oct. Figure 19.

Distribution and biology: restricted to central southern Namaqualand, subsp. *serpentina* occurs on the low, sandy or stony hills inland of the coast between Killians Pass and Kotzesrus (Figure 17). Plants grow in gritty soils, either on stony slopes or in deep, red, quartzitic sand. Like the other subspecies of *Ferraria macrochlamys*, the flowers of subsp. *serpentina* produce modest quantities of unusually dilute nectar, mean 8.1 % sucrose equivalents (Goldblatt *et al.* 2009). Pollination is unknown.

Diagnosis and relationships: evidently first collected by the American botanist, A.L. Grant in 1929 in 'Namaqualand' and shortly thereafter by R.H. Compton near Wallekraal in 1935, these specimens were misunderstood by De Vos (1979), who identified them as *F. divaricata* subsp. *divaricata* (now *F. variabilis*). Later collections made in 2001 and 2002 east of Kotzesrus, some 70 km south-southeast of Wallekraal, but in a similar sandy habitat, made it clear that the flowers of these plants closely resemble those of what are now *F. macrochlamys* subsp. *macrochlamys* and subsp. *kamiesbergensis*, differing if at all only in their slightly smaller size. Thus they have a pale yellow perianth and narrow, comparatively deep floral cup. Most striking are the leaves, the narrow blades of which are undulate in loose concertina fashion and have unthickened, plane margins. The leaf contrasts starkly with the straight leaves of typical *F. macrochlamys*, which have strongly thickened, crisped or crenate margins, and in addition in some populations, shortly velvety. The flowers of subsp. *serpentina* have a floral cup, 9–11 mm deep, ± 5 mm wide at the rim, outer tepals 25–30 mm long, and filaments 10–11 mm long, thus slightly smaller than in most populations of typical *F. macrochlamys*, which have a cup, 11–13 mm deep, 6–7 mm wide at the rim, outer tepals 28–32 mm long, and filaments ± 12 mm long. The inner spathes are 37–45 mm long, compared to 45–62 mm in subsp. *macrochlamys*, and the flowers have pedicels 10–15 mm long (versus 20–23 mm in subsp. *macrochlamys*), reflecting the shorter spathes. A particularly narrow-leaved form of subsp. *serpentina* has been recorded in the Komaggas area west of Springbok by Rupert Koopman, the blades ± 2 mm wide and when dry, showing the outline of a raised central vein.

Representative specimens

NORTHERN CAPE.—2917 (Springbok): near Kommagas, sandy field, (–CD), 10 Sept. 2007, *Koopman s.n.* (NBG). 3017 (Hondeklipbaai): Wallekraal, (–BC), 30 Aug. 1935, *Compton* 5405 (BOL, NBG); Farm Horees 441, on road between Killian's Pass and Wallekraal, (–BC), 8 Oct. 2003, *Le Roux* 5124 (NBG); road to Groen River Mouth, near Farm Nariep, (–DC), 16 Sept. 2008, *Goldblatt & Porter* 13131 (MO, NBG); ± 6 km NE of Kotzesrus on road to Garies, 573 ft [175 m], (–DD), 28 Aug. 2001, *Goldblatt & Porter* 11782 (MO), 2 Sept. 2002, *Goldblatt & Porter* 12141 (MO, NBG, PRE); ± 10 km NE of Kotzesrus, (–DD), 3 Sept. 2001, *Goldblatt & Porter* 11820 (MO).

WESTERN CAPE.—3018 (Kamiesberg): Bitterfontein–Garies, at border of Northern Cape, stony slopes facing Swartdoorn River, (–CC), 24 Sept. 2008, *Goldblatt & Porter* 13167 (MO, NBG, PRE).

18. ***Ferraria brevifolia*** G.J.Lewis in *Annals of the South African Museum* 40: 119 (1954); De Vos: 369 (1979). Type: South Africa, [Western Cape], 2 miles [3 km] south of Nuwerus, Sept. 1945, *Lewis* 1374 (SAM, holo.!).



FIGURE 19.—*Ferraria macrochlamys* subsp. *serpentina*, Goldblatt & Porter 13131. A, flowering plant; B, staminal column and style; C, capsules. Scale bar: A, C, 10 mm; B, 2.5 mm. Artist: J.C. Manning.

Plants 70–120(–180) mm high, usually $\pm$ acaulescent. Stem with 2–4 short branches borne close to ground, all $\pm$ equal in length. Leaves overlapping to form a tight fan, sheaths completely enclosing stem and much exceeding blades, blades oblong, mostly $7\text{--}15 \times 5\text{--}7$ (–10) mm, obtuse or acute with tips often hooked; margins thickened especially abaxially, thickenings often crenate to slightly crisped. *Rhipidia* 2-flowered; inner spathe mostly 45–55 mm long, outer 35–38 mm long, sheathing in lower $\frac{2}{3}$, arching outward distally. Flowers on pedicels 15–23 mm long, lasting two days, pale to watery yellow with darker yellow to brown or orange margins, nectaries small, at base of tepals, claws forming a narrow cup, ± 12 mm deep, ± 7 mm wide at rim, faintly sweet-scented; outer tepals $32\text{--}40 \times \pm 9$ mm, attenuate, tips slightly coiled, claws slender, 10–13 mm long, inner tepals 30–37 mm long. Stamens with filaments united in a column ± 10 mm long, free in upper ± 1 mm; anther thecae divergent, initially ± 2.5 mm long, ± 1.5 mm long after dehiscence; pollen orange. Ovary fusiform, (15–)18–25 mm long, with a beak 8–12 mm long; style branches ± 1.5 mm long, dividing into diverging, prominently fringed arms, ± 1.5 mm long; stigmas on small lobes below tips of style arms and arching over anthers.

Capsules ovoid, 15–25 mm long. Seeds angular, irregularly 5- or 6-sided, ± 3 mm diam., brown, shiny. Flowering time: Aug.–Sept.

Distribution and biology: with a recorded range covering a linear distance of about 40 km (Figure 17), *Ferraria brevifolia* has one of the narrowest distributions of any member of the genus. Records are mostly from the immediate vicinity of Nuwerus, but plants have also been collected near Bitterfontein to the north—its most northern station is just 10 km north of the town. Plants occur on shrub-covered slopes of gritty, granite-derived ground. The flowers last two days and secrete small quantities of nectar of the low concentration, $\pm 6.4\%$ sucrose equivalents, typical of the *F. uncinata* alliance. There are no reports of pollination in the species.

Diagnosis and relationships: distinctive in *Ferraria*, the leaves of *F. brevifolia* form a tight, 2-ranked fan and have elongate sheaths 40–80 mm long, much exceeding the short, ovate, obtuse blades, 7–15 mm long. The blades, usually less than half as long as the sheaths, have relatively thick margins and oblique, acute or apiculate, hooked tips. The pale yellow flowers, in contrast, are virtually identical to those of *F. macrochlamys* and have

a narrow floral cup, ± 12 mm deep, and tepal limbs, 22–28 mm long, with crisped, light brown or rarely reddish brown margins. The flowers produce a faint, slightly sweet scent. They can be distinguished from those of its apparent nearest relative, *F. macrochlamys*, if at all, by their somewhat longer outer tepals with long, tapering loosely coiled tips. Although only formally described in 1954, an early collection of the species, and possibly the first, *Schlechter 11031*, made in 1897, bears the annotation '*F. namaquensis* Schltr.' in Schlechter's hand.

Representative specimens

WESTERN CAPE.—3018 (Kamiesberg): ± 10 km N of Bitterfontein, granite bank, (–CC), 2 Sept. 2000, *Goldblatt & Nänni 11450* (MO); hills at Bitterfontein, 1200 ft [365 m], (–CC), 2 Sept. 1897, *Schlechter 11031* (BOL, K, MO, PRE, S; B, BM, BR, Z, not seen). 3118 (Vanhynsdorp): Nuwerus, stony veld, (–AB), 7 Sept. 1945, *Barker 3734* (NBG), 6 Aug. 1972 (flowered at Vredendal), *Hall 4114* (NBG, PRE); 2 miles [3 km] south of Nuwerus, (–AB), 6 Sept. 1974, *De Vos 2326* (PRE).

EXCLUDED SPECIES

Ferraria fimbriata Burm. in *Nova acta physico-medico Academiae Caesareae Leopoldino-Carolinae germanicae naturae curiosorum* 2: 201 (1761). Type: South Africa, without precise locality, illustration in Burman, loc. cit.: t. 3, fig. 2 (1761).

The woodcut illustration is inadequate to determine this plant to species (see History). Our best guess is that this may represent *Ferraria divaricata* or alternatively *F. variabilis*.

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REFERENCES

ANDREWS, H. 1803. *Ferraria viridiflora*. *The botanist's repository* 4: t. 285. London.
 BAKER, J.G. 1876. New Gladiolae. *Journal of Botany*, new ser. 5: 333–339.
 BAKER, J.G. 1878. On the Liliaceae, Iridaceae, Hypoxidaceae, and Haemodoraceae of Welwitsch's Angolan herbarium. *Transactions of the Linnean Society, London, Botany*, ser. 2, 1: 245–273.
 BAKER, J.G. 1877 [as 1878]. *Systema Iridearum*. *Journal of the Linnean Society, Botany* 16: 61–180.
 BAKER, J.G. 1892. *Handbook of the Irideae*. Bell, London.
 BAKER, J.G. 1896. Iridaceae. In W.T. Thiselton-Dyer, *Flora capensis* 6: 7–71. Reeve, Ashford.

BAKER, J.G. 1898. Iridaceae. In W.T. Thiselton-Dyer, *Flora of tropical Africa* 7: 337–376. Reeve, London.
 BAKER, J.G. 1901. Iridaceae. In H. Schinz, Beiträge zur Kenntniss der Afrikanischen Flora (Neue Folge). *Bulletin de l'Herbier Boissier*, sér. 2, 1: 853–868.
 BARNES, P.E. 1930. Plants—new and noteworthy. *South African Gardening and Country Life* 20: 313, 314.
 BOLUS, L. 1931. Novitates africanae. New Iridaceae. *Journal of Botany (London)* 69: 258–262.
 BOLUS, L. 1932a. Plants—new and noteworthy. *South African Gardening and Country Life* 22: 57.
 BOLUS, L. 1932b. Plants—new and noteworthy. *South African Gardening and Country Life* 22: 275–277.
 BURMAN, J. 1761. *Ferrariae character*. *Nova acta physico-medico Academiae Caesareae Leopoldino-Carolinae germanicae naturae curiosorum* 2: 198–202.
 CARTER, S. 1963. Synonymy in the Iridaceae. *Kew Bulletin* 17: 317.
 COETZEE, J. 1993. African flora since the terminal Jurassic. In P. Goldblatt, *Biological relationships between Africa and South America*: 37–61. Yale University Press, New Haven.
 DE VOS, M.P. 1977. Knolontwikkeling by sommige genera van die Iridaceae en die systematiese posisie. *Tydskrif vir Natuurwetenskap* 17: 9–19.
 DE VOS, M.P. 1979. The African genus *Ferraria*. *Journal of South African Botany* 45: 295–375.
 DIETRICH, A.G. 1832. *Species plantarum*, edn. 6, 2. Nauck, Berlin.
 DINTER, K. 1920. *Plantae novae Schäferianae*. *Repertorium Novarum Species Regni Vegetabilium* 16: 335–344.
 ECKLON, C.F. 1827. *Topographisches Verzeichniss der Pflanzensammlung von C.F. Ecklon*. Esslingen.
 FAEGRI, K. & VAN DER PIJL, L. 1979. *The principles of pollination ecology*, edn 3. Pergamon Press, New York.
 FERRARI, G.B. 1633. *Flora seu de florum cultura*. Rome [1746 Amsterdam].
 FOSTER, R.C. 1936. Notes on nomenclature in Iridaceae. *Contributions from the Gray Herbarium of Harvard University* 114: 37–50.
 GEERINCK, D. 2005. Iridaceae. *Flore d'Afrique Centrale*. Jardin Botanique National de Belgique, Meise.
 GESS, F.W. 1997. Contributions to a knowledge of *Ceramius* Latreille, *Celonites* Latreille, *Jugurtia* Saussure and *Masarina* Richards in South Africa (Hymenoptera: Vespidae: Masarinae). *Journal of Hymenopteran Research* 6: 36–74.
 GOLDBLATT, P. 1971. Cytological and morphological studies in the southern African Iridaceae. *Journal of South African Botany* 37: 317–460.
 GOLDBLATT, P. 1972. A revision of the genera *Lapeirousia* Pourret and *Anomatheca* Ker in the winter rainfall region of South Africa. *Contributions from the Bolus Herbarium* 4: 1–111.
 GOLDBLATT, P. 1976. Evolution, cytology and subgeneric classification in *Moraea* (Iridaceae). *Annals of the Missouri Botanical Garden* 63: 1–23.
 GOLDBLATT, P. 1986. The moraeas of southern Africa. *Annals of Kirstenbosch Botanical Gardens* 14: 1–224.
 GOLDBLATT, P. 1990. Phylogeny and classification of Iridaceae. *Annals of the Missouri Botanical Garden* 77: 607–627.
 GOLDBLATT, P. 1993. Iridaceae. *Flora zambesiaca* 12,4. Flora Zambesiaca Managing Committee, London.
 GOLDBLATT, P. 1996. *Gladiolus in tropical Africa*. Timber Press, Portland, OR.
 GOLDBLATT, P. 1998. Reduction of *Barnardiella*, *Galaxia*, *Gynandriris*, *Hexaglottis*, *Homeria* and *Roggeveldia* in *Moraea* (Iridaceae: Irideae). *Novon* 8: 371–377.
 GOLDBLATT, P. & BERNHARDT, P. 1999. Pollination mechanics of *Moraea* species (Iridaceae) with a staminal column. *Annals of the Missouri Botanical Garden* 86: 47–56.
 GOLDBLATT, P., BERNHARDT, P. & MANNING, J.C. 2009. Adaptive radiation of the putrid perianth; fly, wasp and bee pollination in the African genus *Ferraria* (Iridaceae). *Plant Systematics and Evolution* 278: 53–65.
 GOLDBLATT, P., DAVIES, T.J., MANNING, J.C., POWELL, M.P., VAN DER BANK, M. & SAVOLAINEN, V. 2008. Iridaceae 'Out of Australasia'? Phylogeny, biogeography, and divergence time based on plastid DNA sequences. *Systematic Botany* 33: 495–508.
 GOLDBLATT, P., DAVIES, T.J., MANNING, J.C., VAN DER BANK, M. & SAVOLAINEN, V. 2006. Phylogeny of Iridaceae subfamily Crocoideae based on combined multigene plastid DNA analysis. In J.T. Columbus, E.A. Friar, J.M. Porter, L.M. Prince & M.G. Simpson, *Monocots: comparative biology and evolu-*

- tion, vol. 1: 399–411. Rancho Santa Ana Botanical Garden, Claremont, California.
- GOLDBLATT, P. & MANNING, J.C. 2002. Rediscovered after 200 years, *Moraea ovata* Thunberg is a rare *Ferraria* (Iridaceae: Iridoideae) from Namaqualand, South Africa. *Novon* 12,4: 460–464.
- GOLDBLATT, P. & MANNING, J.C. 2004. New species of *Ixia* (Crocoideae) and *Moraea* (Iridoideae), and taxonomic notes on some other African Iridaceae. *Novon* 14: 288–298.
- GOLDBLATT, P. & MANNING, J.C. 2005. Taxonomic notes on *Babiana* and *Ferraria* (Iridaceae) in arid western southern Africa. *Bothalia* 35: 71–74.
- GOLDBLATT, P. & MANNING, J.C. 2006. Radiation of pollination systems in the Iridaceae of sub-Saharan Africa. *Annals of Botany (London)* 97: 317–344.
- GOLDBLATT, P., MANNING, J.C. & BERNHARDT, P. 1998. Adaptive radiation of bee-pollinated *Gladiolus* species (Iridaceae) in southern Africa. *Annals of the Missouri Botanical Garden* 85: 492–517.
- GOLDBLATT, P., MANNING, J.C. & BERNHARDT, P. 1999. Evidence of bird pollination in Iridaceae of southern Africa. *Adansonia*, sér. 3, 21: 25–40.
- GOLDBLATT, P., MANNING, J.C. & BERNHARDT, P. 2001. Radiation of pollination systems in *Gladiolus* (Iridaceae: Crocoideae) in southern Africa. *Annals of the Missouri Botanical Garden* 88: 713–734.
- GOLDBLATT, P., SAVOLAINEN, V., PORTEOUS, O., SOSTARIC, I., POWELL, M.P., REEVES, G., MANNING, J.C., BARRACLOUGH, T.G. & CHASE, M.W. 2002. Radiation in the Cape flora and the phylogeny of peacock irises *Moraea* (Iridaceae) based on four plastid DNA regions. *Molecular Phylogenetics and Evolution* 25: 341–360.
- GOLDBLATT, P. & TAKEI, M. 1997. Chromosome cytology of Iridaceae, base numbers, patterns of variation and modes of karyotype change. *Annals of the Missouri Botanical Garden* 84: 285–304.
- GUNN, M. & CODD, L.E. 1981. *Botanical exploration of southern Africa*. Balkema, Cape Town.
- JACQUIN, N.J. VON. 1770. *Hortus botanicus vindobonensis*. Kalwoda, Vienna.
- JACQUIN, N.J. VON. 1790. *Collectanea botanica* 4. Wappler, Vienna.
- JACQUIN, N.J. VON. 1804. *Plantarum rariorum horti caesarei schoenbrunnensis* 4. Wappler, Vienna.
- JUSSIEU, A.L. 1789. *Genera plantarum*. Herissant, Paris.
- KER GAWLER, J. 1804. *Ferraria antherosa*. Green variegated ferraria. *Curtis's Botanical Magazine* 19: t. 751.
- KER GAWLER, J. 1827. *Genera iridearum*. De Mat, Brussels.
- LEWIS, J.G. 1954. Iridaceae—new species and miscellaneous notes. *Annals of the South African Museum* 40: 115–135.
- LINNAEUS, C. 1759. *Flora capensis*. Edman, Uppsala.
- LINNAEUS, C. 1763. *Species plantarum*, edn 2. Salvius, Stockholm.
- LODDIGES, C. 1828. *Ferraria atrata*. *The botanical cabinet* 14: t. 1356.
- MANNING, J.C. & GOLDBLATT, P. 1996. *West Coast*. South African Wild Flower Guide 7. Botanical Society of South Africa, Cape Town.
- MANNING, J.C., GOLDBLATT, P. & SNIJMAN, D. 2002. *The color encyclopedia of Cape bulbs*. Timber Press, Portland, OR.
- MANNHEIMER, C., MARAIS, A. & SCHUBERT, S. 2008. *Toxic plants of veterinary importance in Namibia*. Ministry of Agriculture, Water and Forestry, Windhoek.
- MATHEW, B. 1980. *The iris*. Batsford, London.
- MILLER, P. 1759a. *Figures of plants*, vol. 2. Miller, London.
- MILLER, P. 1759b. *The gardeners dictionary*, edn 7. Miller, London.
- MILLER, P. 1768. *The gardeners dictionary*, edn 8. Miller, London.
- MOLSEED, E. 1970. The genus *Tigridia* (Iridaceae) of Mexico and Central America. *University of California Publications in Botany* 54: 1–128.
- MOORE, H.E. 1974. *Ferraria crispa* (Iridaceae). *Baileya* 19: 110.
- MORISON, R. 1680. *Plantarum historiae universalis*. Oxford.
- NELSON, C.E. 2006. 'Forsyth (fl. 1835)' a phantom botanical collector at the Cape of Good Hope explained. *Bothalia* 36: 167, 168.
- RAND, R.F. 1898. Wayfaring notes in Rhodesia. *Journal of Botany (London)* 36: 141–145.
- RAVEN, P.H. & AXELROD, D. 1974. Angiosperm biogeography and past continental movements. *Annals of the Missouri Botanical Garden* 61: 539–673.
- REDOUTÉ, J.P. 1802. *Ferraria crispa*. *Les Liliacées* 1: t. 6. Paris.
- REEVES, G., CHASE, M.W., GOLDBLATT, P., RUDALL, P.J., FAY, M.F., COX, A.V., LEJEUNE, B. & SOUZA-CHIES, T. 2001. Molecular systematics of Iridaceae: evidence from four plastid DNA regions. *American Journal of Botany* 88: 2074–2087.
- RENDLE, A.B. 1899. Monocotyledons. In W.P. Hiern, *Catalogue of the African plants collected by Dr. Friedrich in 1853–61*, vol. 2. Trustees of the British Museum, London.
- RENDLE, A.B. 1905. Apetalae and monocotyledons. In A.B. Rendle, Mr. Eyles's Rhodesian plants: 52–54. *Journal of Botany (London)* 43: 44–54.
- RODIN, R.J. 1985. The ethnobotany of the Kwanyama Ovambo. *Mono-graphs in Systematic Botany from the Missouri Botanical Garden* 9.
- RUDBECK, O. 1701. *Reliquiae rudbeckianae*. Smith, London.
- SALISBURY, R.A. 1796. *Prodromus stirpium in horto ad Chapel Allerton vigentium*. London.
- SCHINZ, H. 1900. Iridaceae. In C. de Candolle, E. Koehne & H. Schinz, *Diagnoses plantarum Africanum novarum. Mémoires de l'Herbier Boissier* 10: 77.
- SCOTT ELLIOT, G. 1891. Notes on the fertilisation of South African and Madagascan flowering plants. *Annals of Botany* 5: 333–405.
- STRID, A. 1974. A taxonomic revision of *Bobartia* L. (Iridaceae). *Opera Botanica* 37: 1–45.
- SWEET, R. 1826a. *Ferraria uncinata*. *The British flower garden*: t. 161.
- SWEET, R. 1826b. *Ferraria obtusifolia*. *The British flower garden*: t. 148.
- SWEET, R. 1827. *Ferraria divaricata*. *The British flower garden*: t. 192.
- THUNBERG, C.P. 1787. *Dissertation de Moraea*. Uppsala.
- THUNBERG, C.P. 1800. *Prodromus plantarum capensium*. Edman, Uppsala.
- TILLIE, N., CHASE, M.W. & HALL, T. 2001. Molecular studies in the genus *Iris* L.: a preliminary study. *Annali di Botanica (Roma)*, nov. ser. 1, 2: 105–122.
- VOGEL, S. 1954. Blütenbiologische Typen als Elemente der Sippen-gliederung. *Botanische Studien* 1: 1–338.
- WILLDENOW, C.L. 1800. *Species plantarum*, edn 4, 3. Berlin.

Annotated catalogue of the flowering plants of São Tomé and Príncipe

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Keywords: diversity, flowering plants, São Tomé and Príncipe

ABSTRACT

A catalogue of the flowering plants of the islands of São Tomé and Príncipe (Gulf of Guinea) is presented. Flowering plant diversity figures are updated to: 135 families (20 introduced), 624 genera (172 introduced), 1 104 species (301 introduced) plus 15 additional infraspecific taxa. At present 119 taxa (107 species and 12 infraspecific taxa) are known to be endemic to the two islands. The catalogue includes accepted names, synonyms used in recent literature, common names, voucher specimens and information on habit and habitat and on plant uses, particularly medicinally.

INTRODUCTION

The islands São Tomé and Príncipe (STP) are part of an archipelago of four islands situated in the Gulf of Guinea. These islands resulted from volcanic activity along a NE-SW line of fractures that extends from Mounts Kupe and Manenguba in Cameroun, stretching southward towards St Helena. S.Tomé and Príncipe form a political entity, whereas the two other islands, Bioko and Annobon, are part of Equatorial Guinea. Bioko lies on the continental shelf, and is separated from the mainland by a stretch of water that is less than 100 m deep, but the other three islands apparently have an oceanic origin and are generally thought to have never been linked to the continent (e.g. Exell 1944, 1956). Bioko's flora is similar to that of the neighbouring continent; it has a higher diversity of Angiosperms than those of the other three islands, but lower levels of endemism. Annobon is the furthest away from the mainland. Its flora has characteristics of that of an oceanic island (Exell 1973).

The first studies of the flora of S.Tomé and Príncipe were undertaken at the University of Coimbra, Portugal, by J. Henriques (1838–1928), who based his work on the collections made during the 19th century by A. Moller (1842–1920) and F. Quintas (birth and death dates unknown, collected in 1885–1893). In 1932, A. Exell (1901–1993) visited the four islands in the Gulf of Guinea as part of a four-month expedition, collecting extensively. Resulting from this collecting trip, he eventually published the *Catalogue of the vascular*

plants of S.Tomé (Exell 1944), in which 17 new species were described and several new records noted. In the ensuing years, Exell published papers (e.g. Exell & Rozeira 1958) and a supplement to the catalogue (Exell 1956), and finally produced a preliminary checklist, *Angiosperms of the islands of the Gulf of Guinea* (Exell 1973). Other relevant botanists who collected on these islands were A. Chevalier (1873–1956) in 1905, T. Monod (1902–2000) in 1956 and J. Espírito Santo (1901–unknown) in the 1960s–70s.

After a period of 20 years, the interest in the flora of these islands was rekindled through the European-funded ECOFAC project (www.ecofac.org), as well as by research on medicinal plants. Extensive collecting was done over the last 10 years by Santomean, Belgian and Portuguese collectors. Several studies were published on the flora of the islands (see Figueiredo 1994a for a comprehensive botanical bibliography), but the only published plant diversity list remains Exell's preliminary checklist (1973) which was a simple list of names without vouchers or further information.

Numerous new collections were made over the past 20 years, and it is now possible to improve Exell's list considerably. In this new catalogue we include common names, habit and habitat, medicinal uses and information on the ornamental or food value of the taxa. Recent trends to interlink plant diversity studies, such as conducting comprehensive surveys of useful plants, have resulted in a fresh appreciation for the considerable value of herbaria as untapped data sources. There has also been a resurgence in an appreciation for common names as an important source of information for plant uses. The reliability of such information increases exponentially if the names can be linked to specimens, given that such vouchered anecdotes can be verified by future researchers. In addition, common names represent an important, but sadly vanishing, component of the culture of a country and its peoples. In this paper we create the critically important link between voucher specimens, scientific names in current use, common names, and uses of the plants.

Phytogeography

The island of S.Tomé in particular, has floristic elements that are remarkable in the context of African phy-

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togeography. In this regard, disjunctions of afromontane taxa are particularly striking. For example, *Melchiora mannii* (Oliv.) Kobuski, which is endemic to S.Tomé, is closely related to a species occurring in the eastern parts of the Democratic Republic of Congo (DRC) and on the Usambara and Uluguru Mountains. More than 2 000 km separate these two species. *Afrocarpus mannii* (Hook.f.) C.N.Page, an endemic of the summit of S.Tomé, is another well-known example of a wide disjunction. Its nearest relative, *Afrocarpus usambarensis* (Pilg) C.N.Page, occurs in eastern Africa. The same type of disjunction is also found in some lowland forest taxa, such as *Lasiodiscus mildbraedii* Engl. This species is distributed in the eastern DRC and, at much lower altitudes, in S.Tomé, in remnants of the lowland forest. A single specimen was also collected in Cameroun.

Narrow afromontane palaeoendemics are probably remnants of species which were much more widespread during cooler climatic periods, becoming restricted to mountains during warmer periods. When the climate became colder allowing afromontane taxa to extend to lower altitude, several lowland species became confined to refuges that retained suitable environmental conditions. They may have survived on the island where adverse conditions were ameliorated by the effect of a milder oceanic climate. Exell (1944) suggested that S.Tomé might be of a different 'botanical age' in relation to the other islands in the archipelago, as well as Mount Cameroun, which would explain the confinement of several taxa to that island and their absence from the other mountains on the mainland. He hypothesized that although these mountains might be of the same geological age, S.Tomé might have been the first to become available for colonization and it would contain elements (palaeoendemics) of an older flora which was already confined to refuges when the other local mountains became available for colonization.

Vegetation

When the islands of S.Tomé and Príncipe were discovered by Portuguese sailors in 1471–1472, they were uninhabited and totally covered with dense tropical rainforest. The occupation of the islands took place in 1486 and with it the establishment of farms (*roças*), initially for the production of sugar cane, later for cocoa and coffee. These had, and still have, a profound impact on the vegetation of the islands. Deforestation was particularly high during the 19th century, when the lowland forests, up to an altitude of $\pm 1\ 500$ m were almost completely replaced with plantations, with a few original trees kept for shade. When, at the end of the 16th century, sugar cane production was stopped, there was a regeneration of part of the vegetation, giving rise to large patches of secondary vegetation. Several classifications exist for the vegetation of the island of S.Tomé, but the most commonly used one is that of Monod (1960) who divided the island into four regions based on characteristic species. The littoral region includes dunes [with *Ipomoea pes-caprae* (L.) R.Br. subsp. *brasiliensis* (L.) Ooststr., *Canavalia rosea* (Sw.) DC., *Cynodon dactylon* (L.) Pers. and *Sporobolus virginicus* (L.) Kunth] and mangroves (with *Rhizophora harrisonii* Leechm., *Acrostichum aureum* L. and *Pandanus thomensis* Henriq.).

The next region, extending to an altitude of 800 m includes the lowland rainforest that was mostly replaced with cocoa plantations. In the north of the island where rainfall is much lower, there are anthropogenic savannas characterized by grasses and legumes. At an altitude of 800–1 400 m, the mountain rainforest is dominated by Rubiaceae and Euphorbiaceae and many epiphytes, particularly orchids. Among the numerous endemics characteristic of this area, are several trees such as *Trichilia grandifolia* Oliv., *Craterispermum montanum* Hiern, *Tabernaemontana stenosphon* Stapf, *Erythrococca molleri* (Pax) Prain and *Discoclaoxylon occidentale* (Müll.Arg.) Pax & K.Hoffm., and the lianas *Mussaenda tenuiflora* Benth. var. *thomensis* G.Taylor, *Sabicea exellii* G.Taylor and *Ecpoma cauliflora* (Hiern) N.Hallé. The undergrowth is home to species of *Begonia* L. and *Peperomia* Ruiz & Pav., and the very common *Psychotria subobliqua* Hiern and *Calvoa crassinoda* Hook.f.

Above 1 400 m and up to the summit of the island (2 024 m), a mist forest is encountered with the endemic trees *Afrocarpus mannii*, *Melchiora mannii*, *Psychotria guerkeana* K.Schum., *P. nubicola* G.Taylor, and *Peddiea thomensis* Exell occurring. Under the canopy species of *Begonia* and *Tristemma* Juss., *Anthocleista scandens* Hook.f., *Pilea manniana* Wedd. and *P. rivularis* Wedd. are found in numbers. The presence of *Erica thomensis* (Henriq.) Dorr & E.G.H.Oliv. and *Lobelia barnsii* Exell at a higher altitude indicates a tendency towards a mountain grassland. The area of Lagoa Amélia (at $\pm 1\ 430$ m) has been well collected and its plant diversity is well known. For example, this small area of ± 4 km² has 55 taxa of pteridophytes. The Lagoa (= lake) is the crater of an ancient volcano. It is now a bog surrounded by tree ferns (*Alsophila manniana* (Hook.) R.M.Tryon) and giant begonias (*Begonia crateris* Exell). The bog itself is populated by ferns such as *Nephrolepis cordifolia* (L.) C.Presl var. *pumicicola* (F.Ballard) Hovenkamp & Miyam. (typical of lava-derived soils), *Lycopodiella cernua* (L.) Pic.-Serm. and *Lepisorus excavatus* (Bory ex Willd.) Ching.

The vegetation of Príncipe is similar to that of S.Tomé, with a predominance of representatives of the families Rubiaceae, Euphorbiaceae and Orchidaceae, and a scarcity of Fabaceae taxa. Mangroves also occur there, but savannas are absent. Being an island of much lower altitude (948 m), the forest resembles the low altitude forest in S.Tomé, but the ridges at low altitude tend to show some characteristics of formations that are only found at much higher altitude in S.Tomé. Submontane forest is only recorded on the summit of the island, the Pico do Príncipe.

Diversity

The flora of S.Tomé and Príncipe has a high diversity and endemism. This issue has been previously covered in the literature (e.g. Figueiredo 1994b). The present work updates the figures of flowering plant diversity to: 135 families (29 introduced), 624 genera (172 introduced), 1 104 species (301 introduced) plus 15 additional infraspecific taxa. At present, 119 taxa (107 species and 12 infraspecific taxa) are known to be endemic to the two islands.

There is only one native gymnosperm in STP, *Afrocarpus mannii* (Hook.) C.N.Page, a species endemic to S.Tomé which is widely planted as an ornamental tree. However, it is rare in the wild where it occurs only at high altitudes. The predominant families in the flora of STP are the Orchidaceae, Rubiaceae and Euphorbiaceae. Together they account for more than half the number of endemic taxa. *Polystachya* Hook. (Orchidaceae) and *Psychotria* L. (Rubiaceae) have the highest levels of endemism. In the remaining families, the endemism of taxa of the genus *Begonia* (Begoniaceae) is noteworthy, particularly that of the gigantic species *B. baccata* Hook.f. and *B. crateris*, which can reach a height of 4 m. Endemic species of *Impatiens* L. (Balsaminaceae) and *Calvoa* Hook.f. (Melastomataceae) are also noteworthy for the ornamental value of their flowers. The pteridophytes are particularly diverse and plentiful in the flora of S.Tomé and Príncipe, with 157 species and 13 endemics. This group has been recently revised (Figueiredo 1998, 2000, 2001, 2002a; Figueiredo & Gascoigne 2001).

MATERIAL AND METHODS

The collections cited in this catalogue are those of the authors and other recent collectors such as J. Lejoly, S.P. Carvalho, G. Joffroy and G.C. Matos. Only recent collections (from 1990 or later) are cited. Most of the recent collections from the islands are deposited at COI (Paiva, Madureira & Martins), LISC (Carvalho, Figueiredo, Matos) and BRLU (Joffroy, Lejoly, Stévant). The national herbarium in S.Tomé (STPH) has duplicates or the first set of many of the recent collections. Herbarium abbreviations follow Thiers (continuously updated: <http://sweetgum.nybg.org/ih/>).

The nomenclature follows Klopfer *et al.* (2006) and AFPD (2009). The synonyms cited in the list were accepted by Exell (1973) or in recent literature.

Common names were mostly obtained from the literature (Rozeira 1958; Silva 1959; Santo 1969; Roseira 1984; Figueiredo 2002b). Medicinal uses were compiled from the literature (Sequeira 1994; Martins 2001; Madureira 2006; Madureira *et al.* 2007) and herbarium specimens.

LIST OF FLOWERING PLANTS

Accepted names are in bold, synonyms in italics. Common names appear in brackets after the taxon and author's name(s). Abbreviations/symbols used in the list are: *, introduced; ?, recorded in literature but specimens not known, or doubts about their origin; §, record requiring confirmation; D, distribution in S.Tomé and Príncipe (STP); E, edible; ^E, endemic; H, habit and habitat; M, medicinal (see Appendix); N, notes; O, ornamental; P, Príncipe; ST, S.Tomé; V, voucher(s).

ACANTHACEAE

(Daniel & Figueiredo 2009)

ACANTHUS L.

montanus (Nees) T.Anderson (*Castanheiro-de-S.Tomé*, *Cumbo-muala-ve*, *Cundú-de-muala-vé*)

H: perennial herb with spiny leaves and white flowers, on roadsides and plantations. M: 27; 171. D: STP. V: *Daniel 11183* (CAS, STPH); *Matos 7522* (BRLU, LISC).

ASYSTASIA Blume

gangetica (L.) T.Anderson (*Fiá-mamblêblê*, *Fiá-qui-sobô*, *Fiá-qui-sobô-homem*, *Homê*, *Mualá*)

H: perennial herb with blue flowers dotted purple, on roadsides, cultivated areas, plantations, ruderal. M: 40; 65; 79; 88; 124; 142. D: STP. V: *Figueiredo 207* (LISC); *Matos 7734* (LISC).

BRACHYSTEPHANUS Nees

^E**occidentalis** Lindau

H: herb or shrub with white flowers, in montane forest, secondary forest and margins of watercourses. D: ST. V: *Paiva 208* (COI).

BRILLANTAISIA P.Beauv.

lamium (Nees) Benth. (*Fia-de-mina-grande*, *Fia-fôgô*)

H: perennial herb with blue flowers, in forest, secondary forest and plantations, ruderal. D: STP. V: *Figueiredo 31* (LISC); *Matos 7737* (LISC).

owariensis P.Beauv. (*Mamblêmbê*)

H: herb with blue flowers in secondary forest and on roadsides. D: ST. V: *Figueiredo 213* (LISC).

vogeliana (Nees) Benth.

H: herb with white or blue flowers, in rainforest and secondary forest. D: ST. V: *Figueiredo 32* (K, LISC).

DICLIPTERA Juss.

verticillata (Forssk.) C.Chr.

H: herb with blue, purple flowers, in secondary forest, on roadsides. D: STP. V: *Matos 7515* (BRLU, LISC, STPH).

ELYTRARIA Michx.

marginata Vahl (*Focha-anzolo*, *Santage-basso-café*)

H: herb with white or lilac flowers, in secondary forest, cultivated areas and river margins. M: 16; 51; 59; 96; 173. D: STP. V: *Oliveira 530* (BRLU, STPH), *1351* (BRLU).

HETERADELPHIA Lindau

^E**paulowilhelmia** Lindau

H: perennial herb or shrub with purple flowers, in rainforest. D: ST. V: *Matos 7302* (BRLU, LISC).

HYPOESTES Sol. ex R.Br.

sp.

D: ST. N: *Hypoestes* sp. was recorded by Exell (1944) based on the collection *Don s.n.* (BM) and said to be possibly a new species.

JUSTICIA L.

tenella (Nees) T.Anderson

H: herb with pink flowers or white with purple patch on lower lip (Exell 1944), in secondary forest. D: STP. V: *Matos 7393* (BRLU, LISC, STPH); *Oliveira 135/98* (STPH).

^E**thomensis** Lindau

H: herb. D: ST. N: rare or even extinct plant only known from the type collection [*Souza s.n.* (COI)].

NELSONIA R.Br.

smithii Oerst.

H: herb with creeping stem sending up flowering shoots, flowers white tinged with pink or crimson (Exell 1944), in secondary forest. D: STP. V: *Oliveira 504* (BRLU, LISC), *594* (BRLU, STPH).

PHAULOPSIS Willd.**micrantha** (Benth.) C.B. Clarke (*Fia-glavana*)H: herb with white flowers. M: 84; 96; 150. D: ST. V: *Oliveira* 264 (STPH).**RHINACANTHUS** Nees**virens** (Nees) Milne-Redh.H: herb with white flowers in secondary forest. D: P. V: *Oliveira* 133/98 (BRLU, LISC, STPH).***RUELLIA** L.***brevifolia** (Pohl) Ezcurra (*Mato-baná, Pega-pega*)H: herb or undershrub with red flowers, in secondary forest. D: ST. V: *Figueiredo* 30 (LISC).**STENANDRIOPSIS** S. Moore**thomensis** (Milne-Redh.) HeineH: herb with pink or blue flowers, in forest. D: STP. V: *Lejoly* 95/97 (BRLU, LIC, STPH); *Oliveira* 547 (BRLU, STPH).***AGAVACEAE*****AGAVE** L.***sisalana** Perrine (*sisal*)H: succulent shrub. D: ST. V: *Paiva* 128 (COI).**?*FURCRAEA** Vent.**?*foetida** (L.) Haw.

N: recorded by Exell (1944) based on the literature; no specimens known.

AIZOACEAE**SESUVIUM** L.**portulacastrum** (L.) L.

H: perennial herb occurring in coastal areas. E: leaves. D: ST.

ALANGIACEAE**ALANGIUM** Lam.**chinense** (Lour.) Harms

H: tree up to 22 m high, with white to yellowish flowers, in secondary forest. D: ST.

?ALLIACEAE**?*ALLIUM** L.**?*cepa** L. (*Cebola*)

N: cultivated for the bulbs, recorded by Exell (1973) based on Silva (1958) without specimen citation.

?*sativum L. (*Alho*)

N: cultivated for the bulbs, recorded by Exell (1973) based on Silva (1958) without specimen citation.

AMARANTHACEAE***ACHYRANTHES** L.***aspera** L. (*Fia-ponto, Folha-galo, Folha-ponto, Mato-bana, Papué*)H: herb in plantations. M: 14; 41; 67; 60; 89; 90; 168. D: ST. V: *Madureira & Martins* 86 (COI).**ALTERNANTHERA** Forssk.**littoralis** P. Beauv. var. **maritima** (Mart.) Pedersen*maritima* (Mart.) A. St.-Hil.H: succulent prostrate herb, in dunes. D: STP. V: *Paiva* 266 (COI).***pungens** Kunth (*Piancablá*)H: prostrate herb, on roadsides and cultivated ground. D: STP. V: *Paiva* 1051 (COI).***sessilis** (L.) DC. (*Quá-quá-clôso*)H: herb, in plantations and on roadsides, ruderal. M: 48; 54; 96; 124. D: STP. V: *Madureira & Martins* 295 (COI); *Paiva* 159 (COI).**AMARANTHUS** L.***caudatus** L. (*Jimboa*)H: herb, in plantations. E: leaves, seeds. D: ST. V: *Oliveira* 201 (BRLU).***dubius** Mart. ex Thell.H: herb, ruderal. E: leaves. D: ST. V: *Paiva* 263 (COI).**graecizans** L. (*Chimboa, Gimboa*)H: herb, on roadsides. E: leaves. D: ST. V: *Paiva* 394 (COI).***hybridus** L. subsp. **cruentus** (L.) Thell. (*Gimboa*)H: herb, in cultivated fields. E: leaves, seeds. D: ST. V: *Paiva* 1040 (COI).***spinosus** L. (*Gimboa, Jimboa-brava*)

H: herb. E: leaves. M: 173. D: STP.

viridis** L. (*Belo-viême, Gimboa-doida*)H: herb, on roadsides. E: leaves. M: 124; 173. D: ST. V: *Madureira & Martins* 282 (COI).**BLUTAPARON** Raf.**vermiculare** (L.) Mears var. **vermiculare**H: perennial herb, in coastal areas. D: ST. V: *Matos* 7271 (LISC).**CELOSIA** L.argentea** L.

H: herb. E: leaves. O. D: ST.

leptostachya Benth.H: annual herb, in plantations and on roadsides, ruderal. D: ST. V: *Paiva* 160 (COI)**CYATHULA** Blume**prostrata** (L.) Blume var. **pedicellata** (C.B. Clarke) Cavaco (*Fia-bana, Mato-bana, Pegacalato*)H: small prostrate herb, ruderal. D: STP. V: *Figueiredo* 218 (LISC); *Paiva* 450 (COI).**DEERINGIA** R. Br.**sp.**D: P. N: Exell (1944, 1973) recorded *Deeringia amaranthoides* (Lam.) Merr. as an introduced plant in Príncipe (based on Barter 2009 (K)). He cited *D. celosioides* R. Br., nom. illegit, as a synonym. In the AFPD (2009) database, *D. celosioides* is accepted as a species endemic to Príncipe.***GOMPHRENA** L.***globosa** L.

H: annual herb. O. D: ST.

IRESINE** P. Browneherbstii** Lindl.H: herb with red leaves, ruderal. D: ST. V: *Lejoly* 93/601 (BRLU).**PUPALIA** Juss.**lappacea** (L.) A. Juss. (*Pega-lato, Pega-rato*)H: herb, on roadsides and cultivated fields, ruderal. M: 67. D: ST. V: *Madureira & Martins* 275 (COI).**AMARYLLIDACEAE****CRINUM** L.**jagus** (J. Thomps.) Dandy (*Cebola-cencê, Sabola-cencê*)H: bulbous plant with white flowers, in secondary forest and plantations. M: 12; 33; 50; 66; 85; 186. D: ST. V: *Paiva* 458 (COI).***HIPPEASTRUM** Herb.***puniceum** (Lam.) Kuntze

H: bulbous plant with pink flowers. O. D: STP.

HYMENOCALLIS** Salisb.littoralis** (Jacq.) Salisb. (*Flor-branca, Sabola-cencê*)H: bulbous plant with white flowers. M: 12; 66; 98; 114; 191. D: P. V: *Madureira & Martins* 648 (COI).**ANACARDIACEAE*****ANACARDIUM** L.***occidentale** L. (fruit: *Cajú*; tree: *Cajueiro*)H: tree, cultivated and occurring on roadsides. E: fruits, seeds. M: 2; 22; 23; 26; 37; 60; 67; 114; 171. D: STP. V: *Paiva* 109 (COI).

LANNEA A.Rich.**welwitschii** (Hiern) Engl. (*Mucumbli*)H: tree, on secondary forest (300–1 500 m). M: 22; 57; 87; 109; 124. D: ST. V: *Madureira & Martins* 217 (COI).***MANGIFERA** L.***indica** L. (fruit: *Manga*; tree: *Mangueira*)H: large tree with small red or yellow flowers, cultivated and occurring on roadsides. E: fruits. M: 14; 27; 37; 40; 57; 67; 98; 177. D: STP. V: *Madureira & Martins* 459 (COI); *Paiva* 821 (COI).**PSEUDOSPONDIAS** Engl.**microcarpa** (A.Rich.) Engl. (*Guegue*, *Safú-d'obô*, *Safú-dodo*, *Zenze*, *Zenzem*)H: tree with yellowish white flowers (Exell 1944), in secondary forest and on roadsides. M: 62; 124; 157. D: STP. V: *Madureira & Martins* 512 (COI); *Paiva* 1915 (COI).**SORINDEIA** Thouars**grandifolia** Engl. (*Gogo*, *Safú-de-obô*)H: tree, in rainforest and secondary forest. D: ST. V: *Matos* 7683 (LISC).**juglandifolia** (A.Rich.) Planch. ex Oliv.H: tree, in forest. D: ST. V: *Lejoly* 98/236 (BRLU).***SPONDIAS** L.***cytherea** Sonn. (fruit: *Cajamanga*; tree: *Cajamangueira*)*dulcis* Sol. ex ParkinsonH: tree with small white flowers. E: fruits. D: STP. V: *Paiva* 799 (COI).***mombin** L. (*Geg*, *Gig*, *Guêgue*, *Guêguê*)*lutea* L.H: small tree, in hedges. E: fruits. M: 14; 41; 54; 56; 75; 84; 122. D: STP. V: *Paiva* 814 (COI).**ANISOPHYLLEACEAE****ANISOPHYLLEA** R.Br. ex Sabine**cabole** Henriq. (*Cabolê*)H: tree 35–40 m high (Exell 1944). D: ST. N: an undetermined species of *Anisophyllea* has also been reported from Príncipe. V: *Matos* 7237a (LISC).**ANNONACEAE****ANNONA** L.***cherimola** L. (*Crimola*)

H: small tree. E: fruits. D: ST.

glabra L. (*Nona*, *Nona-concha*, *Nopa*, *Nopa-concha*)

H: tree. E: fruits. D: ST.

muricata** L. (*Chabe-chabe*, *Chapo-chapo*, *Coração-da-índia*, *Coração-de-preto*, *Coração-preto*, *Sape-sape*, *Sapo-sapo*)H: tree. E: fruits. M: 94; 98; 123. D: STP. V: *Paiva* 1042 (COI).reticulata** L. (*Fruta-conde*)H: tree with reddish flowers, cultivated and occurring in secondary forest. E: fruits. D: STP. V: *Oliveira* 225/98 (BRLU), 1435 (BRLU).**senegalensis** Pers.*arenaria* Thonn.H: shrub or small tree. D: ST? N: recorded by Exell (1944, 1973) as *A. arenaria* Thonn., based on *Don s.n.* (BM).***squamosa** L. (*Fruta-pinha*, *Nona*)H: tree. E: fruits. M: 150. D: ST. V: *Madureira & Martins* 435 (COI).**?*ASIMINA** Adans.**?*triloba** (L.) Dunal

D: P? N: a doubtful record from the literature according to Exell (1944, 1973); no specimens known.

CANANGA** (DC.) Hook.f. & Thomsonodorata** (Lam.) Hook.f. & Thomson (*Ilange-ilange*, *Pompeia*)H: tree with strongly fragrant flowers. O. M: 138. D: ST. V: *Figueiredo* 123 (K).**MONODORA** Dunal**brevipēs** Benth. (*Iobo*)H: tree, in plantations. D: STP. V: *Paiva* 822 (COI).**myristica** (Gaertn.) Dunal (*Ióbô*, *Iôbo*, *Jobó*, *Xipobó*, *Yobó*)H: tree, in plantations. M: 2; 20; 57; 98; 99; 146. D: STP. V: *Madureira & Martins* 76 (COI), 455 (COI).**POLYALTHIA** Blume**oliveri** Engl. (*Cabore-de-Bom-Sucesso*, *Inhé-preto*, *Pau-preto*, *Preto*)H: tall tree with white flowers, in rainforest. M: 20; 22. D: STP. V: *Madureira & Martins* 589 (COI); *Oliveira* 588 (BRLU).**UVARIA** L.**ovata** (DC.) A.DC. subsp. **ovata**

sp. sensu auctt. Santo (1970), Exell (1973).

H: shrub with yellow flowers forming thickets, in savanna. D: ST. V: *Espírito Santo* 4357 (LISC).**XYLOPIA** L.**aethiopica** (Dunal) A.Rich. (*Cabela*, *Inhé-bobô*, *Noé*, *Pimenta-do-Congo*, *Untué-do-bô*)H: tree ± 20 m high with fragrant white flowers (Exell 1944), in secondary forest. E: fruits. M: 22; 43; 62. D: STP. V: *Joffroy* 147 (BRLU); *Paiva* 1473 (COI).**quintasii** Engl. & Diels

H: tree up to 35 m high, in rainforest. D: ST.

staudtii Engl. & Diels (*Inhé-bobé*, *Inhé-branco*, *Inhé-ganso*, *Unué-bolina*)*africana* (Benth.) Oliv.H: tree 9–30 m high, in plantations, secondary forest and on roadsides. D: STP. V: *Paiva* 943 (COI), 1419 (COI).**APIACEAE****APIUM** L.**leptophyllum** (Pers.) F.Muell. ex Benth.

H: annual herb. D: P.

CENTELLA L.**asiatica** (L.) Urb. (*Fiá-d'olhá*, *Folha-de-orelha*, *Folha-viola*, *Olhadatô*, *Ufiá-copo*)H: perennial herb with red flowers, creeping and sometimes climbing (Exell 1944). M: 29; 44; 69; 155; 174. D: STP. V: *Figueiredo* 115 (K).***ERYNGIUM** L.***foetidum** L. (*Celo-sum-zom-maiá*, *Cheiro-de-João-Maria*, *Coentro-de-S.Tomé*, *Jamaia*, *Lamaia*, *Selo-sum-João-Maiá*, *Selo-sum-zon-maia*)H: biennial herb. E: leaves. M: 2; 52; 61; 81; 94; 145; 150; 156. D: STP. V: *Paiva* 634 (COI), 1149 (COI).**HYDROCOTYLE** L.**bonariensis** Lam. (*Fiá-copo*, *Fiá-d'olhá*, *Homê-d'olhá*)H: perennial herb. M: 2; 44; 69; 155; 174. D: STP. V: *Paiva* 249 (COI), 1436 (COI).**mannii** Hook.f.H: prostrate herb trailing along the ground (Exell 1944). D: ST. V: *Matos* 7428 (BRLU, LISC).***PETROSELINUM** Hill***crispum** (Mill.) A.W.Hill (*Salsa*)

H: biennial herb. E: leaves. D: ST.

APOCYNACEAE***ASCLEPIAS** L.***curassavica** L.H: herb, in gardens and escaped. O. D: ST. V: *Figueiredo* 60 (K).***CASCABELA** Raf.***thevetia** (L.) Lippold*Thevetia peruviana* (Pers.) K.Schum.H: shrub, with yellow flowers, ruderal. D: ST. V: *Paiva* 1297 (COI).***CATHARANTHUS** G.Don***roseus** (L.) G.Don (*Lábios-de-mulata*, *Vinca*)H: shrub or perennial herb, with white flowers with a red or pink centre (Exell 1944), ruderal. M: 118; 171. O. D: ST. V: *Paiva* 433 (COI).**FUNTUMIA** Stapf**africana** (Benth.) Stapf (*Pau-cadeira*, *Pó-cadela*, *Pó-leite*, *Pó-visgo*)H: tree 45–60 m high (Exell 1944), with yellow-white flowers, in forest. M: 56; 115; 176. D: STP. V: *Oliveira* 88 (BRLU).

FUNTUMIA Stapf (cont.)**elastica** (P.Preuss) Stapf (*Funtumia*)

H: tree, with yellow-white flowers, in forest. D: ST.

GONGRONEMA Decne.**latifolium** Benth. (*Otage*)

H: climber with tuberous base. D: ST.

LANDOLPHIA P.Beauv.**landolphioides** (Hallier f.) A.Chev.*dawei* StapfH: liana with a trunk up to 0.4 m in diameter. E: fruits. D: ST. V: *Oliveira 51/99* (BRLU).**MARSDENIA** R.Br.**exellii** C.NormanH: liana with yellow flowers, in forest. D: ST. V: *Lejoly 98/269* (BRLU).***NERIUM** L.***oleander** L.H: shrub. O. D: ST. V: *Oliveira 217* (BRLU).**ONCOSTEMMA** K.Schum.**cuspidatum** K.Schum.D: ST. N: this monotypic genus has been reduced to synonymy of *Tylophora* by Meve & Omlor (2000) and found to be a synonym of *T. oblonga* N.E.Br. The new combination *Tylophora cuspidata* (K.Schum.) Meve & Omlor, said to take precedence over *T. oblonga*, is illegitimate.***PLUMERIA** L.***rubra** L.

H: shrub or tree, very fragrant. O. D: ST.

RAUVOLFIA L.**caffra** Sond. (*Cata-cuéné*, *Cata-glandje*, *Cata-grande*. Note: not to be confused with *Cata-pequena*)*macrophylla* StapfH: tree, with white flowers and blackish purple fruits, in forest. M: 2; 25; 44; 79; 99; 123; 127; 146; 155; 168; 175. D: ST. V: *Madureira & Martins 16* (COI).**vomitioria** Afzel. (*Cata*, *Cata-manginga*, *Cata-pequena*, *Cata-piquina*, *Cata-ussubi*)*dichotoma* K.Schum.H: shrub or small tree with white flowers and red fruits, in forest and plantations. M: 60; 79; 99; 103; 123; 175; 184. D: STP. V: *Figueiredo 256* (LISC).**TABERNAEMONTANA** L.***divaricata** (L.) R.Br. ex Roem. & Schult.*Ervatamia coronaria* (Jacq.) Stapf*E. divaricata* (L.) BurkillH: shrub or small tree with white flowers, in gardens. D: STP. V: *Paiva 290* (COI).**pachysiphon** Stapf (*Cata-glandje*, *Cata-grande*)H: shrub or small tree, with white or yellowish flowers, in forest. D: ST. V: *Oliveira 1430* (BRLU).***stenosiphon** Stapf (*Cata*, *Cata-d'ôbo*, *Cata-piquina*, *Pau-lírio*)H: small tree with fragrant white flowers, in forest. M: 8; 77; 103. D: STP. *Oliveira 141/98* (LISC); *Paiva 76* (COI).**VOACANGA** Thouars**africana** Stapf (*Bule*, *Cata-contra*, *Cata-glandje*, *Cata-grande*, *Cata-quiô*, *Gata-grande*, *Guibule*)*lemosii* PhilipsonH: small tree, with yellow or white flowers, in forest. M: 8; 103. D: ST. V: *Paiva 1194* (COI).**AQUIFOLIACEAE****ILEX** L.**mitis** (L.) Radlk.H: tree, with white flowers, in forest. D: ST. V: *Oliveira 985* (BRLU).**ARACEAE*****ALOCASIA** (Schott) G.Don***macrorrhiza** (L.) G.Don (*Côco-vêneno*, *Matabala-veneno*)H: perennial herb with a tuberous rootstock in secondary forest and plantations. O. M: 5; 133; 174. D: STP. V: *Madureira & Martins 449* (COI).***CALADIUM** Vent.***bicolor** (Aiton) Vent. (*Coco-floli*, *Côco-vêneno*)H: perennial herb with a tuberous rootstock, in secondary forest and plantations. O. D: STP. V: *Paiva 1200* (COI), *1427* (COI).***COLOCASIA** Schott***esculenta** (L.) Schott (*Coco*, *Matabala*, *Micoco*)

H: large herbaceous plant cultivated for the corm (taro). D: STP.

CULCASIA P.Beauv.**angolensis** Welw. ex Schott (*Pimenta-da-terra*)*barombensis* N.E.Br.

H: climber, in forest. D: ST.

scandens P.Beauv. (*Homê-dum-ôso*, *Homem-de-um-osso-sô*)H: epiphyte, climbing herb, in forest. M: 22; 87; 96. D: ST. V: *Madureira & Martins 66* (COI).***DIEFFENBACHIA** Schott***seguine** (Jacq.) SchottH: herb. O. D: ST. V: *Oliveira 216* (BRLU).***XANTHOSOMA** Schott***sagittifolium** (L.) Schott (*Coco*, *Matabala*, *Matabala-branca*, *Matabala-gema-de-ovo*, *Matabala-vermelha*, *Micoco*)*maffafa* Schott*violaceum* SchottH: large herbaceous plant much cultivated for the corm (coco-yam). M: 188. D: STP. V: *Paiva 761* (COI), *1331* (COI).**ARALIACEAE*****HEDERA** L.***helix** L. (*Hera*)H: climber. O. D: ST. N: recorded by Exell (1944, 1973) but it is possible that it may be a different species of *Hedera*.**POLYSCIAS** J.R.Forst. & G.Forst.***quintasii** Exell (*Guêguê-fasso*, *Velá*)H: tree, in forest. D: STP. V: *Oliveira 1253* (BRLU).**SCHEFFLERA** J.R.Forst. & G.Forst.**barteri** (Seem.) HarmsH: liana, in secondary forest. D: STP. V: *Figueiredo 48* (K).**mannii** (Hook.f.) HarmsH: small shrub or tree, in forest. D: ST. V: *Matos 7513* (LISC).**ARECACEAE**Note: the following palm trees have also been recorded in cultivation: *Roystonea regia* (Kunth) O.F.Cook, *Butia eriospatha* (Mart. ex Drude) Becc., *Caryota urens* L.**BORASSUS** L.**aethiopum** Mart. (*Palmeira-do-marfim*, *Palmeira-leque*, *Úlua*)

H: tree up to 20 m high. D: ST.

COCOS** L.nucifera** L. (*Coco*, *Cóconjá*, *Côncônja*, *Coqueiro*)

H: tree. E: fruit. D: STP.

ELAEIS Jacq.**guineensis** Jacq. (*Andim*, *Dendem*, *Déndém*, *Palmeira-andim*, *Palmeira-dendim*, *Palmeira-do-dendem*, *Pema*)

H: tree up to 30 m high. E: fruit (oil). D: STP.

PHOENIX** L.dactylifera** L. (fruit: *Tâmara*; tree: *Tamareira*)

H: tree with trunk up to 20 m high. E: fruit. D: ST.

ARISTOLOCHIACEAE**ARISTOLOCHIA** L.***littoralis** Parodi

H: climber, yellow flowers spotted with pink (Exell 1956). O. D: ST.

ASPHODELACEAE

ALOE** L.humilis** (L.) Mill. (*Áliba-blabosa*, *Erva-babosa*)

H: scapose perennial herb. M: 39; 51; 54; 49; 60; 72; 77; 93; 123; 124.
D: ST. V: *Madureira & Martins 354* (COI).

ASPARAGACEAE

ASPARAGUS** L.officinalis** L. (*Espargo*)

N: herb cultivated for the young shoots, recorded by Exell (1973)
based on Silva (1958) without specimen citation.

ASTERACEAE

ACANTHOSPERMUM** Schrankhispidum** DC. (*Mosquito-dia*)

H: annual herb with yellowish green flowers (Exell 1944). D: STP.

ACMELLA Rich. ex Pers.**caulirhiza** Delile (*Fiá-dentche*, *Fiá-dente*)

Spilanthes filicaulis (Schumach. & Thonn.) C.D.Adams

H: herb with yellow flowers. M: 132; 175. D: STP. V: *Madureira & Martins 296* (COI); *Matos 7491* (LISC).

ADENOSTEMMA J.R.Forst. & G.Forst.**mauritanum** DC.

H: herb with white flowers, in forest and secondary forest. D: ST. V:
Lejoly 94/551 (BRLU, LISC).

perrottetii DC. (*Lingua-tela*, *Tonfonso*)

H: herb with white flowers, in forest, plantations and on roadsides. M:
141. D: ST. V: *Madureira 646* (COI).

AGERATUM** L.conyzoides** L. subsp. **conyzoides** (*Fiá-cuncunha*, *Fiá-malé*, *Fiá-malé-di-que*, *Fiá-malé-home*, *Folha-malé*)

H: annual herb with blue-purple or white flowers, in secondary forest, plantations and on roadsides, ruderal. M: 124; 150. D: STP. V: *Paiva 1385* (COI), *1782* (COI).

AMBROSIA L.**maritima** L. (*Atinija*, *Atlija*, *Atlimija*, *Atrimija*, *Natruja*)

H: annual herb or perennial from woody rootstock. M: 29; 77; 115; 150; 184; 189. D: STP. V: *Madureira & Martins 93* (COI).

?ASPILIA Thouars**?rudis** Oliv. & Hiern subsp. **rudis**

H: erect, often perennial herb with pale yellow or almost white flowers. D: P. Recorded by Exell (1944) based on a citation in *Flora of tropical Africa* of a collection by Barter that he did not see.

BIDENS L.**pilosa** L. (*Áliba-gúhia*, *Fiá-gúhia*, *Pega-pega*)

H: herb with white flowers, in secondary forest, plantations and on roadsides. M: 29; 46; 69; 88. D: STP. V: *Paiva 572* (COI), *705* (COI).

CHRYSANthemum** L.indicum** L.

H: perennial herb. O. D: ST.

?CICHORIUM** L.?intybus** L.

H: perennial herb. E: leaves (var. *foliosum*), roots (var. *sativum*). D: ST. N: a doubtful record based on a specimen collected by Don and cited by Bentham in *Niger flora*. Exell (1944) did not see the specimen.

CONYZA Less.**attenuata** DC. (*Folha-male*, *Língua-de-vaca*, *Lingua-tela*)

persicifolia (Benth.) Oliv. & Hiern

H: annual herb, in forest. D: ST. V: *Matos 7369* (LISC).

***bonariensis** (L.) Cronquist

H: annual erect herb. D: STP.

CRASSOCEPHALUM Moench**crepidioides** (Benth.) S.Moore

H: annual herb with yellow or mauve flowers, in forest and plantations. D: ST. V: *Lejoly 98/211* (BRLU).

montuosum (S.Moore) Milne-Redh.

H: herb, ruderal. D: ST. V: *Matos 7438* (LISC).

rubens (Juss. ex Jacq.) S.Moore

H: herb, in secondary forest and plantations. D: ST.

sarcobasis (DC.) S.Moore

H: herb, in disturbed ground. D: ST. V: *Matos 7466* (BRLU).

DICHROCEPHALA L'Hér. ex DC.**integrifolia** (L.f.) Kuntze subsp. **integrifolia**

H: annual herb with whitish flowers, ruderal. D: ST. V: *Lejoly 95/057* (LISC).

ECLIPTA L.**prostrata** (L.) L. (*Folha-bobá*, *Folha-sapateiro*)

H: annual or perennial herb with white flowers. D: STP

ELEPHANTOPUS** L.mollis** Kunth (*Fia-budo*, *Fia-dentche*, *Folha-budo*, *Macabali*, *Macablali*)

H: herb with white flowers, in secondary forest, plantations, and on roadsides. H: 3; 22; 112; 129; 130; 150; 174; 175. D: STP. V: *Figueiredo 105* (K).

EMILIA Cass.**?coccinea** (Sims) G.Don

N: recorded by Exell (1973) based on Silva (1958) without specimen citation.

sonchifolia (L.) DC. ex Wight

H: annual herb. E: leaves. D: STP.

§EPALTES Cass.**§*brasiliensis** DC.

H: herb. D: STP. N: Exell (1944) cited three collections of this taxon (*Barter 1976*, *Mann s.n.* and *Welwitsch 3520*). We did not see these specimens but it is possible that they refer to *Litogyne gariepina* (DC.) Anderb., a species widespread from West Africa to South and East Africa that includes as synonyms the three species of *Epaltes* previously cited for tropical Africa. *E. brasiliensis* has apparently never been recorded for Africa.

ETHULIA L.f.**conyzoides** L.f. subsp. **conyzoides**

H: annual herb, with white, mauve or purple flowers. D: ST.

GALINSOGA** Ruiz & Pav.parviflora** Cav.

H: annual herb with white flowers, on disturbed ground and on roadsides. D: ST. V: *Matos 7603* (LISC).

HELICHRYSUM Mill.**foetidum** (L.) Moench var. **foetidum**

H: annual or perennial herb, with yellow flowers, in forest. D: ST. V: *Matos 7371* (LISC).

MICROGLOSSA DC.**pyrifolia** (Lam.) Kuntze

H: shrub or scandent shrub, with white, cream-coloured, yellowish or pinkish flowers, in forest. D: STP. V: *Matos 7564* (LISC).

MIKANIA Willd.**chenopodiifolia** Willd. (*Matucana*)

cordata sensu auct. non (Burm.f.) B.L.Rob.

sp. sensu auct. Exell (1956, 1973)

H: shrub with white flowers. M: 31; 77; 98; 129; 140. D: STP. V: *Figueiredo 257* (LISC).

MIKANIOPSIS Milne-Redh.**paniculata** Milne-Redh.

H: perennial climber with orange-yellow flowers. D: ST. V: *Matos 7312* (LISC).

PSEUDOGNAPHALIUM Kirp.**luteo-album** (L.) Hilliard & B.L.Burt subsp. **luteo-album**

Gnaphalium luteo-album L.

H: annual or perennial herb with whitish or yellowish flowers, on roadsides, ruderal. D: STP. V: *Paiva 1064* (COI).

SOLANECIO (Sch.Bip.) Walp.**biafrae** (Oliv. & Hiern) C.Jeffrey*Crassocephalum biafrae* (Oliv. & Hiern) S.Moore

H: perennial, climbing, subsucculent herb with yellow flowers. E: leaves. D: ST.

SONCHUS L.**oleraceus** L. (*Serralha*)H: annual or biennial herb with yellow flowers, in forest, plantations and on roadsides. E: leaves. D: ST. V: *Paiva* 33 (COI).**STRUCHIUM** P.Browne**sparganophora** (L.) Kuntze (*Libo-d'água*, *Libô-d'aua*)*Sparganophorus sparganophora* (L.) C.Jeffrey, nom. illegit.H: perennial, slightly succulent herb, with whitish or pinkish flowers, in humid areas. M: 123; 137; 190. D: STP. V: *Paiva* 1292 (COI).***SYNEDRELLA** Gaertn.***nodiflora** Gaertn. (*Fiá-malé-dôdô*, *Fiá-malé-muála*, *Folha-malé-doida*, *Macabali-fia-budo*)H: annual or perennial herb with yellow flowers, in secondary forest, plantations, and on roadsides, ruderal. M: 27; 51; 52; 81; 94; 113; 123; 156. D: STP. V: *Paiva* 1006 (COI), 1784 (COI).***TITHONIA** Desf. ex Juss.***diversifolia** (Hemsl.) A.Gray (*Girassol*)H: annual or perennial herb or subshrub up to 2.5 m high, with yellow flowers, ruderal. M: 123. D: ST. V: *Paiva* 1281 (COI).**VERNONIA** Schreb.**amygdalina** Delile (*Libô*, *Libô-da-terra*, *Libô-de-que*, *Libô-mucambú*, *Limbo*, *Pau-fede*)H: undershrub, shrub or tree, with white flowers, ruderal. E: leaves. M: 60; 123. D: ST. V: *Paiva* 1289 (COI).**stellulifera** (Benth.) C.Jeffrey (*Fia-bungá*)*Triplotaxis stellulifera* (Benth.) Hutch.H: annual herb with mauve to purple flowers, in secondary forest. D: STP. V: *Figueiredo* 41 (K).***ZINNIA** L.***peruviana** (L.) L.

H: annual herb, with red, pink or purplish flowers. D: ST.

AVERRHOACEAE**AVERRHOA** L.***carambola** L. (fruit: *Carambola*; tree: *Caramboleira*)H: shrub or small tree, cultivated. E: fruits. D: ST. V: *Paiva* 1327 (COI).**AVICENNIACEAE**

(Daniel & Figueiredo 2009)

Avicennia L.**germinans** (L.) L.H: shrub or tree up to 17 m high, with pneumatophores, halophyte, in mangroves. E: fruits. D: ST. V: *Figueiredo* 93 (K).**BALSAMINACEAE****IMPATIENS** L.***balsamina** L. (*Balsamina*, *Melindres*)*tamsiana* ExellH: herb. O. D: STP. V: *Paiva* 1583 (COI), 1690 (COI).**†buccinalis** Hook.f. (*Camarões*)H: herb or shrub up to 3 m high, with red flowers, in forest or secondary forest. D: ST. V: *Paiva* 1858 (COI).**†manteroana** ExellH: herb with red flowers in humid and rocky places, in rainforest. D: P. V: *Paiva* 1726 (COI).**†thomensis** ExellH: herb up to 1 m high, with red or orange flowers, in humid places, in forest. D: ST. V: *Figueiredo* 255 (LISC).***BASELLACEAE*****BASELLA** L.***alba** L. (*Fiá-tataluga*, *Folha-tataruga*)H: annual or perennial succulent herb. E: leaves. M: 173. D: ST. V: *Madureira & Martins* 339 (COI).**BEGONIACEAE****BEGONIA** L.**ampla** Hook.f. (*Fia-bôba-d'ôbo*, *Fiá-bôba-glandji*)H: perennial herb, epiphyte, with white flowers, in forest and secondary forest. M: 1; 16; 119; 129. D: STP. V: *Figueiredo* 72 (K).**annobonensis** A.DC.H: annual epiphytic succulent herb, in forest. D: STP. V: *Figueiredo* 260 (LISC).**†baccata** Hook.f. (*Fiá-bôba*, *Fiá-bôba-d'ôbo*, *Folha-boba-vermelha*)H: herb, in forest. M: 16; 38; 84; 142. D: ST. V: *Figueiredo* 39 (K, LISC).**†crateris** Exell (*Fia-bôba-d'ôbo*)H: herb, in forest. D: ST. N: considered by some authors as a synonym of *B. baccata*. V: *Lejoly* 94/559 (BRLU, LISC).**†fusialata** Warb. var. **principensis** J.J.de Wilde

H: herb. D: P.

†loranthoides Hook.f. subsp. **loranthoides**

H: herb. D: STP.

†molleri (C.DC.) Warb.

H: herb. D: ST.

rostrata Welw. ex Hook.f. var. **rostrata**H: annual succulent herb. D: ST. V: *Figueiredo* 161 (LISC).**subalpestris** A.Chev.*macambrarensis* ExellH: herb, in forest. D: ST. V: *Matos* 7552 (BRLU, LISC).**thomeana** C.DC.H: perennial herb, in forest. D: ST. V: *Matos* 7704 (LISC).**BIGNONIACEAE*****JACARANDA** Juss.***mimosifolia** D.Don (*Jacarandá*)

H: tree with purple flowers. O. D: ST. N: recorded in the literature as introduced, there is a single tree known (at Roça Agostinho Neto).

NEWBOULDIA Seem.**laevis** (P.Beauv.) Seem. ex Bureau (*Quimé*, *Quine*)H: shrub or tree, with pink flowers, ruderal. M: 28; 57. D: ST. V: *Paiva* 674 (COI).**SPATHODEA** P.Beauv.**campanulata** P.Beauv.*nilotica* Seem.

H: tree. O. D: ST.

TECOMA** Juss.sp.** (*Maioba-bini*)H: vine. O. M: 7; 96; 128; 146; 153. D: ST. V: *Madureira & Martins* 308 (COI).***BIXACEAE*****BIXA** L.***orellana** L. (*Anato*, *Gicló*, *Gincló*, *Quisafú*, *Tintureira*, *Urucú*)H: shrub or small tree with pink flowers. E: seeds. O. M: 22; 27; 63; 67. N: seeds contain a natural orange-red dye. D: STP. V: *Paiva* 493 (COI).**BOMBACACEAE****ADANSONIA** L.**digitata** L. (*Imbondeiro*, *Micondó*)H: large tree in savanna. E: leaves, fruits, seeds. D: STP. V: *Paiva* 1238 (COI).**CEIBA** Mill.**pentandra** (L.) Gaertn. (*Ocá*)

H: large tree in secondary forest. E: seeds. M: 6; 124. D: STP. V: *Oliveira 139* (BRLU).

***PACHIRA** Aubl.

***glabra** Pasq.

Bombacopsis glabra (Pasq.) A.Robyns

H: tree, in secondary forest and plantations. E: seeds. D: STP. V: *Paiva 1237* (COI), *1950* (COI).

BORAGINACEAE

CORDIA L.

***gerascanthus** L.

H: tree up to 25 m high, with white flowers, in town. D: ST.

platythyrsa Baker (*Pau-tabaque*, *Pó-tabaque*, *Tabaque*)

H: tree up to 18 m high, with creamy white flowers, in secondary forest. D: ST. V: *Lejoly 93/641* (BRLU).

EHRETIA P.Browne

cymosa Thonn. var. **zenkeri** (Gürke ex Baker & C.H.Wright) Brenan
zenkeri Gürke ex Baker & C.H.Wright

H: shrub or small tree up to 12 m high, with white flowers and yellow fruits, in forest. D: ST. V: *Lejoly 97/344* (BRLU).

***scrobiculata** Hiern

H: small tree with whitish flowers. N: probably extinct. D: P.

***HELIOTROPIUM** L.

***indicum** L. (*Fia-galo*, *Folha-galo*, *Galo*)

H: annual herb with red flowers, ruderal. M: 41; 51; 57; 70; 77; 89; 90; 112; 183; 184. D: STP. V: *Paiva 1290* (COI), *1413* (COI).

BRASSICACEAE

***BRASSICA** L.

***juncea** (L.) Czern. & Coss. (*Mostarda*)

H: perennial herb with yellow flowers. E: seed (spice: *mostarda*). D: ST.

***CAPSELLA** Medik.

***bursa-pastoris** (L.) Medik.

H: annual herb, ruderal. D: ST.

CARDAMINE L.

africana L.

H: annual herb with white flowers, in forest and secondary forest. D: ST. V: *Lejoly 97/220* (BRLU).

?hirsuta L.

N: a doubtful record in Exell (1973) probably due to a typographic error; the references cited refer to the occurrence in Bioko and not in S.Tomé.

***DIPILOTAXIS** DC.

***tenuisiliqua** Delile

H: herb. D: ST. V: *Matos 7300* (BRLU).

***LEPIDIUM** L.

***didymum** L.

Coronopus didymus (L.) Sm.

H: annual or biennial herb. E: leaves. D: ST.

***LOBULARIA** Desv.

***maritima** (L.) Desv.

H: annual or perennial herb, with white, pink or purple flowers. D: ST.

***RAPHANUS** L.

***sativus** L. (*Nabo-macau*)

H: annual or biennial herb with white or pink flowers. E: roots. D: ST.

RORIPPA Scop.

micrantha (Roth) Jonsell

indica sensu auct. non (L.) Hiern

H: annual herb with yellow flowers. D: ST.

***nasturtium-aquaticum** (L.) Hayek (*Agrião*, *Fia-guihom*, *Fia-guiom*, *Guiom*)

H: aquatic or semi-aquatic perennial herb with white flowers. E: leaves, stems. M: 27; 177. D: ST. V: *Madureira & Martins 617* (COI).

*BROMELIACEAE

***ANANAS** Mill.

***comosus** (L.) Merr. (*Ananas*, *Nanás*)

H: herb cultivated for fruit. M: 24; 98; 124. D: STP. V: *Madureira & Martins 647* (COI).

BUDDLEJACEAE

LACHNOPYLIS Hochst.

thomensis Philipson

Nuxia congesta R.Br. ex Fresen. var. *thomensis* (Philipson) J.Lewis

H: shrub or small tree, in forest. D: ST. V: *Matos 7384* (LISC).

BURMANNIACEAE

GYMNOSIPHON Blume

sp.

H: colourless saprophyte, in forest. D: P. V: *Stévant 264* (BRLU).

BURSERACEAE

DACRYODES Vahl

edulis (G.Don) H.J.Lam (fruit: *Mubafo*, *Safu*, *Safú*, *Safu-safu*; tree: *Safueiro*, *Safuzeiro*)

H: tree, in forest and plantations, producing a blue-violet fruit. E: fruits. M: 185. D: STP. V: *Paiva 521* (COI).

SANTIRIA Blume

trimera (Oliv.) Aubrév. (*Bálsamo-de-S.Tomé*, *Belambo*, *Goqui*, *Óleo-melambo*, *Pau-óleo*, *Pó-óleo*, *Pó-óleo-d'obô*)

H: tree, in forest. M: 4; 22; 31; 51; 54; 57; 124; 177; 184;. D: STP. V: *Madureira & Martins 249* (COI).

*?BUXACEAE

***?BUXUS** L.

***?sempervirens** L.

N: a doubtful record by Exell (1944, 1973) based on a citation by Chevalier without specimens.

CACTACEAE

RHIPSALIS Gaertn.

baccifera (J.S.Muell.) Stearn subsp. **baccifera**

H: hanging epiphytic, succulent shrub. D: STP. V: *Paiva 1173* (COI).

CAMPANULACEAE

WAHLENBERGIA Schrad. ex Roth

silenoides Hochst. ex A.Rich.

H: herb. D: ST. V: *Matos 7563* (LISC).

*CANNABACEAE

***CANNABIS** L.

***sativa** L. (*Liamba*)

H: annual herb. E: seeds (oil). D: ST.

*CANNACEAE

***CANNA** L.

***indica** L. (*Cana-de-jardim*, *Cana-florífera*, *Erva-conteira*, *Salaconta*, *Salaconta-blanca*, *Salaconta-pleta*)

H: rhizomatous perennial herb with red flowers. O. M: 45; 67; 69; 79; 98; 128; 153. D: STP. V: *Paiva 364* (COI).

CAPPARACEAE

BUCHHOLZIA Engl.

coriacea Engl. (*Cola-congo*)

H: tree up to 12 m high, in forest and secondary forest. M: 6; 173; 174. D: ST. V: *Paiva 1271* (COI).

CAPPARIS L.**erythrocarpos** Isert

H: shrub or climber, in savanna. D: ST. V: *Lejoly* 93/654 (BRLU).

tomentosa Lam.

H: shrub or climber, in savanna. D: ST. V: *Figueiredo* 83 (K).

CLEOME L.**gynandra** L.

Gynandropsis gynandra (L.) Briq.

H: annual herb. D: ST.

rutidosperma DC. (*Fia-stlela, Mussanfi*)

H: annual herb. M: 61; 89. D: STP. V: *Madureira & Martins* 342 (COI).

CAPRIFOLIACEAE**SAMBUCUS L.*****mexicana** C.Presl ex DC.

H: shrub or tree with white flowers. D: ST. V: *Matos* 7520 (BRLU).

CARICACEAE**CARICA L.*****papaya** L. (fruit: *Mamom, Papaia*; tree: *Mamoeiro, Papaeira*)

H: small tree. E: fruits. M: 32; 98; 114; 135; 146. D: STP. V: *Madureira & Martins* 29 (COI).

CARYOPHYLLACEAE**DRYMARIA** Willd. ex Schult.**cordata** (L.) Willd. ex Roem. & Schult. (*Chile-branco, Pega-pega, Tchile-blanco*)

H: perennial prostrate herb with white flowers, in secondary forest, plantations, and on roadsides, ruderal. M: 36; 53; 57; 174. D: STP. V: *Paiva* 1022 (COI).

STELLARIA L.**mannii** Hook.f.

H: annual or perennial herb, in forest. D: ST. V: *Paiva* 84 (COI).

***media** (L.) Vill. subsp. **media**

H: annual herb. D: ST.

CASUARINACEAE**CASUARINA L.*****equisetifolia** L.

H: tree. D: ST. V: *Oliveira* 236 (BRLU).

CELASTRACEAE**HELICTONEMA** Pierre**velutinum** (Afzel.) Pierre ex N.Hallé

Hippocratea velutina Afzel.

H: liana with white flowers, in forest. D: ST. V: *Lejoly* 97/297 (LISC).

MAYTENUS Molina**^Emonodii** Exell

N: rare species, collected only once. D: ST.

SALACIA L.**pyriformis** (Sabine) Steudel

H: climber, in forest. D: ST.

CHENOPODIACEAE**CHENOPODIUM L.*****album** L. subsp. **album**

H: annual herb. E: leaves. D: ST.

***ambrosioides** L. (*Erva-de-santa-maria, Fiá-madre-matruço, Fiá-matluço, Fia-santa-maia, Folha-santa-maria, Macluso, Mastruço, Masturço, Matluço, Matlusso, Matruço, Milongo-de-febres*)

H: annual, rarely perennial herb, ruderal. E: leaves, seeds. M: 2; 61; 89; 95; 116; 124; 135; 156. D: STP. V: *Paiva* 1287 (COI).

?CHRYSOBALANACEAE**?NEOCARYA** (DC.) Prance ex F.White**?macrophylla** (Sabine) Prance ex F.White

Parinari macrophylla Sabine

N: doubtful record (Exell 1944, 1973) based on a collection by Don which may have originated from the continent.

?PARINARI Aubl.**?curatellifolia** Planch. ex Benth.

mobola Oliv.

N: doubtful record (Exell 1973) based on a citation by Silva (1958) without specimens.

?excelsa Sabine

N: doubtful record (Exell 1944, 1973) based on a collection by Don which may have originated from the continent.

CLUSIACEAE**GARCINIA L.*****mangostana** L. (*Mangostão*)

H: tree. E: fruits. D: ST. V: *Paiva* 764 (COI).

?smeathmannii (Planch. & Triana) Oliv.

polyantha Oliv.

N: doubtful record (Exell 1944, 1973) based on a collection by Barter that may not be from the islands.

MAMMEA L.**africana** Sabine (*Amargoso, Maglôso, Mamão, Mata-passos, Obá, Pau-ová, Pó-ová*)

H: tree, in forest. E: fruits. M: 112. D: STP. V: *Madureira & Martins* 444 (COI).

PENTADESMA Sabine**butyracea** Sabine (*Mata-passos, Obá, Pó-ová*)

H: tree up to 35 m high, in forest. D: ST.

PLATONIA** Mart.esculenta** (Arruda) Oken (*Bacuri, Bacurizeiro*)

H: tree. E: fruits. D: ST.

SYMPHONIA L.f.**globulifera** L.f. (*Oleo-balom, Oleo-barão*)

H: tree up to 40 m high, in forest. M: 5; 133. D: STP. V: *Matos* 7524 (BRLU, LISC).

COMBRETACEAE**COMBRETUM** Loebl.***indicum** (L.) DeFilipps

Quisqualis indica L.

H: climbing shrub with white, pink or red flowers. D: ST.

paniculatum Vent.

H: liana with red flowers, in secondary forest. D: P. V: *Oliveira* 206/98 (BRLU).

CONOCARPUS L.**erectus** L.

H: mangrove shrub or tree. D: ST. V: *Oliveira* 38 (BRLU).

TERMINALIA L.**catappa** L. (*Amendoeira-da-India, Caroeiro, Caroço*)

H: tree, in streets and on roadsides. M: 67. D: STP. V: *Paiva* 286 (COI), 1343 (COI).

COMMELINACEAE**ANEILEMA** R.Br.**beniniense** (P.Beauv.) Kunth

H: straggling herb. D: P.

COMMELINA L.**congesta** C.B.Clarke (*Bodó-bodó*)

H: creeping perennial herb, in forest. M: 75; 142. D: STP. V: *Figueiredo* 37 (K).

diffusa Burm.f. subsp. **diffusa** (*Bodó-bodó, Capim-d'água, Capulo, Dacala, Fia-bodo-bodo, Mucorroana*)

H: annual or perennial herb with blue to violet flowers, ruderal. D: STP. V: *Figueiredo 54* (K).

petersii Hassk.

H: straggling or erect perennial herb with blue flowers, in secondary forest. D: ST. V: *Figueiredo 55* (K).

PALISOTA Rchb. ex Endl.

bracteosa C.B.Clarke

H: herb with pinkish white or white flowers, in forest. D: ST.

pedicellata K.Schum. (*Ucuetê-macaco*, *Vaiélé*)

H: herb, with white flowers, in forest. M: 83; 87; 163. D: STP. V: *Figueiredo 35* (K); *Paiva 1918* (COI).

POLLIA Thunb.

condensata C.B.Clarke (*Bogotá*, *Uquéte-d'obó*)

H: perennial herb with white flowers and blue or violet fruit, in forest. M: 51. D: STP. V: *Figueiredo 100* (K).

mannii C.B.Clarke

H: straggling herb with white flowers. D: ST.

?***RHOEO** Hance

?***spathacea** (Sw.) Stearn

N: recorded by Exell (1944) based on the literature; no specimens known.

STANFIELDIELLA Brenan

imperfata (C.B.Clarke) Brenan var. **imperfata**

H: herb, in forest. D: STP. V: *Figueiredo 116* (K).

***TRADESCANTIA** L.

***zebrina** Heynh. ex Bosse

H: herb with purple flowers. D: STP. V: *Paiva 235* (COI).

CONNARACEAE

AGELAEA Sol. ex Planch.

pentagyna (Lam.) Baill.

coccinea Exell

obliqua (P.Beauv.) Baill. var. *cordata* (G.Schellenb.) Exell

phaeocarpa Exell

reticulata Exell

H: liana, in forest. D: STP. V: *Joffroy 139* (BRLU).

rubiginosa Gilg

principensis Exell

H: liana, in forest. D: P.

CNESTIS Juss.

ferruginea Vahl ex DC. (*Mondim-moela*, *Muandim-muála*)

H: tree, in forest. M: 22; 95. D: STP. V: *Madureira & Martins 75* (COI).

CONNARUS L.

africanus Lam. (*Corda-anã*)

H: shrub or scandent shrub. D: ST.

griffonianus Baill.

H: woody climber, with white flowers. D: P.

ROUREA Aubl.

parviflora Gilg

H: liana, in forest. D: ST. V: *Carvalho 9* (LISC).

CONVOLVULACEAE

***CUSCUTA** L.

***campestris** Yunk.

H: parasitic herb, in plantations and on roadsides. D: ST. V: *Figueiredo 77* (K).

IPOMOEA L.

***alba** L.

H: liana, with white or pink flowers. D: STP.

***batatas** (L.) Lam. (*Batata-doce*)

H: climber with purple, pink or white flowers, on roadsides. E: tuberous roots. D: STP. V: *Oliveira 82* (BRLU).

cairica (L.) Sweet var. **cairica**

H: climber with white to purple flowers. D: STP.

eriocarpa R.Br.

H: annual herb, white to purple flowers, ruderal. E: leaves. D: ST. V: *Matos 7626* (LISC).

***hederifolia** L.

H: annual climbing herb with red flowers. D: STP.

imperati (Vahl) Griseb.

stolonifera J.F.Gmel.

H: on coastal areas. D: ST.

***indica** (Burm.f.) Merr.

H: perennial climber with blue flowers, in gardens. D: ST. V: *Lejoly 97/275* (BRLU, LISC).

mauritanica Jacq.

H: perennial climber with tuberous roots and flowers reddish purple or mauve. D: ST. V: *Oliveira 1015* (BRLU).

pes-caprae (L.) R.Br. subsp. **brasiliensis** (L.) Ooststr. (*Fia-tataluga*, *Folha-de-tartaruga*)

H: climber, with white or purple flowers, in coastal areas. D: STP. V: *Paiva 1284* (COI).

***quamoclit** L.

H: annual or perennial climber, with white, red or pink flowers. D: STP. V: *Paiva 1801* (COI).

rubens Choisy

H: perennial climber, with purple or mauve flowers. D: ST.

***setifera** Poir.

H: climber. D: P.

***tiliacea** (Willd.) Choisy

H: liana with yellow-orange flowers. D: STP. V: *Oliveira 561* (BRLU); *Paiva 1303* (COI).

MERREMIA Dennst.

aegyptia (L.) Urb. (*Matazem*)

H: annual climber with purple flowers, in coastal areas. M: 86; 98; 122; 124; 128; 179. D: ST. V: *Paiva 282* (COI).

umbellata (L.) Hallier f. subsp. **umbellata**

H: perennial climber with yellow flowers. D: P.

XENOSTEGIA D.F.Austin & Staples

tridentata (L.) D.F.Austin & Staples subsp. **angustifolia** (Jacq.) Lejoly & Lisowski

Merremia tridentata (L.) Hallier f. subsp. *angustifolia* (Jacq.) Ooststr.

H: trailing herb. D: ST.

CRASSULACEAE

KALANCHOE Adans.

crenata (Andrews) Haw. var. **crenata** (*Fia-damina*, *Fia-da-mina-qué*, *Ufiá-cabecê*)

H: succulent herb with yellow, orange or magenta flowers. M: 54; 57; 79; 94; 119; 124; 174. D: ST. V: *Madureira & Martins 72* (COI).

***pinnata** (Lam.) Pers. (*Fia-damina*, *Folha-da-mina*)

Bryophyllum pinnatum (L.f.) Oken

H: perennial, succulent plant. M: 37; 54; 57; 79; 94; 119; 124; 167; 174. D: STP. V: *Madureira & Martins 139* (COI).

CUCURBITACEAE

CAYAPONIA Silva Manso

africana (Hook.f.) Exell

H: perennial, climbing herb, in forest and secondary forest. D: ST. V: *Figueiredo 249* (LISC).

?**CITRULLUS** Eckl. & Zeyh.

?**lanatus** (Thunb.) Matsum. & Nakai (*Melancia*)

N: annual climbing herb with yellow flowers cultivated for fruit (watermelon), recorded doubtfully for Príncipe (Exell 1944) without recorded specimens.

COCCINIA Wight & Arn.

barteri (Hook.f.) Keay

H: climbing herb, in forest. D: ST. V: *Matos 7419* (BRLU, LISC).

CUCUMIS L.

***sativus** L. (*Pepino*)

H: annual climber with yellow flowers. E: fruits, leaves. D: ST.

metuliferus E.Mey ex Naudin

H: annual climbing or trailing herb. E: fruits. D: ST.

DIPLOCYCLOS (Endl.) Post & Kuntze

palmatus (L.) C.Jeffrey (*Coedano*, *Stlófi-d'obô*, *Ucoedano*, *Uquedano*)

H: perennial climber. M: 47. D: ST. V: *Madureira & Martins 477* (COI).

LAGENARIA Ser.**breviviflora** (Benth.) Roberty (*Chimom-coiá, Simão-Correia*)H: perennial climber with yellow flowers, in forest, secondary forest and cultivated ground. M: 5; 22; 53; 87; 150. D: STP. V: *Figueiredo 203* (LISC).**siceraria** (Molina) Standl. (*Cabaça, Oco*)H: annual climber. E: fruits, leaves. D: ST. V: *Oliveira 226* (BRLU).**LUFFA** Mill.**cylindrica** (L.) M.Roem. (*Mamalongo*)*aegyptiaca* Mill.H: annual herb or perennial climber with yellow flowers, ruderal. E: young fruits. N: fruits are used as sponges. D: ST. V: *Paiva 1298* (COI).**MOMORDICA** L.**charantia** L. var. **charantia** (*Chlofi, Fia-sanzom, Melão-de-São-Caetano, Sancaetano, Stlofi, Tloufi*)H: annual climber or trailer with yellow flowers, in forest and plantations, ruderal. E: fruits, leaves. M: 57; 60; 79; 95; 112; 124; 136; 150; 158; 183. D: STP. V: *Figueiredo 201* (LISC).**charantia** L. var. **abbreviata** Ser. (*Chcofi, Fia-estelófi*)H: annual climber or trailer. E: fruits. D: STP. V: *Paiva 1145* (COI).**foetida** Schumach.H: perennial climbing herb with woody rootstock, ruderal. D: ST. V: *Lejoly 95/111* (BRLU).**PEPONIUM** Engl.**vogelii** (Hook.f.) Engl. (*Batata-pim-pim*)H: climbing or trailing herb with yellow flowers. M: 16; 87; 178; 183. D: ST. V: *Paiva 1148* (COI).***SECHIUM** Juss.***edule** (Jacq.) Sw. (*Chuchu, Pimpinela*)H: climber or trailing herb with cream-coloured flowers, on roadsides. E: fruits, leaves, roots. D: ST. V: *Paiva 106* (COI).**ZEHNERIA** Endl.**gillettii** (De Wild.) C.Jeffrey

H: climbing herb with slender stems. D: ST.

scabra (L.f.) Sond. subsp. **scabra**H: perennial herb, climbing or trailing, near cultivated ground, on roadsides. D: ST. V: *Paiva 1158* (COI).***CYCLANTHACEAE*****CARLUDOVICA** Ruiz & Pav.***palmata** Ruiz & Pav.H: tufted perennial palm-like plant. D: ST. V: *Paiva 1941b* (COI).**CYPERACEAE****ABILDGAARDIA** Vahl**ovata** (Burm.f.) Kral*Fimbristylis ovata* (Burm.f.) Kern

H: perennial herb. D: ST.

CAREX L.**^fleptocladus** C.B.ClarkeH: herb, in forest. D: ST. V: *Lejoly 94/560* (LISC).**CYPERUS** L.**articulatus** L.H: herb. D: P. V: *Oliveira 532* (BRLU).**§baronii** C.B.Clarke

H: herb. D: ST.

difformis L.

H: annual herb. D: ST.

distans L.f. (*Zuça*)H: herb, in forest. D: STP. V: *Paiva 80* (COI).**esculentus** L.H: perennial herb. D: STP. V: *Paiva 967* (COI).**exaltatus** Retz.

H: herb. D: ST.

haspan L.

H: herb. D: ST.

laxus Lam. subsp. **buchholzii** (Boeckeler) Lye*diffusus* Vahl subsp. *buchholzii* (Boeckeler) Kük.H: herb. D: STP. V: *Lejoly 94/564* (BRLU).**renschii** Boeckeler var. **renschii***sylvicola* Ridley

H: herb. D: ST.

rotundus L. (*Zuça*)

H: herb. D: STP.

sphacelatus Rottb.H: herb, in forest. D: STP. V: *Oliveira 521* (BRLU).**ELEOCHARIS** R.Br.**geniculata** (L.) Roem. & Schult.

H: herb. D: ST.

FIMBRISTYLIS Vahl**cymosa** R.Br.

N: recorded for Príncipe by Exell (1973) based on a reference by Silva (1958); no specimens known.

dichotoma (L.) Vahl

H: perennial herb. D: STP.

ferruginea (L.) Vahl

H: perennial herb. D: ST.

FUIRENA Rottb.**umbellata** Rottb.

H: perennial herb. D: ST.

HYPOLYTRUM Rich.**^fgrande** (Uittien) KoyamaH: herb. D: STP. V: *Matos 7696* (LISC).**heteromorphum** NelvesH: herb. D: STP. V: *Joffroy 198* (BRLU).**KYLLINGA** Rottb.**erecta** Schumach.H: herb. D: ST. V: *Stévant 167* (BRLU).**memoralis** (J.R.Forst. & G.Forst.) Dandy ex Hutch. & DalzielH: perennial herb. D: STP. V: *Oliveira 512* (BRLU).**peruviana** Lam.

H: herb. D: STP.

pumila Michx.H: herb. D: STP. V: *Matos 7604* (LISC).**MAPANIA** Aubl.**^fferruginea** Ridl. (*Pema-d'obo*)H: herb, in forest. M: 34. D: STP. V: *Paiva 1111* (COI), *1490* (COI).**MARISCUS** Vahl**cylindristachyus** Steud. (*Zuça*)*alternifolius* sensu auct. non VahlH: herb, ruderal. D: STP. V: *Paiva 573* (COI), *704* (COI).**dubius** (Rottb.) Kük. ex C.E.C.Fisch.

H: herb. D: STP.

flabelliformis Kunth var. **flabelliformis**H: herb. D: STP. V: *Matos 7453* (LISC).**ligularis** (L.) Urb. (*Zuça*)H: herb. D: STP. V: *Matos 7661* (LISC).**longibracteatus** Cherm.

H: herb. D: ST.

PYCREUS P.Beauv.**polystachyos** (Rottb.) P.Beauv.H: herb. D: STP. V: *Matos 7254* (LISC).**REMIREA** Aubl.**maritima** Aubl.

H: herb. D: P.

RHYNCHOSPORA Vahl**corymbosa** (L.) Britton

H: perennial herb. D: ST.

SCLERIA P.J.Bergius**naumanniana** BoeckelerH: herb, in forest. D: STP. V: *Stévant 113* (BRLU).**TORULINIUM** Desv. ex Ham.**odoratum** (L.) S.S.HooperH: herb. D: STP. V: *Paiva 1155* (COI).

DICHAPETALACEAE

DICHAPETALUM Thouars[†]**bocageanum** (Henriq.) Engl. (*Melambó*)

H: tree (?). D: ST. N: apparently rare; only two collections have been recorded.

DILLENIACEAE

^{*}**DILLENIA** L.^{*}**indica** L.H: shrub or small tree, with white flowers. E: fruits. D: ST. V: *Lejoly 95/051* (BRLU, LISC).**TETRACERA** L.**alnifolia** Willd. subsp. **alnifolia**H: liana, in forest. D: STP. V: *Joffroy 134* (BRLU, LISC).

DIOSCOREACEAE

DIOSCOREA L.^{*}**alata** L. (*Gudú, Inhame-branco, Inhame-gudú, Som-longo, Sónlongó*)

H: climber up to 15 m high, producing one tuber. E: tuber. D: ST.

bulbifera L. (*Cará-zambuco, Cuíni, Inhame, Inhame-zambuco, Ofó, Otoni*)H: climber with small woody tuber and axillary bulbils. E: tuber. M: 5. D: STP. V: *Paiva 1013* (COI), *1476* (COI).**cayensis** Lam. (*Inhame-amarelo, Inhame-branco, Inhame-gundú, Ofó*)H: climber producing tubers. E: tuber. M: 152. D: STP. V: *Lejoly 98/253* (BRLU); *Paiva 1872* (COI).**dumetorum** (Kunth) Pax (*Bofó, Inhame-bravo, Ofó, Quinin, Unquinin*)

H: climber with tubers. E: tuber (famine-food). D: ST.

minutiflora Engl. (*Inhame-de-Benin*)

H: climber with tubers. E: tuber (famine-food). D: ST.

sansibarensis Pax (*Cuini*)

H: climber with tubers. E: tuber (famine-food). D: ST.

DRACAENACEAE

DRACAENA L.**arborea** (Willd.) Link (*Pau-sabão, Pó-sabom*)H: tree to 20 m high, with creamy white flowers. M: 22; 51; 158; 170; 175. D: STP. V: *Madureira & Martins 122* (COI).**aubryana** Brongn. ex E.Morren (*Fia-fita*)*monostachya* BakerH: shrub with white to greenish white flowers. D: P. V: *Stévart 241* (BRLU).**laxissima** Engl. (*Folha-pempe, Jambele*)H: shrub to 2 m high, with greenish white flowers. D: STP. V: *Figueiredo 62* (K); *Paiva 618* (COI).

EBENACEAE

DIOSPYROS L.**ferrea** (Willd.) Bakh.

H: tree. E: fruits. D: ST.

ERICACEAE

ERICA L.[†]**thomensis** (Henriq.) Dorr & E.G.H.Oliv. (*Urze*)H: shrub, in primary forest. D: ST. V: *Matos 7370* (LISC).^{*}**RHODODENDRON** L.^{*}**mucronatum** (Blume) G.Don

H: shrub. D: ST.

ERYTHROXYLACEAE

ERYTHROXYLUM P.Browne^{*}**coca** Lam.

H: shrub. D: ST.

emarginatum Thonn.H: shrub or small tree, in forest. D: ST. V: *Oliveira 1173* (BRLU).

EUPHORBIACEAE

ACALYPHA L.**amentacea** Roxb. subsp. **wilkesiana** (Müll.Arg.) Fosberg
wilkesiana Müll.Arg.H: shrub. O. D: ST. V: *Stévart 164* (BRLU).**ciliata** Forssk.H: annual herb, in secondary forest. D: ST. V: *Oliveira 344* (BRLU).**ALCHORNEA** Sw.**cordifolia** (Schumach. & Thonn.) Müll.Arg. (*Bengue, Bugi-bugi, Buje-buje, Bungi-bungi*)H: shrub or small tree, erect or climbing, in forest, savanna and secondary forest. M: 16; 79; 90; 94; 95; 124; 130; 158. D: STP. V: *Figueiredo 238* (LISC).**hirtella** Benth.H: tree or shrub, in forest. D: STP. V: *Matos 7706* (LISC).**laxiflora** (Benth.) Pax & K.Hoffm.H: shrub or small tree, in savanna. D: ST. V: *Figueiredo 80* (K).**ANTHOSTEMA** A.Juss.**aubryanum** Baill.

H: tree, in swamps or river margins. D: STP.

ANTIDESMA L.**membranaceum** Müll.Arg.H: shrub or tree, in forest. D: ST. V: *Matos 7635* (LISC).**vogelianum** Müll.Arg.H: shrub or tree, in forest. D: ST. V: *Figueiredo 241* (LISC).^{*}**BREYNIA** J.R.Forst. & G.Forst.^{*}**disticha** J.R.Forst. & G.Forst. (*Filanto, Lágrima-de-Cristo, Pau-flôr, Pó-floli*)*nivosa* (W.G.Sm.) SmallH: shrub, used as hedge plant. O. M: 94; 150. D: ST. V: *Paiva 653* (COI).**BRIDELIA** Willd.**micrantha** (Hochst.) Baill. (*Gigô, Muindo, Vundem*)*stenocarpa* Müll.Arg.H: tree, in forest. M: 13; 22; 56; 57; 71; 134; 177. D: STP. V: *Madureira & Martins 261* (COI).**CAPERONIA** A.St.-Hil.**latifolia** Pax

H: herb, by watercourses. D: ST.

CAVACOA J.Léonard**quintasii** (Pax & K.Hoffm.) J.Léonard

H: tree up to 20 m high, in forest. D: ST.

^{*}**CHAMAESYCE** Gray^{*}**hirta** (L.) Millsp. (*Belo-vlêmê, Fia-sanopê, Folha-centopeia*)H: herb, ruderal. M: 5; 28; 77; 98; 174. D: STP. V: *Paiva 271* (COI).^{*}**hyssopifolia** (L.) Small

H: annual herb. D: STP.

^{*}**prostrata** (Aiton) Small (*Cento, Centopeia, Fia-cento, Fiá-flêminga-blanc, Folha-formiga*)H: herb, ruderal. M: 10; 64; 98; 117; 161. D: STP. V: *Paiva 291* (COI).^{*}**serpens** (Kunth) Small (*Fia-flomiga, Folha-formiga*)H: herb, ruderal. D: ST. V: *Paiva 122* (COI).**CLEISTANTHUS** Hook.f. ex Planch.**libericus** N.E.Br. (*Nono, Vilo, Vilo-pleto, Viro-preto*)H: shrub or small tree, in forest. D: ST. V: *Matos 7691* (LISC).^{*}**CODIAEUM** Rumph. ex A.Juss.^{*}**variegatum** (L.) Blume ex A.Juss. var. **variegatum**

N: ornamental shrub recorded by Exell (1944) based on a literature citation; no specimens known.

CROTON L.**draconopsis** Müll.Arg. (*Pau-purga*)H: tree, in forest. D: ST. V: *Oliveira 1323* (BRLU).

CROTON L. (cont.)^E**stellulifer** Hutch. (*Cubango*)H: tree, in forest. M: 6; 9. D: STP. V: *Madureira & Martins 483* (COI).**DISCOCLAOXYLON** (Müll.Arg.) Pax & K.Hoffm.^E**occidentale** (Müll.Arg.) Pax & K.Hoffm.H: tree, in forest. D: STP. V: *Joffroy 230* (BRLU); *Matos 7502* (LISC).**DISCOGLYPREMNA** Prain**caloneura** (Pax) Prain (*Pau-branco*, *Pó-blanco*)

H: tree, in forest. D: ST.

DRYPETES Vahl^E**glabra** (Pax) Hutch. (*Mama-d'obô*, *Mamon-d'obô*)H: tree in forest. D: ST. V: *Matos 7235* (LISC).^E**henriquesii** (Pax) Hutch. (*Mamon-d'obô*, *No-no*)H: tree, in forest. M: 8; 22. D: ST. V: *Madureira & Martins 407* (COI).**principum** (Müll.Arg.) Hutch.

H: tree, in forest. D: P.

ELAEOPHORBIA Stapf**drupifera** (Thonn.) Stapf (*Maglôso*, *Margoso*, *Pága-oé*, *Paga-ôlho*, *Paga-olho-de-marcação*, *Paga-uê*, *Pága-uê*, *Pau-amargoso*, *Tapa-oê*)H: tree, in forest edges. M: 13; 177. D: STP. V: *Paiva 1169* (COI).**ERYTHROCOCCA** Benth.^E**columnaris** (Müll.Arg.) PrainH: shrub or small tree, in forest. D: P. V: *Oliveira 215/98* (BRLU).^E**molleri** (Pax) Prain (*Bugi-bugi*, *Lutchica*)H: shrub or small tree, in forest. D: ST. V: *Figueiredo 252* (LISC).**EUPHORBIA** L.**cervicornu** Baill.

H: perennial herb. D: ST.

^{*}**heterophylla** L.H: herb, on roadsides. D: ST. V: *Paiva 108* (COI).^{*}**peplus** L.

H: annual herb. D: ST.

^{*}**pulcherrima** Willd. ex KlotzschH: herb, in gardens. D: ST. V: *Paiva 830* (COI).^{*}**tirucalli** L. (*Álvo-sin-fiá*, *Árvore-sem-folha*)H: shrub or tree, used as hedge plant. O. M: 27; 57; 146. D: ST. V: *Madureira & Martins 67* (COI).**EXCOECARIA** L.**guineensis** (Benth.) Müll.Arg.

H: shrub, in forest. D: P.

GROSSERA Pax^E**elongata** Hutch.

H: tree with white flowers, in forest. D: P.

multinervis J.LéonardH: tree with white flowers, in forest and plantations. D: ST. V: *Matos 7648* (LISC).^{*}**HEVEA** Aubl.^{*}**brasiliensis** (A.Juss.) Müll.Arg. (*Borracha*)H: tree, in plantations. D: ST. V: *Paiva 826* (COI).^{*}**guianensis** Aubl.

N: recorded by Exell (1944) based on a citation by Henriques without specimens.

^{*}**JATROPHA** L.^{*}**curcas** L. (*Folha-grão*, *Glom-maluco*, *Glom*, *Grão-maluco*, *Pau-glom*, *Pau-pixe*, *Purgueira*)H: shrub or tree, in plantations and on roadsides. M: 120; 146. D: ST. V: *Paiva 111* (COI).^{*}**multifida** L. (*Flom-gongô*, *Glom-congô*, *Glom-góngô*)H: shrub or tree, used as hedge plant. M: 120; 146. D: STP. V: *Paiva 793* (COI).**KLAINANTHUS** Pierre ex Prain**gabonii** Pierre

H: tree, in forest. D: ST.

MACARANGA Thouars**monandra** Müll.Arg. (*Begbe*, *Bêgbê*, *Pó-ngamala*)

H: shrub or tree, in forest. D: ST.

MAESOBOTRYA Benth.^E**glabrata** (Hutch.) ExellH: shrub or small tree, in forest and secondary forest. D: STP. V: *Oliveira 553* (BRLU), *1391* (BRLU).^{*}**MANIHOT** Mill.^{*}**esculenta** Crantz (*Mandioca*)H: shrub or undershrub with green flowers, on roadsides and cultivated ground. E: roots, leaves. M: 13; 32; 114. D: ST. V: *Paiva 1037* (COI).^{*}**glaziovii** Müll.Arg.

H: shrub or tree. O. D: STP.

MANNIOPHYTON Müll.Arg.**fulvum** Müll.Arg. (*Congo-gloncongo*)

H: straggling bush or liana, in forest. D: STP.

MARGARITARIA L.f.**discoidea** (Baill.) G.L.Webster var. **discoidea** (*Pau-ferro*, *Pó-felo*, *Suvi*)*Phyllanthus discoideus* (Baill.) Müll.Arg.H: tree, in forest and secondary forest. M: 87; 124; 173. D: STP. V: *Madureira & Martins 467* (COI); *Paiva 936* (COI).**NEOBOUTONIA** Müll.Arg.**mannii** Benth. (*Pluga-mato*)H: tree, in forest. M: 146. D: STP. V: *Madureira & Martins 485* (COI).**PHYLLANTHUS** L.^{*}**amarus** Schumacher. & Thonn. (*Cafena-tlache*, *Ucuê-clache*, *Uê-tlache*)H: annual herb, ruderal. M: 77; 98; 117; 130; 178; 179; 181. D: STP. V: *Pagué 4* (COI); *Paiva 1500* (COI).**dinklagei** PaxH: climbing shrub in secondary forest. D: ST. V: *Lejoly 97/357* (BRLU, LISC).**gagnioevae** Brunel & J.P.Roux*odontadenius* Müll.Arg.H: annual or perennial herb, woody at base, in forest. D: STP. V: *Paiva 565* (COI), *1018* (COI).**muellerianus** (Kuntze) ExellH: shrub or climber, occasionally tree, in forest. D: ST. V: *Matos 7451* (LISC).**physocarpus** Müll.Arg.

H: straggling tree, in forest. N: collected also in Nigeria once. D: P.

tessmannii Hutch.

H: shrub or tree, in forest. D: ST.

urinaria L. (*Cafena-tlache*, *Ucuê-clache*, *Uê-tlache*)H: annual herb, ruderal. M: 77; 98; 117; 130; 178; 179; 181. N: very similar to *P. amarus* and not distinguished from that species by the local population. D: ST. V: *Madureira & Martins 300* (COI).**PROTOMEGABARIA** Hutch.**macrophylla** (Pax) Hutch.H: tree, in forest. D: STP. V: *Oliveira 154/98* (BRLU).**PSEUDAGROSTISTACHYS** Pax & K.Hoffm.**africana** (Müll.Arg.) Pax & K.Hoffm. subsp. **africana** (*Cacau-de-obô*, *Dumo-branco*)H: shrub or tree, with white flowers, in forest. D: ST. V: *Matos 7578* (LISC).^{*}**RICINUS** L.^{*}**communis** L. (*Mamanododo*, *Mamóna*, *Mamono*, *Mámónó*, *Mamonon*, *Rícino*, *Zague-zague*)H: shrub, ruderal. M: 39; 69; 146; 174. D: STP. V: *Paiva 801* (COI).**SCLEROCROTON** Hochst.**cornutus** (Pax) Kruijt & Roebers*Sapium cornutum* PaxH: climbing shrub or tree, in forest. D: ST. V: *Oliveira 7* (BRLU).**SHIRAKIOPSIS** Esser**elliptica** (Hochst.) Esser (*Pau-maria*)*Sapium ellipticum* (Hochst.) PaxH: shrub or tree, in secondary forest. D: ST. V: *Lejoly 97/201* (BRLU, LISC).**TETRORCHIDIUM** Poepp.**didymostemon** (Baill.) Pax & K.Hoffm. (*Branco*, *Pau-branco*, *Pau-mole*, *Pó-blanco*, *Pó-moli*)H: tree, in secondary forest. D: ST. V: *Oliveira 1546* (BRLU).

THECACORIS A.Juss.***manniana** (Müll.Arg.) Müll.Arg. (*Pau-fígado*)

H: tree, ± 12 m high, in forest. D: ST.

***membranacea** PaxH: shrub, in secondary forest. D: ST. V: *Oliveira* 62/98 (LISC).**stenopetala** (Müll.Arg.) Müll.Arg.

H: small tree up to 6 m high with greenish white flowers, in forest. D: P.

TRAGIA L.**tenuifolia** Benth.

H: climbing undershrub, in forest. D: ST.

UAPACA Baill.**guineensis** Müll.Arg. (*Mangue-d'obô, Nêspira-de-bosque, Nespla-d'obô*)H: tree, in forest and secondary forest. M: 3; 22; 61; 124. D: STP. V: *Madureira & Martins* 171 (COI).***?VERNICIA** Lour.***?cordata** (Thunb.) Airy Shaw (*Aleurite*)*Aleurites cordata* (Thunb.) R.Br. ex Steud.

N: recorded by Exell (1973) based on a citation by Silva (1958) without specimens.

FABACEAE**ABRUS** Adans.**precatorius** L.H: climbing herb with pink to purple flowers and black and scarlet seeds. D: ST. V: *Matos* 7320 (LISC).**ACACIA** Mill.***farnesiana** (L.) Willd. (*Bana-muála*)

H: shrub or tree with yellow flowers. D: ST.

kamerunensis Gand. (*Piam-fôgô*)H: liana or climbing shrub, in forest. M: 122; 165. D: ST. V: *Madureira & Martins* 211 (COI).***nilotica** (L.) Willd. ex Delile subsp. **indica** (Benth.) Brenan

H: tree. D: ST.

pentagona (Schumach.) Hook.f.

H: liana, in forest. D: P.

ADENANTHERA** L.pavonina** L. (*Acácia-coral*)H: tree with small yellowish flowers and scarlet lens-shaped seeds. D: ST. V: *Matos* 7681 (BRLU, LISC).**AESCHYNOMENE** L.**indica** L.

H: annual or perennial herb. D: STP.

ALBIZIA** Durazz.lebbeck** (L.) Benth.H: tree, with purple flowers. D: ST. V: *Figueiredo* 90 (K).***procera** (Roxb.) Benth.

H: tree. D: ST.

ALYSICARPUS Desv.**vaginalis** (L.) DC. var. **vaginalis**

H: perennial herb with pink flowers. D: ST.

ARACHIS** L.hypogaea** L. (*Amendoim, Ginguba, Gumbá*)H: annual herb with yellow flowers. E: seeds. M: 27; 103; 154. D: ST. V: *Madureira & Martins* s.n. (COI).**BAPHIA** Afzel. ex Lodd.**nitida** Lodd.H: shrub or tree, in rainforest and coastal areas. D: ST. V: *Oliveira* 529 (BRLU); *Stévant* 166 (BRLU).***BAUHINIA** L.***monandra** KurzH: tree with pink flowers. D: ST. V: *Figueiredo* 86 (K).***purpurea** L.*Perlebia purpurea* (L.) A.SchmitzH: shrub with purple flowers. D: ST. V: *Paiva* 832 (COI).***tomentosa** L.*Pauletia tomentosa* (L.) A.Schmitz

H: shrub or tree with large yellow flowers. D: ST.

CAESALPINIA L.**bonduc** (L.) Roxb. (*Hidó-hidó, Ido-ido*)H: shrub or tree. M: 27; 170. D: ST. V: *Madureira & Martins* 448 (COI).***pulcherrima** (L.) Sw.

H: tree with red and yellow flowers. O. D: STP.

CAJANUS** DC.cajan** (L.) Millsp. (*Feijão-congo, Fezom-côngô, Uandru*)H: perennial shrub with yellow flowers. E: seeds. M: 106. D: STP. V: *Madureira & Martins* 331 (COI).***CALOPOGONIUM** Desv.***mucunoides** Desv.

H: annual or perennial climber with blue flowers. D: ST.

CANAVALIA DC.***ensiformis** (L.) DC.

H: annual climber with white flowers. E: young pods or immature seeds. D: ST.

rosea (Sw.) DC. (*Fia-açaçã*)*maritima* ThouarsH: herb with blue flowers, in coastal areas. D: ST. V: *Paiva* 980 (COI).**CASSIA** L. emend. Gaertn.***alata** L.

H: shrub ± 4 m high with yellow flowers. D: ST.

fistula** L. (*Canafistula, Canapistula, Cassia-oficinal*)H: deciduous or semi-evergreen tree up to 15 m high, with scented, pale or vivid yellow flowers. M: 79; 87; 98; 103; 114; 119. D: ST. V: *Madureira & Martins* 326 (COI).javanica** L.

H: tree ± 6 m high, with purple to pink flowers. D: ST.

mannii Oliv.*sieberiana* sensu auct. non DC.

H: tree with white or pink flowers, in forest. D: STP.

***obtusifolia** L.*Senna obtusifolia* (L.) Irwin & Barneby

H: annual or perennial herb or undershrub, possibly introduced. D: ST.

occidentalis** L. (*Fedegoso, Maioba, Maiopa, Manhanoca, Munhanóca*)H: herb or undershrub with yellow flowers, on roadsides. M: 19; 27; 53; 57; 77; 98; 99; 103; 114; 135; 158. D: STP. V: *Paiva* 1067 (COI).**podocarpa** Guill. & Perr. (*Fia-zaia, Folha-zaia*)H: shrub with yellow flowers. M: 68; 146; 178. D: ST. V: *Madureira & Martins* 309 (COI).**senna** L. (*Maloba*)*angustifolia* VahlH: shrub with yellow flowers. D: ST. V: *Paiva* 1288 (COI).**septemtrionalis** Viv.*floribunda* sensu auct. non Cav.*laevigata* Willd.*Senna septemtrionalis* (Viv.) H.S.Irwin & BarnebyH: undershrub with yellow flowers, on roadsides. D: ST. V: *Figueiredo* 112 (K).siamea** Lam.

H: tree with yellow flowers. D: ST.

***sophera** L. (*Maioba-beni*)

H: shrub with yellow flowers. D: STP.

spectabilis** DC.H: tree with yellow flowers. D: ST. V: *Paiva* 254 (COI).CENTROSEMA** Benth.***plumieri** (Pers.) Benth.H: climbing shrub. D: ST. V: *Oliveira* 913 (BRLU).***pubescens** Benth.H: climber with purple flowers, on roadsides. M: 146; 186. D: ST. V: *Paiva* 972 (COI).***?CERCIS** L.***?siliquastrum** L. (*Olaia*)

N: recorded by Exell (1973) based on a citation by Silva (1958) without specimens.

CHAMAECRISTA Moench**pratensis** (R.Vig.) Du Puy*Cassia mimosoides* L.H: herb with yellow flowers. D: ST. V: *Lejoly* 93/653 (BRLU).**CLITORIA** L.**falcata** Lam.*rubiginosa* Juss. ex Pers.H: climber with white flowers streaked with mauve or red. M: 64. D: ST. V: *Paiva* 1198 (COI).**ternatea** L. var. **ternatea**H: perennial climbing herb. M: 64; 119. D: ST. V: *Madureira & Martins* 351 (COI).? **COLOPHOSPERMUM** J.Kirk ex J.Léonard? **mopane** (J.Kirk ex Benth.) J.Kirk ex J.Léonard

N: doubtfully recorded by Exell (1973) based on a citation by Silva (1958) without specimens.

CROTALARIA L.**doniana** Baker

H: perennial herb. D: ST.

ochroleuca G.Don

H: annual herb. D: ST.

pallida Aiton var. **obovata** (G.Don) Polhill*mucronata* Desv.

H: annual or perennial herb or shrub. D: STP.

retusa L. var. **retusa** (*Maleboque*, *Malimboque*, *Marimboque*)H: herb with yellow and pink flower, ruderal. M: 146. D: STP. V: *Paiva* 978 (COI).**trichotoma** Bojer*zanzibarica* Benth.

H: annual or perennial herb. D: ST.

CYNOMETRA L.**mannii** Oliv. (*Quebla-machado*, *Zungo*, *Zungu*)H: tree up to 20 m high, in forest. M: 33; 146; 186. D: ST. V: *Figueiredo* 245 (LISC).**DALBERGIA** L.f.**ecastaphyllum** (L.) Taub. (*Majá*, *Popian*)H: shrub or tree, in mangroves and coastal bush. D: STP. V: *Paiva* 1168 (COI).? **DANIELLIA** Benn.? **oblonga** Oliv.N: very large tree, reported by Exell (1944) based on *Chevalier* 14227 (S.Tomé, Porto Alegre), a collection not seen by Exell nor by us.* **DELONIX** Raf.* **regia** (Bojer ex Hook.) Raf.H: tree with red flowers. O. D: ST. V: *Paiva* 800 (COI).* **DESMANTHUS** Willd.* **virgatus** (L.) Willd. (*Fiá-foguete*, *Pau-foguete*, *Pó-foguete*)H: undershrub with white or yellow flowers, on roadsides, ruderal. M: 5; 133. D: STP. V: *Figueiredo* 91 (K).**DESMODIUM** Desv.**adscendens** (Sw.) DC. var. **adscendens** (*Fia-vintém*, *Pega-pega*)H: perennial herb with pink flowers. M: 3; 11; 174. D: STP. V: *Madureira & Martins* 142 (COI).**gangeticum** (L.) DC.H: perennial herb or shrub. D: STP. V: *Oliveira* 1198 (BRLU).* **incanum** DC. (*Pega-pega*, *Vala-casé*)*canum* (J.F.Gmel) Schinz & Thell.H: perennial herb with purple flowers, on roadsides and in plantations. M: 61. D: STP. V: *Figueiredo* 45 (K); *Paiva* 1416 (COI).* **procumbens** (Mill.) Hitchc.H: herb. D: ST. V: *Matos* 7324 (BRLU).**ramosissimum** G.Don (*Pega-pega*)H: shrub with white and mauve flowers. M: 61; 112; 158; 168; 183. D: STP. V: *Madureira & Martins* 287 (COI); *Stévant* 160 (BRLU).**repandum** (Vahl) DC.H: perennial herb or shrub with orange red flowers, in secondary forest and plantations. D: ST. V: *Figueiredo* 109 (K).**salicifolium** (Poir.) DC.H: perennial herb or shrub. D: ST. V: *Stévant* 16 (BRLU).* **tortuosum** (Sw.) DC.H: perennial herb or undershrub with purple flowers, on roadsides. D: ST. V: *Paiva* 409 (COI).**triflorum** (L.) DC.

H: annual or perennial herb. D: STP.

velutinum (Willd.) DC. subsp. **velutinum** (*Valacasei*)H: woody perennial herb or shrub, in savanna. D: STP. V: *Matos* 7327 (LISC).**DIALIUM** L.**guineense** Willd. (*Salambá*)H: tree. D: STP. V: *Matos* 7686 (LISC).**DIOCLEA** Kunth**reflexa** Hook.f. (*Coda-ipé*, *Códó-plégo*, *Corda-iplé*)H: climbing shrub. D: STP. V: *Matos* 7276 (LISC).**ERYTHRINA** L.? **caffra** Thunb.

N: doubtful record of a South African species (Exell 1944) based on a literature citation; no specimens known.

droogmansiana De Wild. & T.Durand

H: shrub or tree up to 20 m high, in forest. D: ST.

* **fusca** Lour.H: tree. D: ST. V: *Paiva* 150 (COI).* **mitis** Jacq.*umbrosa* Kunth

N: recorded by Exell (1973) based on a citation by Silva (1958); no specimens known.

* **poeppigiana** (Walp.) O.F.Cook (*Litrina*)H: tree, in plantations and secondary forest. M: 58; 191. D: ST. V: *Figueiredo* 118 (K).**variegata** L. (*Litrina*)*indica* Lam.H: tree. M: 58; 191. D: STP. V: *Figueiredo* 234 (LISC).* **velutina** Willd.

N: recorded by Exell (1944, 1973) and by Silva (1958); no specimens known.

FAIDHERBIA A.Chev.**albida** (Delile) A.Chev.

H: tree up to 18 m high with yellow flowers. D: ST.

* **HAEMATOTOXYLUM** L.* **campechianum** L.

H: tree. D: ST.

INDIGOFERA L.**astragalina** DC.

H: annual herb. D: ST.

colutea (Burm.f.) Merr. var. **colutea**

H: annual semi-woody herb. D: ST.

hirsuta L. var. **hirsuta**

H: annual semi-woody herb. D: ST.

spicata Forssk. var. **spicata** (*Bancá*)H: perennial herb. M: 99; 126. D: ST. V: *Madureira & Martins* 286 (COI).* **suffruticosa** Mill. (*Agô*)H: undershrub, possibly introduced. D: ST. V: *Lejoly* 97/294 (LISC).**tinctoria** L. var. **tinctoria** (*Agô*, *Agô-mato*, *Anileiro*)H: shrub. N: one of the original plants used to produce indigo dye. D: STP. V: *Matos* 7321 (LISC).**trita** L.f. var. **subulata** (Vahl ex Poir.) AliH: woody herb. D: ST. V: *Matos* 7231 (LISC).* **INGA** Mill.* **edulis** Mart. (*Cajareiro*, *Cajaseiro*, *Ingareiro*, *Ingaseiro*)H: tree. E: fruits. D: STP. V: *Figueiredo* 53 (K).* **LEUCAENA** Benth.* **leucocephala** (Lam.) de Wit (*Leucena*, *Pau-foguete*)H: shrub or tree with white flowers, ruderal. D: STP. V: *Figueiredo* 92 (K).**LONCHOCARPUS** Kunth**sericeus** (Poir.) Kunth (*Colema*, *Colima*, *Colma*)H: shrub or small tree with lilac flowers, in savanna. M: 146; 175. D: STP. V: *Madureira & Martins* 487 (COI).

MACHAERIUM Pers.**lunatum** (L.f.) Ducke*Drepanocarpus lunatus* (L.f.) G.Mey.

H: shrub with purple flowers, in coastal areas. D: STP.

MILLETTIA Wight & Arn.**barteri** (Benth.) Dunn (*Cólíma-doido*)H: shrub or liana. M: 147; 167. D: ST. V: *Madureira & Martins 423* (COI).**griffoniana** Baill.*Lonchocarpus griffonianus* (Baill.) Dunn

H: tree up to 10 m high, with reddish purple flowers. D: ST.

thoningii (Schumach. & Thonn.) Baker (*Cólíma, Cólíma-fria, Colma*)

H: tree up to 18 m high, with reddish purple flowers. D: ST.

MIMOSA** L.polydactyla** Humb. & Bonpl. ex Willd. (*Fiá-malícia, Fissopé, Mafi-sopé*)H: perennial herb with white flowers. D: STP. V: *Paiva 713* (COI).***pudica** L. var. **hispida** Brenan (*Fia-malicha, Fia-malichia*)H: annual or perennial herb. M: 167; 170. D: ST. V: *Paiva 156* (COI).**MUCUNA** Adans.**flagellipes** Hook.f.H: liana with creamy white or yellowish flowers, in coastal areas. D: STP. V: *Matos 7651* (LISC).**pruriens** (L.) DC. var. **pruriens** (*Macunjá*)H: climber with violet flowers. E: seeds. M: 27; 98. D: ST. V: *Madureira & Martins 284* (COI); *Paiva 1874* (COI).**sloanei** Fawc. & Rendle

H: climber with yellow flowers. D: ST.

NEONOTONIA J.A.Lackey**wightii** (Wight & Arn.) J.A.Lackey*Glycine wightii* (Wight & Arn.) Verdc.

H: perennial climber with small white or mauve flowers. D: ST.

ORMOCARPUM P.Beauv.**sennoides** (Willd.) DC. subsp. **hispidum** (Willd.) Brenan & J.LéonardH: shrub with red-streaked yellow flowers. M: 22; 61; 150. D: ST. V: *Madureira & Martins 332* (COI).**verrucosum** P.Beauv. var. **verrucosum**H: shrub with white or lilac, purple-striped flowers, in swamps and by the sea. D: STP. V: *Matos 7270* (LISC).***?ORMOSIA** Jacks.***?dasycarpa** Jacks.

N: record (Exell 1973) based on a citation by Silva (1958) without specimens.

PARASERIANTHES** I.C.Nielsenfalcataria** (L.) I.C.Nielsen (*Acácia, Molucana*)*Albizia falcata* (L.) Backer*A. falcataria* (L.) FosbergH: tree, in disturbed forest. D: ST. V: *Paiva 1061* (COI).**PARKIA** R.Br.**biglobosa** (Jacq.) R.Br. ex G.Don (*Farroba, Luba, Lubá, Luva, Uluba oliveri* J.F.Macbr.H: tree with orange or red flowers, in savanna. E: seeds. D: ST. V: *Matos 7707* (BRLU, LISC).***PELTOPHORUM** (Vogel) Benth.***pterocarpum** (DC.) K.Heyne

H: tree up to 17 m high with yellow flowers. D: ST.

PENTACLETHRA Benth.**macrophylla** Benth. (*Moandim, Moandjim, Mondim, Muandi, Muandim, Muange, Sicupira, Uba*)H: large tree with yellowish creamy flowers, in secondary forest. E: seeds. M: 8; 95; 124; 149. D: STP. V: *Paiva 11* (COI), *1475* (COI).***PHASEOLUS** L.***lunatus** L. (*Feijão-cutelinho, Feijão-espadinho*)

H: annual or perennial climber with white flowers. E: fruits, seeds. D: ST.

***vulgaris** L. var. **vulgaris** (*Feijão*)

H: annual climber with white or pink flowers. E: seeds. D: ST.

PSOPHOCARPUS Neck.**scandens** (Endl.) Verdc.H: perennial climbing herb with blue flowers, on roadsides. D: ST. V: *Paiva 946* (COI).***PTEROCARPUS** Jacq.***indicus** Willd.

H: tree with yellow flowers. D: ST.

PUERARIA** DC.phaseoloides** (Roxb.) Benth. var. **javonica** (Benth.) Baker

H: climber. E: roots. D: ST.

RHYNCHOSIA Lour.**densiflora** (Roth) DC. subsp. **debilis** (G.Don) Verdc.

H: climber. D: ST.

minima (L.) DC. var. **prostrata** (Harv.) Meikle (*Sodom-campo*)H: prostrate herb with yellow flowers. M: 67; 96; 146; 167. D: ST. V: *Madureira & Martins 327* (COI).***SAMANEA** Benth.***saman** (Jacq.) Merr. (*Acácia-preta, Inga-saman, Pau-chuva*)

H: large tree. D: ST.

SESBANIA Scop.**sericea** (Willd.) LinkH: annual or biennial herb. D: ST. V: *Matos 7406* (LISC).**SOPHORA** L.**tomentosa** L. subsp. **occidentalis** (L.) Brummitt

H: shrub with yellow flowers. D: ST.

TAMARINDUS** L.indica** L. (tree: *Tamanhã, Tamarindeiro*; fruit: *Tamarindo*)H: tree with yellow flowers with orange or red streaks. E: fruits. D: STP. V: *Paiva 817* (COI).**TEPHROSIA** Pers.***candida** (Roxb.) DC. (*Bancá*)H: shrub or small tree. O. M: 139. D: ST V: *Madureira & Martins 569* (COI).**noctiflora** Bojer ex BakerH: annual or perennial herb. D: ST. V: *Matos 7700* (LISC).**platycarpa** Guill. & Perr.*flexuosa* G.Don

H: annual herb woody at base, with pink or purple flowers. D: ST.

purpurea (L.) Pers. subsp. **leptostachya** (DC.) Brummitt var. **pubescens** Baker

H: perennial herb. D: ST.

uniflora Pers. subsp. **uniflora**H: perennial herb with pink flowers. D: ST. V: *Matos 7328* (LISC).**vogelii** Hook.f. (*Baméa, Bancá, Cafoto*)

H: woody herb with white or violet flowers. D: STP.

TERAMNUS P.Browne**labialis** (L.f.) Spreng. subsp. **arabicus** Verdc.H: climber with reddish flowers. D: STP. V: *Paiva 979* (COI).**TETRAPLEURA** Benth.**tetraptera** (Schumach. & Thonn.) Taub. (*Cuspila, Cuspira*)

H: tree with yellowish to pinkish flowers. D: ST.

URARIA Desv.**picta** (Jacq.) DC. (*Fiá-placela*)H: undershrub with pink, blue or reddish flowers, in savanna. D: ST. V: *Matos 7460* (LISC).***?VICIA** L.***?faba** L. (*Fava, Faveira*)

N: record (Exell 1973) based on a citation by Silva (1958) without specimens.

VIGNA Savi**adenantha** (G.F.Mey.) Maréchal, Mascherpa & Stainier*Phaseolus adenanthus* G.Mey.

H: perennial climber. D: ST.

gracilis (Guill. & Perr.) Hook.f.H: twining herb with yellow flowers. D: P. V: *Stévert 14* (BRLU).

VIGNA Savi (cont.)**luteola** (Jacq.) Benth. var. **luteola***oblonga* sensu auct. non Benth.H: perennial climber. D: ST. V: *Matos 7517* (LISC).**racemosa** (G.Don) Hutch. & Dalz.H: perennial climbing herb with blue flowers. D: STP. V: *Figueiredo 206* (LISC).**unguiculata** (L.) Walp. subsp. **alba** (G.Don) Pasquet*alba* (G.Don) Planch. ex Baker f.*unguiculata* subsp. *dekintiana* sensu auct. non (Harms) Verdc.H: perennial herb with white or bluish-purple flowers. E: seeds. D: ST. V: *Matos 7620* (LISC).***ZORNIA** J.F.Gmel.***latifolia** Sm. var. **latifolia**H: annual or perennial herb with yellow flowers, in savanna. D: P. V: *Matos 7764* (LISC).

FLACOURTIACEAE

CASEARIA Jacq.**barteri** Mast. (*Bôbô-bôbô*, *Inhé-bobô*)*mannii* Mast.H: shrub or tree, in forest and secondary forest. D: STP. V: *Figueiredo 242* (LISC).**FLACOURTIA** Comm. ex L'Hér.**indica** (Burm.f.) Merr.*flavescens* Willd.

H: climbing shrub or tree, in forest. E: fruits. D: ST.

HOMALIUM Jacq.**africanum** (Hook. f.) Benth. (*Quebra-machado*)

H: shrub, in forest. D: ST.

^bhenriquesii Gilg ex Engl. (*Quebra-machado*)H: tree, in forest. M: 33; 146; 186. D: ST. V: *Madureira & Martins 410* (COI).**ONCOBA** Forssk.**spinosa** Forssk. (*Dibixi*, *Malebouque*, *Malimboque*)H: shrub, in forest and savanna. M: 168. D: ST. V: *Figueiredo 243* (LISC).**OPHIOBOTRYS** Gilg**zenkeri** Gilg (*Clacia*, *Claclá*, *Cuaco-bangana*, *Stlala-stlala*)H: shrub or tree, in forest. M: 17. D: ST. V: *Madureira & Martins 624* (COI).***FUMARIACEAE*****FUMARIA** L.***muralis** Sond. ex W.D.J.KochH: herb with pink flowers. D: ST. V: *Lejoly 98/214* (BRLU).

GENTIANACEAE

ANTHOCLEISTA Afzel. ex R.Br.**microphylla** WernhamH: tree or climber with white flowers, in forest and secondary forest. D: STP. V: *Figueiredo 67* (K).**nobilis** G.Don*macrophylla* G.DonH: tree with white flowers, in forest and secondary forest. D: STP. V: *Matos 7449* (LISC); *Oliveira 221/98* (BRLU).**scandens** Hook.f.H: tree or climber with white flowers, in forest and secondary forest. D: ST. V: *Matos 7359* (LISC).

GESNERIACEAE

EPITHEMA Blume**tenue** C.B.Clarke

H: herb, in forest. D: ST.

STREPTOCARPUS Lindl.**elongatus** Engl.*thomensis* ExellH: herb up to 0.3 m high with white flowers, in forest. D: ST. V: *Matos 7674* (LISC).**nobilis** C.B.Clarke

H: herb, in forest. D: ST.

GOODENIACEAE

SCAEVOLA L.**plumieri** (L.) Vahl

H: shrub, in littoral regions. D: ST.

HERNANDIACEAE

HERNANDIA L.**^bbeninensis** Welw. ex Henriq. (*Bungá*, *Pau-candeia*)H: tree, in forest. M: 92; 160. D: ST. V: *Madureira & Martins 22* (COI).**?*HYDRANGEACEAE****?*HYDRANGAEA** L.**?sp.**

N: recorded by Exell (1944) based on a citation by Chevalier; no specimens known.

HYPERICACEAE

HARUNGANA Lam.**madagascariensis** Lam. ex Poir. (*Pau-sangue*, *Pó-sangue*, *Sangue*)H: shrub or small tree, in forest and secondary forest. M: 13; 124. D: STP. V: *Madureira & Martins 460* (COI); *Paiva 1060* (COI).***IRIDACEAE*****NEOMARICA** Sprague***caerulea** (Ker Gawl.) Sprague

D: STP.

IRVINGIACEAE

IRVINGIA Hook.f.**gabonensis** (Aubry-Lecomte ex O'Rorke) Baill. (*Manga-macaco*)

H: tree, in forest. D: P.

JUNCACEAE

LUZULA DC.**mannii** (Buchenau) Kirschner & Cheek subsp. **mannii***campestris* (L.) DC. var. *mannii* Buchenau

H: perennial herb. D: ST.

LAMIACEAE

ACHYROSPERMUM Blume**oblongifolium** Baker (*Beganssom*, *Folha-belga*)H: undershrub with green-white flowers. M: 5; 51. D: ST. V: *Madureira & Martins 310* (COI).**?ELSHOLTZIA** Willd.**?sp.**

N: recorded for S.Tomé by Exell (1944) based on a literature citation; no specimens known.

LEONOTIS (Pers.) R.Br.**nepetifolia** (L.) R.Br. (*Penicano*, *Pinicane*, *Pinincano*)H: herb up to ± 1.5 m high, with pink flowers. M: 5; 22; 54; 60; 61; 77; 123; 150; 158; 174. D: STP. V: *Madureira & Martins 158* (COI).***MENTHA** L.***rotundifolia** (L.) Huds. (*Letrão*)

H: perennial herb. E: leaves. D: ST.

OCIMUM L.

***americanum** L. (*Fiá-mosquito*)
canum L.

H: perennial herb, near cultivated areas. M: 79; 99; 134; 174. D: ST. V: *Madureira & Martins 604* (COI).

***basilicum** L. (*Fia-mosquito, Madlicom, Mosquito*)

H: perennial herb, near cultivated areas. E: leaves. M: 79; 99; 134; 174. D: ST. V: *Paiva 1035* (COI).

gratissimum L. var. **gratissimum** (*Fia-micoco, Micóco, Micoco-di-que, Pau-mosquito*)

H: perennial herb with white flowers. E: leaves. M: 21; 27; 52; 79; 156; 166. D: STP. V: *Paiva 1045* (COI), *1502* (COI).

***minimum** L. (*Madlicom*)

basilicum sensu auct. pro parte, non L.

H: perennial herb, near cultivated areas. M: 27; 52; 76; 156. D: ST. V: *Madureira & Martins 104* (COI).

PLATOSTOMA P.Beauv.

africanum P.Beauv.

H: herb up to 0.6 m high, in forest. D: ST.

***SALVIA** L.

***coccinea** Buc'hoz ex Etl.

H: perennial herb with red flowers. O. D: ST.

***splendens** Ker Gawl.

H: perennial herb with red flowers, on roadsides. D: ST. V: *Paiva 1005* (COI).

SOLENOSTEMON Thonn.

monostachyus (P.Beauv.) Briq. (*Fiá-manjoló, Magero, Manjoló*)

H: annual or perennial herb with bluish flowers, in forest, secondary forest, plantations, ruderal. E: leaves. M: 79; 94; 165; 169. D: STP. V: *Paiva 355* (COI).

***STACHYS** L.

***arvensis** (L.) L.

H: annual herb. D: ST. V: *Matos 7229* (LISC).

***LAURACEAE**

***CINNAMOMUM** L.

***burmanni** (Nees & T.Nees) Blume (*Canela-brava*)

H: small tree. E: bark (spice: *cassia*). D: STP. V: *Matos 7583* (LISC).

***camphora** (L.) J.Presl (aromatic compound: *Cânfora*; tree: *Canforeira*)

H: tree, in secondary forest. D: ST. V: *Oliveira 150* (BRLU).

***verum** J.Presl (*Canela, Canela-d'obô, Caneleira, Pau-canela*)

zeylanicum Blume

H: small tree with whitish flowers, in secondary forest. E: bark (spice: *canela*). M: 173. D: STP. V: *Figueiredo 49* (K).

***PERSEA** Mill.

***americana** Mill. (fruit: *Abacate, Avacate, Avocado, Bacatche*; tree: *Abacateiro*)

H: large tree, with small yellowish flowers. E: fruits. M: 51; 57; 61; 64; 91; 137; 150; 161; 165; 168. D: STP. V: *Madureira & Martins 273* (COI).

LEEACEAE

LEE L.

guineensis G.Don

H: shrub or small tree, with red, orange or yellow flowers. E: fruits. D: ST. V: *Oliveira 1429* (BRLU).

***tinctoria** Baker (*Celé-alé, Celé-celé, Cêlê-cêlê*)

H: shrub or small tree with red or orange flowers. D: ST. V: *Figueiredo 244* (LISC); *Paiva 1925* (COI).

LEMNACEAE

LEMNA L.

aequinoctialis Welw.

perpusilla sensu auct. non Torrey

H: aquatic floating herb. D: ST.

LENTIBULARIACEAE

UTRICULARIA L.

mannii Oliv.

H: small, perennial epiphyte with yellow flowers, in forest. D: STP. V: *Joffroy 209* (BRLU); *Paiva 1082* (COI).

striatula Sm.

H: small epiphyte, in forest. D: P. V: *Paiva 1483* (COI).

LINACEAE

HUGONIA L.

platysepala Welw. ex Oliv.

H: climbing shrub or small tree, with white or yellow flowers, in forest. D: P.

LOBELIACEAE

LOBELIA L.

***barnsii** Exell

H: herb, in mountain forest. D: ST. V: *Matos 7703* (LISC).

molleri Henriq.

H: herb up to 0.6 m high with white flowers, in forest. D: ST. V: *Matos 7543* (LISC).

LORANTHACEAE

HELIXANTHERA Lour.

mannii (Oliv.) Danser var. **mannii**

H: parasitic shrub with pendent stems, in forest and plantations. D: ST. V: *Oliveira 855* (BRLU).

MALPIGHIACEAE

ACRIDOCARPUS Guill. & Perr.

longifolius (G.Don) Hook.f. (*Micando-homem, Milandó-homem, Milondó-homem*)

H: small tree or climbing shrub with yellow flowers in secondary forest and plantations. M: 22; 167. D: STP. V: *Paiva 1009* (COI).

HETEROPTERYS Kunth

leona (Cav.) Exell

H: climber with yellow flowers. D: STP.

MALVACEAE

***ABELMOSCHUS** Medik.

***esculentus** (L.) Moench (*Iquiabo, Quiabo*)

H: annual herb with yellow flowers, in plantations and on roadsides. E: fruits. M: 95. D: STP. V: *Paiva 781* (COI).

***moschatus** Medik.

H: Perennial herb. E: leaves, fruits. D: ST.

ABUTILON Mill.

grandiflorum G.Don (*Fiá-máliva, Máliva, Malva*)

H: herb or shrub with yellow to orange flowers. M: 40; 61; 64; 89; 98; 103; 158; 174. D: ST. V: *Madureira & Martins 112* (COI).

***grandifolium** (Willd.) Sweet (*Mandioca-brava*)

H: perennial herb with yellow to orange flowers. D: ST. V: *Paiva 1062* (COI).

***striatum** Dicks. ex Lindl. (*Mandioca-brava, Mata-boi*)

venosum Lemaire

H: shrub with orange to purple flowers in secondary forest and on roadsides. M: 139. D: ST. V: *Madureira & Martins 473* (COI).

***GOSSYPIUM** L. (*U-u-dêçu, Algodão*)

***barbadense** L.

H: shrub with yellow flowers. M: 69; 111; 181. D: STP.

***hirsutum** L.

H: shrub with yellow flowers. M: 69; 111; 181. D: ST.

HIBISCUS L.

***acetosella** Welw. ex Hiern (*Fia-mussa, Fia-mússua, Mussa, Mussa-blanco, Mússua*)

H: annual or perennial herb or shrub, ruderal. E: leaves, flowers. M: 40; 60. D: STP. V: *Madureira & Martins 649* (COI); *Paiva 632* (COI).

HIBISCUS L. (cont.)**donianus** D.Dietr.H: annual herb. D: ST. V: *Matos 7318* (LISC).***mutabilis** L.

H: shrub with white or pink flowers. D: STP.

physaloides Guill. & Perr.

H: woody herb. D: ST.

***rosa-sinensis** L.H: shrub with red flowers. D: STP. V: *Madureira & Martins 650* (COI).**sabdariffa** L.

H: annual or perennial herb with white to yellow flowers. D: ST.

surattensis L.H: annual herb with yellow flowers. M: 57. D: STP. V: *Madureira & Martins 148* (COI).**tiliaceus** L. (*Fiteira*)

H: shrub or tree with yellow flowers in coastal areas or near water-courses. D: ST.

MALVASTRUM** A.Graycoromandelianum** (L.) Garcke (*Itóto-doido*, *Otótó*, *Otótó-homé*)H: herb with pale yellow flowers. M: 158. D: STP. V: *Madureira & Martins 193* (COI).**SIDA** L.**acuta** Burm.f. subsp. **acuta** (*Itótó*, *Ototo*, *Otótó*, *Otótó-mualá*, *Ototo-pequeno*, *Ototo-piquina*)H: herb or undershrub with yellow flowers, ruderal. M: 143; 175. D: STP. V: *Paiva 631* (COI), *827* (COI).**cordifolia** L.

H: shrub with yellow or white flowers. D: ST.

javensis Cav.*pilosa* Retz.*veronicifolia* Lam.

H: prostrate herb with yellow flowers. D: ST.

rhombifolia L. (*Bobó-bobó*, *Catumba-jinji*, *Itoto*, *Ototo*, *Ototo-pequeno*, *Ototo-vento*)H: undershrub with yellow flowers, ruderal. D: STP. V: *Figueiredo 73* (K); *Paiva 637* (COI).**rigida** (D.Don) D.Dietr.

H: herb or undershrub. D: ST.

urens L.

H: perennial herb or undershrub. D: ST.

URENA** L.lobata** L. (*Otótó-fogo*, *Otótó-glandje*, *Ototo-glandji*, *Ototo-grande*, *Ototo-ome*, *Otótó-vento*)H: perennial herb or undershrub with pink flowers, ruderal. M: 61; 91; 158; 175; 183. D: STP. V: *Figueiredo 42* (K); *Paiva 1418* (COI).**WISSADULA** Medik.**rostrata** (Schumach.) Hook.f. (*Ototo-vento*, *Otótó-vento*)*amplissima* (L.) R.E.Fries var. *rostrata* (Schumach.) R.E.Fries

H: undershrub. D: STP.

MARANTACEAE**CALATHEA** G.Mey.**sp.**H: herb with red-purple flowers. D: ST. V: *Lejoly 93/619* (BRLU).***MARANTA** L.***arundinacea** L.

H: herb cultivated for the fleshy rhizome. E: rhizome. D: STP.

THAUMATOCOCCUS Benth.**daniellii** (Bennet) Benth. (*Majunga*, *Mangungo*)H: rhizomatous herb. E: seed aril. M: 27; 60. D: STP. V: *Madureira & Martins 302* (COI); *Paiva 626* (COI).**MELASTOMATACEAE****CALVOA** Hook.f.**^Econfertifolia** Exell

H: herb up to 0.4 m high, with pink flowers, in forest. D: ST.

^Ecrassinoda Hook.f.*molleri* GilgH: shrub up to 2.5 m high, with pink flowers, in forest and secondary forest. D: ST. V: *Figueiredo 199* (LISC).**grandifolia** Cogn.H: undershrub up to 1.2 m high, with pink flowers, in forest and secondary forest. D: STP. V: *Figueiredo 202* (LISC); *Oliveira 516* (BRLU).**hirsuta** Hook.f.*henriquesii* Cogn.H: herb up to 0.3 m high, with white or pink flowers, in forest. D: STP. V: *Oliveira 569* (BRLU); *Paiva 1079* (COI).**^Eintegrifolia** Cogn.

H: herb up to 0.4 m high, with pink flowers, in forest. D: ST.

sinuata Hook.f.H: herb or shrub up to 1.2 m high, in forest. D: P. V: *Figueiredo 160* (LISC).**DISSOTIS** Benth.**barteri** Hook.f. ex TrianaH: herb or shrub up to 2 m high, with pink flowers, in forest. D: P. V: *Stévant 259* (BRLU).**HETEROTIS** Benth.**rotundifolia** (Sm.) Jacq.-Fél.H: decumbent herb rooting at nodes, with pink flowers, in forest. D: STP. V: *Stévant 242* (BRLU).**MELASTOMASTRUM** Naudin**capitatum** (Vahl) A.Fern. & R.Fern.H: perennial herb or shrub up to 0.9 m high. D: ST. V: *Oliveira 1042* (BRLU).**MEMECYLON** L.**sp.**H: shrub or small tree. D: ST. V: *Oliveira 1407* (BRLU).**TRISTEMMA** Juss.**coronatum** Benth.

H: herb or undershrub with pink or white flowers. D: P.

hirtum P.Beauv.H: herb or undershrub with pink flowers. D: STP. V: *Matos 7638* (LISC).**littorale** Benth. subsp. **biafranum** Jacq.-Fél. var. **biafranum***incompletum* sensu auct. pro parte non R.Br.

H: shrub. D: P.

^Elittorale Benth. subsp. **biafranum** Jacq.-Fél. var. **insulare** Jacq.-Fél. (*Fiá-vela*)*incompletum* sensu auct. pro parte non R.Br.H: shrub. M: 124; 129. D: ST. V: *Madureira & Martins 503* (COI).**littorale** Benth. subsp. **littorale**

H: shrub. D: P.

^Emauritanium J.F.Gmel. var. **mildbraedii** (Gilg) Jacq.-Fél.*mildbraedii* Gilg ex Engl.H: shrub with pink to mauve flowers. D: ST. V: *Figueiredo 251* (LISC).**^Emauritanium** J.F.Gmel. var. **rozeiranum** Jacq.-Fél. (*Anjógó*)*incompletum* sensu auct. pro parte non R.Br.H: shrub with pink to reddish flowers. M: 173. D: ST. V: *Paiva 61* (COI).**^Emauritanium** J.F.Gmel. var. **thomense** (J.H.P.B.Ferreira) Jacq.-Fél.*thomensis* J.H.P.B.FerreiraH: shrub with pink to mauve flowers. D: ST. V: *Figueiredo 211* (LISC).**WARNECKEA** Gilg**membranifolia** (Hook.f.) Jacq.-Fél. (*Clossom-liso*)*Memecylon membranifolium* Hook.f.*M. fernandianum* Gilg ex Engl.H: shrub or tree. M: 154. D: ST. V: *Madureira & Martins 181* (COI).**memecyloides** (Benth.) Jacq.-Fél. (*Glêlê-nhame*, *Toni-fachico*)*Memecylon memecyloides* (Benth.) ExellH: shrub or tree with blue flowers. M: 79. D: STP. V: *Madureira & Martins 202* (COI).**MELIACEAE****CARAPA** Aubl.**procera** DC. (*Gógó*, *Gogo-vermelho*, *Gôgo-viêmê*)H: tree with white and pink flowers, in forest and plantations. M: 13; 126; 183. D: ST. V: *Madureira & Martins 403* (COI).

CEDRELA** P.Browneodorata** L. (*Cedrela, Cidrela, Pau-cebola, Pó-cébóla*)H: tree with small white flowers. M: 60; 123; 175. D: ST. V: *Madureira & Martins 441* (COI).***MELIA** L.***azedarach** L. (*Lilás-do-Cabo, Sicomoro*)

H: tree with small purple or lilac flowers. D: STP.

TOONA** (Endl.) M.Roem.ciliata** M.Roem. (*Pau-alho, Pó-alho*)H: tree with small white flowers. D: ST. V: *Oliveira 1059* (BRLU).**TRICHILIA** P.Browne***grandifolia** Oliv. (*Cola-de-macaco, Cola-macaco, Vêludo*)H: tree, in forest. M: 22; 189. D: ST. V: *Matos 7576* (LISC).**TURRAEA** L.**vogelii** Hook.f. ex Benth. (*Valaplê, Vara-preta*)H: woody climber or scandent shrub. M: 22. D: STP. V: *Matos 7630* (LISC).

MENISPERMACEAE

CHASMANTHERA Hochst.**dependens** Hochst.

H: liana up to 20 m high, with yellow flowers, in cultivated ground. D: ST.

STEPHANIA Lour.**dinklagei** (Engl.) Diels

H: liana up to 20 m high, in forest. D: P.

TILIACORA Colebr.**sp.**H: liana. D: ST. V: *Lejoly 98/268* (BRLU).

MORACEAE

ARTOCARPUS** J.R.Forst. & G.Forst.altilis** (Parkinson) Fosberg (fruit: *Castanha, Fluta, Fluta-pom, Fruta-pão*; tree: *Arteira, Árvore-da-castanha, Árvore-do-pão, Pau-castanha*)H: tree. E: fruits. M: 8; 61. D: STP. V: *Paiva 257* (COI).***heterophylla** Lam. (fruit: *Jaca*; tree: *Jaqueira, Pau-jaca*)H: tree. E: fruits. M: 27; 87. D: STP. V: *Paiva 494* (COI).***CASTILLA** Cerv.***elastica** Sessé ex Cerv.

H: tree up to 18 m high. D: STP.

CECROPIA** Loefl.peltata** L. (*Gófé, Gôfe*)H: tree up to 25 m high, with yellow or green flowers. D: ST. V: *Paiva 93* (COI).**FICUS** L.***carica** L. (*Figueira*)H: tree. E: fruits. D: ST. V: *Oliveira 246* (BRLU).**chlamydocarpa** Warb. ex Mildbr. & Burret subsp. **chlamydocarpa**

H: strangler fig, in forest. D: STP.

chlamydocarpa** Warb. ex Mildbr. & Burret subsp. **fernandesiana** (Hutch.) C.C.Berg (*Figo-obata*)*fernandesiana* Hutch.H: strangler fig, in forest. D: ST. V: *Lejoly 97/231* (BRLU, LISC).elastica** Roxb.

H: tree. O. D: ST.

exasperata Vahl (*Memé, Pó-lixia*)H: shrub or tree, in forest. D: ST. V: *Figueiredo 215* (LISC).**kamerunensis** Warb. ex Mildbr. & Burret (*Mussandá, Mussundá*)H: tree or shrub, in forest. D: ST. V: *Oliveira 36* (BRLU).**lutea** Vahl*vogelii* (Miq.) Miq.

H: tree or shrub, in forest. D: ST.

mucoso Welw. ex Ficalho (*Figo-de-porco, Figo-plôcô, Figo-plôcu*)*sidifolia* Welw. ex HiernH: tree, in forest. D: ST. V: *Paiva 1937* (COI).***pumila** L.H: climber. D: ST. V: *Oliveira 66/98* (BRLU).**sur** Forssk. (*Figo-tôdô, Figo-tordo, Tôdô*)*capensis* Thunb.H: tree, in forest. E: fruits. D: STP. V: *Paiva 1181* (COI), *1333* (COI).**thonningii** Blume (*Lemba-lemba, Mussandá*)*annobonensis* Mildbr. & Hutch.H: tree or shrub, in forest. M: 57; 75; 87; 94. D: STP. V: *Figueiredo 87* (K).**MESOGYNE** Engl.**insignis** Engl.*henriquesii* Engl.

H: tree up to 16 m with greenish flowers, in forest and cultivated ground. D: ST.

MILICIA Sim**excelsa** (Welw.) C.C.Berg (*Amoreira, Moreira, Mucambá-vlémé, Mulêla*)*Chlorophora excelsa* (Welw.) Benth. & Hook.f.H: large tree, in forest and plantations. M: 52; 87; 95; 153; 167. D: STP. V: *Oliveira 119* (BRLU).**MUSANGA** C.Sm. ex R.Br.**cecropioides** R.Br. (*Gofé, Gófe, Gófé, Gofe-d'obô, Pau-sabrina*)H: tree up to 20 m high, with green flowers, in forest and secondary forest. D: ST. V: *Paiva 418* (COI).**TRECULIA** Decne. ex Trécul**africana** Decne. ex Trécul var. **africana** (*Giquenge, Isa, Isa-quente, Izaquente, Ogue, Opacala, Quicange, Quicuange, Zéquentche*)H: tree up to 25 m high with small white flowers, in forest. E: fruits. M: 18; 39; 40; 57; 121; 125; 158; 191. D: STP. V: *Paiva 1209* (COI).**TRILEPISIUM** Thouars**madagascariense** DC.

H: tree, up to 30 m high, in plantations. D: ST.

MUSACEAE

ENSETE** Horan.ventricosum** (Welw.) Cheesman*Musa ventricosa* Welw.

D: ST.

MUSA** L.paradisica** L.

M: 68; 79; 103; 116; 126. D: STP.

***balbisiana** Colla*rosacea* Jacq.

D: ST.

MYRISTICACEAE

MYRISTICA** Gronov.fragrans** Houtt. (*Noz-moscada*)H: small tree. E: fruits (spice). D: ST. V: *Paiva 396* (COI).**PYCNANTHUS** Warb.**angolensis** (Welw.) Warb. (*Cachão, Cashon, Cassa, Pau-caixão, Pó-cassom, Pó-cásson*)H: tree, in forest, secondary forest and plantations. M: 51; 61; 79; 87; 90; 125; 167; 175. D: ST. V: *Madureira & Martins 218* (COI).**STAUDTIA** Warb.***pterocarpa** (Warb.) Warb. (*Pau-vermelho, Vermelho, Vlêmê*)H: tree in forest and secondary forest. M: 13; 56; 125. D: ST. V: *Madureira & Martins 162* (COI).

MYRSINACEAE

ARDISIA Sw.**staudtii** Gilg*Afrardisia cymosa* (Baker) MezH: shrub or small tree with red flowers, in forest. D: STP. V: *Matos 7440* (LISC).

MAESA Forssk.

lanceolata Forssk. subsp. **borjaeana** (Henriq.) White (*Mutopa, Pau-cabra*)

borjaeana Henriq.

H: shrub or small tree, with small white or yellowish flowers, in forest and on roadsides. D: ST. V: *Figueiredo 64* (K).

RAPANEA Aubl.

melanophloeos (L.) Mez

thomensis Exell

H: shrub or small tree, with small white or yellowish flowers, in forest. D: ST. V: *Matos 7507* (LISC).

MYRTACEAE

***EUCALYPTUS** L' Hér.

***sp.** (*Calipto*)

H: tree. D: ST. V: *Oliveira 1326* (BRLU).

EUGENIA L.

***brasiliensis** Lam. (*Comoxama, Grumechame, Grumexava, Grumixaba, Grumixama, Grumixameira, Grumixava*)

dombeyi (Spreng.) Skeels

H: tree, in plantations. E: fruits. M: 99. D: ST. V: *Madureira & Martins 669* (COI).

elliottii Engl. & Brehmer

H: shrub or small tree. D: ST.

***uniflora** L. (*Ameixa-do-Pará, Cereja-de-Caiena, Pitanga, Pitangueira*)

H: shrub or tree. E: fruits. M: 173. D: STP. V: *Matos 7690* (LISC).

***MELALEUCA** L.

***leucadendron** (L.) L.

H: shrub, in savanna. D: ST. V: *Matos 7462* (LISC).

***MYRCIARIA** O.Berg

***cauliflora** (Mart.) O.Berg (*Jabuticaba, Jabuticabeira*)

H: small tree. E: fruits. D: ST.

***PSIDIUM** L.

***cattleianum** Sabine (*Gueva-quidô*)

littorale Raddi

H: shrub. E: fruits. M: 27. D: ST. V: *Madureira & Martins 652* (COI).

***guajava** L. (*Gaiaba, Gaiava, Goiaba, Goiabeira, Gueva, Guiaba*)

H: shrub or tree. E: fruits. M: 19; 33; 57; 61; 67; 112; 135; 146; 175. D: STP. V: *Paiva 1520* (COI).

SYZYGIUM Gaertn.

***aromaticum** (L.) Merr. & L.M.Perry (*Cravinho*)

H: tree with red flowers. E: flower buds (spice). D: ST.

guineense (Willd.) DC. (*Matazem, Matchanzoche, Matianzoche*)

H: shrub or tree with white flowers, in forest. M: 22; 109; 125; 167; 183. D: ST. V: *Madureira & Martins 328* (COI).

***jambos** (L.) Alston (*Jambo-jambo, Jamboeiro, Pau-jambre, Pialá*)

H: tree with whitish flowers, in plantations and on roadsides. E: fruits. M: 5; 40; 79; 158; 175. D: STP. V: *Paiva 1031* (COI).

staudtii (Engl.) Mildbr.

H: tree up to 30 m high, in forest. D: ST.

NYCTAGINACEAE

BOERHAVIA L.

diffusa L. (*Erva-tostão, Fia-plocôssom, Fia-plócsom*)

coccinea Mill.

paniculata Rich.

H: perennial herb, ruderal. M: 77; 98; 114; 119; 149. D: STP. V: *Paiva 384* (COI).

***BOUGAINVILLEA** Comm. ex Juss.

***spectabilis** Willd. (*Buganvila*)

H: climbing shrub with purple, red or white flowers. O. D: STP. V: *Paiva 287* (COI).

***MIRABILIS** L.

***jalapa** L. (*Losa-bilança, Rosa-bilança*)

H: perennial herb up to ± 1 m high, with white or red flowers. E: leaves. M: 4; 51; 61; 63; 98; 125; 134. O. D: ST. V: *Paiva 699* (COI).

OCHNACEAE

Note: recent nomenclatural changes at generic level were not considered. The taxonomy follows AFPD (2009).

CAMPYLOSPERMUM Tiegh.

reticulatum (P.Beauv.) Farron var. **reticulatum**

Ouratea brunneopurpurea Gilg

H: shrub or small tree. D: STP.

vogelii (Hook.f.) Farron var. **molleri** (Tiegh.) Farron (*Dumo, Dumo-vermelho, Pau-dumo*)

Ouratea molleri (Tiegh.) Exell

H: shrub or tree with yellow flowers in forest. D: STP. V: *Lejoly 95/020* (BRLU, LISC).

OCHNA L.

membranacea Oliv. (*Pau-dumo, Pó-dumo, Vilo*)

H: shrub or tree in forest, secondary forest and savanna. D: ST. V: *Figueiredo 106* (K).

§multiflora DC.

H: shrub in forest. D: STP. V: *Stévant 255* (BRLU).

OURATEA Aubl.

nutans (Hiern) Exell

H: shrub with yellow flowers. D: P.

sp.

H: shrub. D: ST. V: *Lejoly 98/267* (BRLU).

RHABDOPHYLLUM Tiegh.

arnoldianum (De Wild. & T.Durand) Tiegh.

Ouratea quintasii (Tiegh.) Exell

H: shrub, in forest. D: ST. V: *Oliveira 1409* (BRLU).

OLACACEAE

HEISTERIA Jacq.

parvifolia Sm. (*Nonó, Pau-preto*)

H: tree, in forest and plantations. D: STP. V: *Lejoly 97/272* (BRLU).

OLAX L.

gambecola Baill.

H: shrub with white or yellowish flowers. D: ST.

***XIMENIA** L.

***americana** L. (*Limon-plê*)

H: tree, in savanna. E: fruits. M: 22. D: ST. V: *Matos 7725* (LISC).

OLEACEAE

JASMINUM L.

bakeri Scott-Elliot (*Codó-qué-d'ôbô*)

H: climber with white flowers, in forest. M: 79; 94. D: ST. V: *Joffroy 135* (BRLU).

fluminense Vell.

H: climber with white flowers, in forest. D: ST.

thomense Exell

H: climber with white flowers, in forest. D: ST. V: *Oliveira 1508* (BRLU).

OLEA L.

capensis L. subsp. **hochstetteri** (Baker) Friis & P.S.Green (*Ipé, Pó-ipe*)

hochstetteri Baker

H: shrub or tree with small white flowers, in forest. M: 22. D: ST. V: *Madureira & Martins 412* (COI).

capensis L. subsp. **welwitschii** (Knobl.) Friis & P.S.Green (*Impé, Ipé*)

welwitschii (Knobl.) Gilg & Schellenb.

H: shrub or tree with small white flowers, in forest. D: ST.

***europaea** L. (*Oliveira*)

N: recorded by Exell (1973) based on Silva (1958) without specimen citation.

ONAGRACEAE

LUDWIGIA L.

erecta (L.) H.Hara (*Áliba-gúia, Fiá-gúia*)

H: annual herb with yellow flowers. M: 29; 46; 69; 88. D: ST. V: *Madureira & Martins 195* (COI).

hyssopifolia (G.Don) Exell (*Fia-placela*)

H: annual herb, in secondary forest, savanna and on roadsides. D: STP. V: *Paiva 1197* (COL).

leptocarpa (Nutt.) H.Hara

H: herb with yellow flowers. D: ST.

octovalvis (Jacq.) P.H.Raven subsp. **octovalvis**

H: annual or perennial herb with yellow flowers, in secondary forest and plantations. D: ST. V: *Matos 7261* (LISC).

ORCHIDACEAE

(Stévant *et al.* 2000; Stévant & Oliveira 2001)

AERANGIS Rchb.f.

[†]**flexuosa** (Ridl.) Schltr.

H: epiphytic herb with white flowers, in lowland dry forest. D: ST.

ANCISTRORHYNCHUS Finet

capitatus (Lindl.) Summerh.

H: epiphytic herb with white flowers, in mid-elevation primary forest and old secondary forest. D: P. V: *Stévant 705* (BRLU).

crystalensis P.J.Cribb & Laan

H: epiphytic herb with white flowers, in mid-elevation primary rain-forest. D: P. V: *Stévant 1608* (BRLU).

metteniae (Kraenzl.) Summerh.

H: epiphytic herb with white flowers, lip green, in lowland forest and plantations. D: STP. V: *Stévant 638* (BRLU), *1212* (BRLU).

ANGRAECOPSIS Kraenzl.

[†]**dolabriformis** (Rolfe) Schltr.

H: epiphytic herb, flower colour and habitat unknown. D: ST.

[†]**thomensis** Stévant & P.J.Cribb

H: epiphytic herb, flowers greenish white, in old secondary forest. D: ST. V: *Oliveira 1999/138* (BRLU, STPH).

ANGRAECUM Bory

aporoides Summerh.

H: epiphytic herb with white flowers, in lowland and mid-elevation forest. D: STP. V: *Stévant 464* (BRLU), *667* (BRLU).

[†]**astroarche** Ridl.

H: epiphytic herb, flower colour unknown, in old secondary forest. D: ST.

distichum Lindl.

H: epiphytic herb, white flowers, habitat unknown. D: P.

doratophyllum Summerh.

H: epiphytic herb with white flowers, in mist forest. D: STP. N: endemic to Gulf of Guinea. V: *Stévant 329* (BRLU), *678* (BRLU).

infundibulare Lindl.

H: epiphytic herb with white flowers, habitat unknown. D: P.

sacciferum Lindl.

H: epiphytic herb with greenish white flowers, in mist forest. D: ST. V: *Stévant 104* (BRLU).

BOLUSIELLA Schltr.

iridifolia (Rolfe) Schltr. subsp. **iridifolia**

H: epiphytic herb with white flowers, in plantations. D: ST. V: *Stévant 503* (BRLU).

talbotii (Rendle) Summerh.

H: epiphytic herb. D: STP. V: *Primo & Stévant 77* (BRLU); *Stévant 510* (BRLU).

BRACHYCORYTHIS Lindl.

[†]**basifoliata** Summerh.

H: terrestrial herb with purple flowers, in open vegetation. D: STP. V: *Stévant 363* (BRLU), *436* (BRLU, K).

BULBOPHYLLUM Thouars

acutibracteatum De Wild. var. **acutibracteatum**

H: epiphytic herb with yellow-orange flowers, in summit forest. D: P. V: *Stévant 420* (BRLU, K).

calyptratrum Kraenzl.

H: epiphytic herb with greenish to yellowish flowers, habitat unknown. D: P.

cochleatum Lindl. var. **cochleatum**

H: epiphytic herb with yellow to purple flowers, in montane forest. D: ST. V: *Stévant 652* (BRLU).

cochleatum Lindl. var. **tenuicaule** (Lindl.) J.J.Verm.

H: epiphytic herb with red to purple flowers, in montane open vegetation. D: ST. V: *Stévant 417* (BRLU).

comatum Lindl. var. **inflatum** (Rolfe) J.J.Verm.

H: epiphytic herb with green inflorescence and purple flowers, in open vegetation on ridges. D: STP. V: *Stévant 462* (BRLU, K), *1203* (BRLU).

curvimentatum J.J.Verm.

H: pseudobulb epiphyte. D: ST.

falcatum (Lindl.) Rchb.f. var. **falcatum**

H: epiphytic herb with green to yellow flowers, in submontane forest. D: STP. V: *Rose 1023* (P); *Stévant 71* (BRLU, K).

falcatum (Lindl.) Rchb.f. var. **velutinum** (Lindl.) J.J.Verm.

H: epiphytic herb with green to yellow flowers, in lowland and submontane forest, also in coastal vegetation and plantations. D: STP. V: *Stévant 1211* (BRLU), *1221* (BRLU).

imbricatum Lindl.

H: epiphytic herb with violet and yellow flowers, in plantations. D: ST. V: *Stévant 489* (BRLU).

intertextum Lindl.

H: epiphytic herb with green or purple flowers, in submontane and montane forests. D: STP. V: *Stévant 681* (BRLU).

[†]**lizeae** J.J.Verm.

H: epiphytic herb with green to yellow flowers, in submontane and montane forests. D: ST. V: *Stévant 1882* (BRLU).

[†]**luciphilum** Stévant

H: epiphytic herb with green to yellow flowers, in plantations. D: ST. V: *Oliveira 1999/41* (BRLU).

maximum (Lindl.) Rchb.f.

H: epiphytic herb with yellowish to greenish flowers, in lowland and submontane forests, also in plantations. D: STP. V: *Stévant 397* (BRLU), *497* (BRLU).

mediocre Summerh.

H: epiphytic herb with orange, yellow or whitish flowers, in submontane and montane forests. D: STP. N: endemic to Gulf of Guinea. V: *Stévant 622* (BRLU), *1890* (BRLU).

nigritianum Rendle

H: epiphytic herb with yellowish flowers, in plantations. D: ST. V: *Stévant 1158* (BRLU).

oreonastes Rchb.f.

H: epiphytic herb with orange to yellowish flowers, in ridge forests. D: STP. V: *Primo & Stévant 17* (BRLU); *Stévant 407* (BRLU).

resupinatum Ridl.

H: epiphytic herb with yellowish to purple flowers, in lowland and submontane forests. D: ST.

saltatorium Lindl. var. **albociliatum** (Finet) J.J.Verm.

H: epiphytic herb with greenish to brownish flowers with purple spots and red pubescence, in mid-elevation ridge vegetation. D: P. V: *Stévant 422* (BRLU, K).

sandersonii (Hook.f.) Rchb.f. subsp. **stenopetalum** (Kraenzl.) J.J.Verm.

H: epiphytic herb with yellowish to reddish flowers, in submontane and montane forests, also in plantations. D: ST. V: *Stévant 660* (BRLU).

CALANTHE R.Br.

[†]**sylvatica** (Thouars) Lindl. var. **geerinckiana** Stévant

H: terrestrial herb with white flowers and orange lip, in old plantations. D: ST. V: *Stévant 1194* (BRLU).

sylvatica (Thouars) Lindl. var. **sylvatica**

H: terrestrial herb with white flowers and violet lip, in submontane and montane forests, and in secondary forest in old plantations. D: STP. V: *Stévant 338* (BRLU), *1195* (BRLU).

CHAMAEANGIS Schltr.

[†]**thomensis** (Rolfe) Schltr.

H: epiphytic herb with yellowish to orange flowers, in montane forests. D: ST. V: *Stévant 659* (BRLU).

[†]**vagans** (Lindl.) Schltr.

H: epiphytic herb with yellowish to orange flowers, in lowland forests and on ridges. D: P. V: *Stévant 450* (BRLU, K).

CHEIROSTYLIS Blume

lepida (Rchb.f.) Rolfe

H: terrestrial herb with whitish flowers, in submontane and montane forests. D: ST. V: *Stévant 381* (BRLU).

CORYMBORKIS Thouars

corymbis Thouars

H: terrestrial herb with whitish and greenish flowers, in lowland forests, and in secondary forest in old plantations. D: STP. V: *Stévant 447* (BRLU), *665* (BRLU).

CRIBBIA Senghas**confusa** P.J.Cribb

H: epiphytic herb with orange flowers, in submontane and montane forests. D: ST. V: *Stévant* 674 (BRLU).

[¶]pendula la Croix & P.J.Cribb

H: epiphytic herb with pale greenish flowers, in submontane forests, also in secondary forest at mid-elevations. D: ST. V: *Stévant* 1168 (BRLU).

[¶]thomensis la Croix & P.J.Cribb

H: epiphytic herb with white flowers, in montane forests. D: ST. V: *Stévant* 1228 (BRLU).

CYNORKIS Thouars**anacamptoides** Kraenzl. var. **ecalcarata** P.J.Cribb

H: terrestrial herb with violet flowers, in montane forests. D: ST. V: *Stévant* 385 (BRLU).

debilis (Hook.f.) Summerh.

H: terrestrial herb with purple-spotted flowers, in montane forests. D: ST. V: *Stévant* 42 (BRLU, K).

gabonensis Summerh.

H: terrestrial herb with pale whitish flowers, in lowland to montane forests, also on ridges. D: STP. V: *Stévant* 444 (BRLU, K), 629 (BRLU).

CYRTORCHIS Schltr.**arcuata** (Lindl.) Schltr. subsp. **variabilis** Summerh.

H: epiphytic herb with white flowers and greenish to orange spur, in coastal vegetation, in lowland secondary forest and plantations. D: STP. V: *Stévant* 405 (BRLU, K), 535 (BRLU).

henriquesiana (Ridl.) Schltr.

H: epiphytic herb with white to yellow flowers, in lowland secondary forest and on ridges. D: P. V: *Stévant* 664 (BRLU).

monteiroae (Rchb.f.) Schltr.

H: epiphytic herb with white to yellow flowers, in lowland forest, secondary forest and plantations. D: STP. V: *Stévant* 205 (BRLU, K), 448 (BRLU).

ringens (Rchb.f.) Summerh.

H: epiphytic herb with white flowers and pale rose spur, in secondary forest. D: ST.

DIAPHANANTHE Schltr.**[¶]acuta** (Ridl.) Schltr.

H: epiphytic herb with whitish to yellowish flowers, in lowland and mid-elevation forests. D: ST. V: *Stévant* 691 (BRLU).

[¶]papagayi (Rchb.f.) Schltr.

H: epiphytic herb, unknown flower colour, on rocky places in shade. D: P.

pellucida (Lindl.) Schltr.

H: epiphytic herb with greenish to yellowish flowers, in lowland primary forest and old secondary forest. D: STP. V: *Primo & Stévant* 126 (BRLU); *Stévant* 1207 (BRLU).

rohrii (Rchb.f.) Summerh.

H: epiphytic herb with orange to yellowish flowers, in submontane and montane forest and old secondary forest at high elevation. D: ST. V: *Stévant* 494 (BRLU, K).

DINKLAGEELLA Mansf.**[¶]scandens** Stévant & P.J.Cribb

H: terrestrial herb with white flowers, in swamp meadow. D: ST. V: *Stévant* 1888 (BRLU).

DISPERIS Sw.**reichenbachiana** Rchb.f.

H: terrestrial herb with purple to whitish flowers in submontane and montane primary forest and mid-elevation secondary forest. D: ST. V: *Stévant* 370 (BRLU).

thomensis Summerh.

H: terrestrial herb with white flowers in submontane and montane primary forest. D: ST. V: *Stévant* 48 (BRLU).

GENYORCHIS Schltr.**apetala** (Lindl.) J.J.Verm.

H: epiphytic herb with whitish, reddish and yellowish flowers, in secondary forest and in plantations. D: P. V: *Stévant* 1220 (BRLU).

GRAPHORKIS Thouars**lurida** (Sw.) Kuntze

H: epiphytic herb with brownish and yellowish flowers, in secondary forest and in plantations. D: STP. V: *Stévant* 302 (BRLU), 437 (BRLU).

HABENARIA Willd.**barrina** Ridl.

H: terrestrial with whitish to greenish flowers, in secondary forest and plantations. D: STP. V: *Oliveira* 1999/33 (BRLU); *Stévant* 427 (BRLU).

buettneriana Kraenzl.

H: terrestrial with greenish flowers, in secondary forest and plantations. D: ST. V: *Stévant* 483 (BRLU).

[¶]letouzeyana (Szlach. & Olsz.) P.J.Cribb & Stévant

H: terrestrial with whitish flowers, in old secondary forest and lowland primary forests. D: P. V: *Stévant* 631 (BRLU).

malacophylla Rchb.f. var. **malacophylla**

H: terrestrial with whitish to greenish flowers, in submontane and montane primary forests. D: ST. V: *Stévant* 1223 (BRLU).

stenochila Lindl.

H: terrestrial with white flowers, in lowland vegetation. D: P. V: *Stévant* 640 (BRLU).

thomana Rchb.f.

H: terrestrial with whitish to greenish flowers, in primary lowland to montane forests. D: ST. V: *Stévant* 414 (BRLU); *Paiva* 1927 (COI).

LIPARIS Rich.**deistellii** Schltr.

H: epiphytic herb with greenish to purple flowers, in secondary and submontane forests. D: STP. V: *Stévant* 654 (BRLU), 1226 (BRLU).

epiphytica Schltr.

H: epiphytic herb with greenish to whitish flowers, in montane forests. D: ST. V: *Stévant* 537 (BRLU).

goodyeroides Schltr.

H: terrestrial or lithophytic herb with greenish flowers, in old lowland secondary forest. D: STP. V: *Matos* 7656 (BRLU); *Stévant* 625 (BRLU).

gracilentia Dandy

H: epiphytic herb with greenish and purple flowers, in submontane and montane forests. D: STP. V: *Stévant* 672 (BRLU).

nervosa (Thunb.) Lindl.

H: terrestrial or epiphytic herb with greenish, yellowish, brownish or purple flowers, in lowland secondary forest and in submontane forests. D: STP. V: *Stévant* 196 (BRLU, K), 442 (BRLU).

platyglossa Schltr.

H: terrestrial herb with greenish, yellowish and purple flowers, in old lowland secondary forest. D: P. V: *Stévant* 530 (BRLU).

rosseelii Stévant

H: epiphytic herb with greenish flowers, in secondary submontane forests and in plantations. D: ST. V: *Stévant* 1188 (BRLU).

LISTROSTACHYS Rchb.f.**pertusa** (Lindl.) Rchb.f.

H: epiphytic herb with white and green flowers, in secondary lowland mid-elevation forests. D: P. V: *Stévant* 1216 (BRLU).

MALAXIS Sol. ex Sw.**maclaudii** (Finet) Summerh.

H: terrestrial herb with reddish and purple flowers, in submontane forests. D: ST.

MANNIELLA Rchb.f.**gustavi** Rchb.f.

H: terrestrial herb with brownish, pinkish or greenish flowers, in lowland secondary forest, and in submontane and montane forests. D: STP. V: *Stévant* 443 (BRLU), 642 (BRLU).

MICROCOELIA Lindl.**bulbocalcarata** L.Jonss.

H: epiphytic herb with white and greenish flowers, in old mid-elevation secondary and primary forests. D: P. V: *Stévant* 682 (BRLU).

caespitosa (Rolfe) Summerh.

H: epiphytic herb with white and greenish to brownish flowers, in submontane forests. D: ST. V: *Primo & Stévant* 47 (BRLU).

NERVILIA Comm. ex Gaudich.**bicarinata** (Blume) Schltr.

H: terrestrial herb with yellowish to greenish flowers, in plantations. D: STP. V: *Stévant* 686 (BRLU).

OBERONIA Lindl.**disticha** (Lam.) Schltr.

H: epiphytic herb with whitish to yellowish flowers, in plantations. D: ST. V: *Stévant* 1155 (BRLU).

OECEOCLADES Lindl.[¶]**latifolia** (Rolfe) Garay & P.Taylor

H: pseudobulb geophyte. D: ST.

maculata (Lindl.) Lindl.H: terrestrial herb with whitish, yellowish to greenish flowers with a red lip, in plantations and secondary forest. D: STP. V: *Oliveira 1999/04* (BRLU, STPH); *Stévant 636* (BRLU).**ugandae** (Rolfe) L.A.Garay & P.Taylor

H: terrestrial herb with white and purple flowers, habitat unknown. D: ST.

ORESTIAS Ridl.**micrantha** Summerh.H: terrestrial herb with white or pink flowers, in montane and submontane forest. D: STP. V: *Stévant 540* (BRLU), *642* (BRLU).**stolidostachya** (Rchb.f.) Summerh.*elegans* Ridl.H: terrestrial herb with white or pink flowers, in montane and submontane forest. D: STP. V: *Stévant 210* (BRLU, K), *217* (BRLU).**PHAIUS** Lour.**mannii** Rchb.f.H: terrestrial herb with whitish flowers with pink lip, in old plantations. D: ST. V: *Stévant 532* (BRLU).**PLATYLEPIS** A.Rich.**glandulosa** (Lindl.) Rchb.f.H: terrestrial herb with whitish flowers, in plantations, lowland and mid-elevation forests. D: STP. V: *Stévant 501* (BRLU).**PODANGIS** Schltr.**dactyloceras** (Rchb.f.) Schltr.H: epiphytic herb with white flowers, in plantations and submontane forests. D: ST. V: *Stévant 1197* (BRLU).**POLYSTACHYA** Hook.**albescens** Ridl. subsp. **albescens**H: epiphytic herb with white and pink flowers, widespread in forest and plantations. D: STP. V: *Stévant 1178* (BRLU), *655* (BRLU).[¶]**albescens** Ridl. subsp. **principensis** StévantH: epiphytic or terrestrial herb with white and pink flowers, in open vegetation and on ridges. D: P. V: *Stévant 1227* (BRLU).**bifida** Lindl.*farinosa* Kraenzl.H: epiphytic herb with greenish to yellowish flowers, in montane and submontane forest. D: ST. V: *Stévant 1889* (BRLU).[¶]**biteui** P.J.Cribb, la Croix & StévantH: epiphytic herb with pink and white flowers, in plantations and submontane forest. D: ST. V: *Stévant 446* (BRLU).[¶]**disticha** RolfeH: epiphytic herb with yellow flowers and red spots, in montane forest and open vegetation. D: ST. V: *Stévant 694* (BRLU).[¶]**expansa** Ridl.H: epiphytic herb with white flowers with yellow to orange lip, in secondary forest and plantations. D: ST. V: *Stévant 349* (BRLU).**fusiformis** (Thouars) Lindl.H: epiphytic herb with yellow to greenish flowers, in secondary and submontane forest. D: STP. V: *Stévant 423* (BRLU, K), *1204* (BRLU).**golungensis** Rchb.f.H: epiphytic herb with yellow flowers, in secondary forest and plantations. D: ST. V: *Stévant 1605* (BRLU).**moniquetiana** Stévant & GeerinckH: epiphytic herb with whitish to brownish flowers, in old mid-elevation secondary forest and plantations. D: ST. V: *Stévant 684* (BRLU).**mukandaensis** De Wild.H: epiphytic herb with yellow, brownish to greenish flowers with red spots, in plantations. D: ST. V: *Stévant 1191* (BRLU).**paniculata** (Sw.) Rolfe: epiphytic herb with yellow to orange flowers, in plantations. D: ST. V: *Stévant 499* (BRLU).[¶]**parviflora** Summerh.H: epiphytic herb with yellow to brownish flowers, in submontane and montane forest. D: STP. V: *Stévant 484* (BRLU).**pobeguini** (Finet) RolfeH: epiphytic herb with pink flowers with lilac lip, in plantations or near the sea. D: P. V: *Stévant 1222* (BRLU).**polychaete** Kraenzl.H: epiphytic herb with yellow to greenish flowers with red spots, in plantations. D: ST. V: *Stévant 1156* (BRLU).**principia** Stévant & P.J.CribbH: epiphytic herb with yellow orange flowers in old secondary forest. D: P. V: *Stévant 648* (BRLU).**pyramidalis** Lindl.H: epiphytic herb with yellow flowers with red spots, in plantations, on ridges and in submontane forest. D: STP. V: *Stévant 451* (BRLU, K), *1225* (BRLU).**ridleyi** RolfeH: epiphytic herb with brown, reddish or greenish flowers, in plantations, and in submontane and montane forest. D: ST. N: endemic to Gulf of Guinea. V: *Stévant 1175* (BRLU).[¶]**setifera** Lindl.H: epiphytic herb with yellow flowers with red spots, in ridge vegetation. D: P. V: *Stévant 1215* (BRLU).**tessellata** Lindl.H: epiphytic herb with greenish, yellowish, violet or purple flowers, widespread in lowland and mid-elevation forest. D: STP. V: *Stévant 454* (BRLU), *639* (BRLU).[¶]**thomensis** Summerh.H: epiphytic herb with yellow to purple flowers and white lip, in open vegetation near summit. D: ST. V: *Primo & Stévant 37* (BRLU).**RANGAERIS** (Schltr.) Summerh.**trilobata** Summerh.H: epiphytic herb with brown to white flowers, in lowland and mid-elevation forests. D: ST. V: *Stévant 703* (BRLU).**RHIPIDOGLOSSUM** Schltr.[¶]**brevifolium** Summerh.,*Diaphananthe brevifolia* (Summerh.) Summerh.H: facultative epiphytic herb with translucent whitish flowers, in open vegetation on ridges in montane forest and in crater of Lagoa Amélia. D: ST. V: *Stévant 295* (BRLU).**curvatum** (Rolfe) Garay*Diaphananthe curvata* (Rolfe) Summerh.H: epiphytic herb with greenish to yellowish flowers, in old secondary lowland forest. D: P. V: *Primo & Stévant 49* (BRLU).**rutilum** (Rchb.f.) Schltr.*Diaphananthe rutila* (Rchb.f.) Summerh.H: epiphytic herb with whitish, greenish, brownish or violet flowers, in submontane primary forest and in plantations. D: ST. V: *Stévant 1606* (BRLU).**SOLENANGIS** Schltr.**clavata** (Rolfe) Schltr.H: epiphytic herb with white flowers, in meadow of Lagoa Amélia. D: ST. V: *Stévant 1231* (BRLU).**scandens** (Schltr.) Schltr.

H: epiphytic herb with whitish, yellowish to greenish flowers, in plantations. D: ST.

STOLZIA Schltr.**elaidum** (Lindl.) Summerh.H: epiphytic herb with whitish to greenish flowers, in plantations and on ridges. D: STP. V: *Stévant 458*, *521* (BRLU).[¶]**peperomioides** (Kraenzl.) Summerh. subsp. **thomensis** (Stévant & P.J.Cribb) Stévant, Droissart & Simo*thomensis* Stévant & P.J.CribbH: epiphytic herb with green translucent flowers in evergreen mist forest. D: ST. V: *Stévant 1891* (BRLU).**TRIDACTYLE** Schltr.**armeniaca** (Lindl.) Schltr.

H: epiphytic herb with white to orange flowers; habitat unknown. D: ST.

[¶]**aurantiopunctata** P.J.Cribb & StévantH: epiphytic herb with white and orange flowers, in ridge forests. D: P. V: *Stévant 1224* (BRLU).[¶]**exellii** P.J.Cribb & StévantH: epiphytic herb with whitish and greenish flowers, in submontane and montane forests. D: ST. V: *Stévant 708* (BRLU).**latifolia** Summerh.H: epiphytic herb with yellow flowers, in *Pandanus* forest on ridges. D: P. V: *Stévant 478* (BRLU).[¶]**thomensis** P.J.Cribb & StévantH: epiphytic herb with white flowers, in plantations and submontane forests. D: ST. V: *Stévant 488* (BRLU, K).**tridactylites** (Rolfe) Schltr.H: epiphytic herb with whitish to orange flowers, widespread in forest and plantations. D: STP. V: *Stévant 1229* (BRLU), *1230* (BRLU).

VANILLA Plum. ex Mill.**crenulata** Rolfe

H: terrestrial herb with white, yellowish to orange flowers with pink lip, in lowland forest and ridges. D: P. V: *Stévert* 647 (BRLU).

grandifolia Lindl.

H: terrestrial herb with yellowish flowers, on ridges. D: P. V: *Stévert* 328 (BRLU).

***planifolia** Andr.

H: terrestrial herb with yellowish flowers, cultivated or in old plantations D: STP. V: *Stévert* 270 (BRLU).

ZEUXINE Lindl.**elongata** Rolfe

H: terrestrial herb with white to greenish flowers, in secondary forest. D: STP. V: *Stévert* 135 (BRLU, K), 334 (BRLU).

heterosepala (Rchb.f.) Geerinck

Hetaeria heterosepala (Rchb.f.) Summerh.

H: terrestrial herb with white and pink flowers, in submontane and mid-elevation forests. D: STP. V: *Stévert* 428 (BRLU, K).

stammeri Schltr.

H: terrestrial herb with pink, white to greenish flowers, in lowland forests. D: P. V: *Stévert* 633 (BRLU).

OXALIDACEAE**OXALIS** L.**corniculata** L.

H: annual or perennial herb with yellow flowers. D: STP. V: *Paiva* 567 (COI), 974 (COI).

***corymbosa** DC. (*Fiá-viola*, *Lamera*, *Madringueiro*)

H: perennial herb with pink or purple flowers, in secondary forest, plantations, and on roadsides. M: 33; 79. D: STP. V: *Paiva* 1386 (COI), 1945 (COI).

PANDANACEAE**PANDANUS** Parkinson**candelabrum** P.Beauv.

H: tree. D: P.

^fthomensis Henriq. (*Páia-séla*, *Pau-esteira*, *Pó-paia-cela*)

H: tree ± 15 m high. D: ST. V: *Paiva* 1162 (COI).

PAPAVERACEAE***ARGEMONE** L.***mexicana** L. (*Cundú-de-muala-vê*)

H: annual herb with yellow flowers. N: common name indicated by Santo (1969) is same as for *Acanthus montanus*. D: ST.

PASSIFLORACEAE**ADENIA** Forssk.**cissampeloides** (Planch. ex Hook.) Harms (*Fissandja*)

H: climber. M: 79; 95; 140; 183. D: ST. V: *Madureira & Martins* 486 (COI).

lobata (Jacq.) Engl.

H: climber with greenish yellow flowers. D: STP. V: *Lejoly* 97/230B (BRLU, LISC).

***PASSIFLORA** L.

***edulis** Sims (*Macujá*, *Malacujá*, *Maracujá*, *Maracujá-pequeno*, *Maracujá-roxo*)

H: climber. E: fruits. M: 136. D: ST. V: *Paiva* 188 (COI).

***foetida** L. (*Macujá-de-mato*, *Malacujá-blavo*, *Maracujá-do-mato*, *Martiros-fétidos*)

H: climber. E: fruits. M: 79; 98; 114; 136; 179. D: STP. V: *Paiva* 816 (COI).

***quadrangularis** L. (*Grenadilha*, *Macujá*, *Malacujá*, *Maracujá*, *Maracujá-grande*)

H: climber. E: fruits. M: 42; 98. D: STP. V: *Paiva* 968 (COI).

PHYTOLACCACEAE***PETIVERIA** L.***alliacea** L.

H: perennial herb. D: ST. V: *Oliveira* 883 (BRLU).

PHYTOLACCA L.**dodecandra** L'Hér. (*Fiá-mati*, *Matri*)

dodecandra L'Hér. var. *apiculata* (Engl.) Baker & C.H.Wright

H: climbing shrub, in secondary forest and on roadsides. M: 139. D: ST. V: *Paiva* 1066 (COI).

PIPERACEAE**PEPEROMIA** Ruiz & Pav.**fernandopoiana** C.DC.

H: herb, creeping or trailing, mostly epiphytic, in forest. D: P. V: *Jofroy* 197 (BRLU).

molleri C.DC.

H: epiphytic herb, in forest. D: STP. V: *Paiva* 1399 (COI).

pellucida (L.) Kunth (*Alfabaca*, *Alfavaca*, *Fia-alfobaca*)

H: erect or procumbent, annual herb, in forest. M: 57; 61; 79; 98; 114; 123; 149. D: STP. V: *Paiva* 1406 (COI), 1890 (COI).

retusa (L.f.) A.Dietr. var. **retusa**

retusa (L.f.) A.Dietr. var. *mannii* (Hook.f.) Düll

H: perennial, creeping or epiphytic herb, in forest. D: ST. V: *Matos* 7565 (LISC).

tetraphylla (G.Forst.) Hook. & Arn.

reflexa (L.f.) A.Dietr.

H: perennial, usually epiphytic herb, in forest. D: ST. V: *Matos* 7555 (LISC).

thomeana C.DC.

vaccinifolia C.DC.

H: creeping herb. D: ST.

vulcanica Baker & C.H.Wright

hygrophila Engl.

H: creeping herb. D: ST. V: *Lejoly* 94/528 (BRLU, LISC).

PIPER L.**capense** L.f. (*Fia-boba-piquina*)

H: shrub or undershrub, sometimes liana, in forest, secondary forest and plantations. M: 43; 53; 80; 104; 154; 166. D: STP. V: *Figueiredo* 59 (K); *Paiva* 523 (COI).

guineense Schumach. & Thonn. (*Pau-pimenta*, *Pimenta-de-S.Tomé*, *Pó-pimenta*)

H: liana, in forest. E: fruits (spice). M: 51; 63; 108; 115. D: STP. V: *Madureira & Martins* 463 (COI).

***nigrum** L. (*Pimenta*, *Pimenteira*)

H: climber. E: fruits (spice). M: 63; 152; 164. D: ST. V: *Paiva* 654 (COI).

umbellatum L. (*Fia-bôba*, *Fiá-bôba-d'obô*, *Fia-bobó*, *Folha-bôba*, *Folha-bôba-branca*)

Pothomorphe umbellata (L.) Miq.

H: shrub or woody herb, in forest, secondary forest and on roadsides. M: 16; 51; 150; 159; 166; 167. D: STP. V: *Figueiredo* 40 (K); *Paiva* 1421 (COI).

PLANTAGINACEAE**PLANTAGO** L.***major** L.

H: herb. D: ST.

PLUMBAGINACEAE**PLUMBAGO** L.***auriculata** Lam.

H: shrub with blue flowers. O. D: ST.

zeylanica L.

H: herb with white flowers, in secondary forest. M: 145; 183. D: ST. V: *Madureira & Martins* 498 (COI).

POACEAE**ACROCERAS** Stapf**zizanoides** (Kunth) Dandy

H: perennial grass, over 1 m high. D: ST.

?AGROSTIS L.**?tropica** P.Beauv.

N: recorded by Exell (1944, 1973) based on literature citations; no specimens known.

ANTHEPHORA Schreb.

cristata (Döll) Hack. ex De Wild. & T.Durand
H: annual grass, up to 1 m high. D: ST.

AXONOPUS P.Beauv.

***compressus** (Sw.) P.Beauv.

H: perennial grass up to 0.6 m high. D: ST.

flexuosus (Peter) C.E.Hubb. ex Troupin

H: perennial grass, up to 1 m high. D: P.

***BAMBUSA** Schreb.

***vulgaris** Schrad. ex J.C.Wendl. (*Bambu*)

H: bamboo up to 25 m high. M: 22. D: STP. V: *Paiva* 65 (COI).

***BRIZA** L.

***maxima** L.

H: annual grass, up to 1 m high. D: ST.

CENTOTHECA Desv.

lappacea (L.) Desv.

H: annual grass up to 0.6 m high, in secondary forest, plantations and on roadsides. D: STP. V: *Matos* 7594 (LISC).

CHLORIS Sw.

pilosa Schumach.

H: annual grass up to 1 m high. D: STP.

pycnothrix Trin.

H: annual grass up to 0.5 m high. D: STP. V: *Lejoly* 95/064 (LISC).

***COIX** L.

***lacryma-jobi** L. (*Capim-de-Nossa-Senhora*)

H: annual grass up to 1.3 m high. D: ST.

***CYMBOPOGON** Spreng.

***citratus** (DC.) Stapf (*Belgata*, *Capim-cheiroso*, *Capim-do-Gabão*, *Chá-do-Gabão*, *Chá-do-Príncipe*, *Fiá-chalela*, *Folha-Gabão*)

H: perennial grass to 2 m high. M: 22; 52; 76; 107; 150. D: STP. V: *Madureira & Martins* 335 (COI).

CYNODON Rich.

dactylon (L.) Pers.

H: perennial grass up to 0.4 m high. D: ST. V: *Paiva* 278 (COI).

DACTYLOCTENIUM Willd.

aegyptium (L.) Willd.

H: annual grass up to 0.6 m high. D: ST. V: *Paiva* 395 (COI).

DIGITARIA Haller

horizontalis Willd.

H: annual grass up to 0.6 m high. D: STP.

longiflora (Retz.) Pers.

H: annual grass up to 0.3 m high. D: ST. V: *Paiva* 402 (COI).

ECHINOCHLOA P.Beauv.

colona (L.) Link

H: annual grass up to 1.2 m high. D: ST.

ELEUSINE Gaertn.

indica (L.) Gaertn. (*Áliba-caçu*, *Queblancaná*)

H: annual grass up to 0.6 m high. M: 61; 79; 104; 135; 175. D: STP. V: *Madureira & Martins* 303 (COI).

ERAGROSTIS Wolf

amabilis (L.) Wight & Arn. var. **amabilis**

tenella (L.) P.Beauv. ex Roem. & Schult.

H: annual grass up to 0.5 m high. D: STP. V: *Lejoly* 97/289 (LISC).

domingensis (Pers.) Steud. (*Fiá-vador*, *Folha-de-voador*)

H: annual grass up to 1.2 m high, in coastal areas. D: ST. V: *Paiva* 810 (COI).

superba Peyr.

H: perennial grass up to 1.2 m high, ruderal. D: ST. V: *Paiva* 646 (COI).

ERIOCHLOA Kunth

fatmensis (Hochst. & Steud.) Clayton

nubica (Steud.) Hack. & Stapf ex Thell.

H: annual grass up to 0.7 m high. D: ST.

HETEROPOGON Pers.

contortus (L.) P.Beauv. ex Roem. & Schult.

H: perennial grass up to 1 m high. D: STP. V: *Lejoly* 93/656 (BRLU).

?*HORDEUM L.

?***vulgare** L.

N: recorded by Silva (1958) but no specimens are known.

HYPARRHENIA Andersson ex E.Fourn.

diplandra (Hack.) Stapf

H: perennial grass up to 3 m high. D: ST.

rufa (Nees) Stapf

rufa var. *major* (Rendle) Stapf

H: perennial grass up to 2.5 m high. D: ST. V: *Matos* 7315 (LISC).

ISACHNE R.Br.

buettneri Hack.

H: perennial grass up to 0.5 m high. D: STP. V: *Paiva* 1182 (COI).

mauritiana Kunth

H: perennial grass up to 0.6 m high. D: ST.

LEPTASPIS R.Br.

zeylanica Nees ex Steud.

cochleata Thwaites

H: rhizomatous grass up to 1 m high. D: STP. V: *Matos* 7364 (LISC).

MEGASTACHYA P.Beauv.

mucronata (Poir.) P.Beauv.

H: annual or perennial herb up to 0.9 m high. V: *Matos* 7767 (LISC).

MELINIS P.Beauv.

minutiflora P.Beauv.

H: perennial grass up to 1.5 m high. D: ST.

repens (Willd.) Zizka

Rhynchelytrum repens (Willd.) C.E.Hubb.

H: annual or perennial grass up to 1.5 m high. D: P.

***OLYRA** L.

***latifolia** L. (*Fiá-piála*, *Impialá*)

H: perennial grass up to 4 m high. M: 180; 183. D: STP. V: *Madureira & Martins* 276 (COI).

OPLISMENUS P.Beauv.

burmannii (Retz.) P.Beauv.

H: annual grass up to 0.6 m high, in forest and on roadsides. D: ST. V: *Paiva* 1309 (COI).

hirtellus (L.) P.Beauv. (*Erva-colchão*)

H: perennial grass up to 1 m high, in forest. D: STP. V: *Paiva* 585 (COI), 1137 (COI).

?*ORYZA L.

?***sativa** L. (*Arroz*)

N: recorded by Silva (1958), but no specimens are known.

PANICUM L.

brevifolium L.

H: annual grass up to 0.6 m high. D: STP. V: *Paiva* 1184 (COI).

hochstetteri Steud. (*Erva-de-senhora*)

H: perennial grass up to 1 m high, in forest. D: ST. V: *Paiva* 1095 (COI).

maximum Jacq. (*Capim-gigante*)

H: perennial grass up to 3 m high, on roadsides. D: STP. V: *Paiva* 964 (COI).

PASPALUM L.

conjugatum P.J.Bergius (*Gutchim-duátche*, *Muala-sendê-môm-sendê-ôpê*)

H: perennial grass up to 0.6 m high, in forest. M: 27; 52; 150. D: STP. V: *Paiva* 1383 (COI).

paniculatum L. (*Albarção*, *Aliba-cáçu*, *Aliba-queblancana*, *Comida-de-cachequeque*, *Erva-cacho*, *Mansuensuen*, *Muambe*)

H: perennial grass up to 1.2 m high. D: STP. V: *Paiva* 966 (COI).

scrobiculatum L.

orbiculare G.Forst.

H: perennial grass up to 0.6 m high, in forest. D: ST. V: *Lejoly* 93/642 (BRLU).

vaginatum Sw.

H: perennial grass up to 0.6 m high. D: ST.

PENNISETUM Rich.

laxior (Clayton) Clayton

Beckeropsis laxior Clayton

H: annual grass up to 0.8 m high. D: ST.

PENNISETUM Rich. (cont.)**polystachion** (L.) Schult.

H: annual or perennial grass up to 2 m high. D: STP. V: *Paiva 514* (COI).

purpureum Schumach.

H: perennial grass up to 8 m high. D: ST. V: *Paiva 737* (COI).

POA L.**annua** L.

H: annual grass up to 0.3 m high. D: STP.

PSEUDECHINOLAENA Stapf**polystachya** (Kunth) Stapf

H: annual grass up to 0.3 m high. D: ST.

ROTTBOELLIA L.f.**cochinchinensis** (Lour.) Clayton**exaltata** (L.) L.f.

H: annual grass up to 2.5 m high. D: ST.

SACCHARUM** L.officinarum** L. (*Caná-de-açúcar*, *Caná-sucli*, *Cánam*)

H: perennial grass up to 4 m high. D: STP. V: *Paiva 1038* (COI).

SACCIOLEPIS Nash**africana** C.E.Hubb. & Snowden

H: rhizomatous perennial grass up to 1.8 m high. D: ST.

?*SECALE L.**?*cereale** L.

N: recorded by Silva (1958), but no specimens are known.

SETARIA P.Beauv.**barbata** (Lam.) Kunth

H: annual grass up to 1.5 m high. D: STP.

longiseta P.Beauv.

H: perennial grass up to 0.9 m high. D: STP.

megaphylla (Steud.) T.Durand & Schinz (*Erva-boi*, *Ogá-ogá*, *Uága-uága*, *Ugá-ugá*)**chevalieri** Stapf

H: perennial grass up to 3 m high. M: 29; 31; 62; 64; 129. D: STP. V: *Paiva 544* (COI), *1318* (COI).

SORGHUM Moench**arundinaceum** (Desv.) Stapf (*Mansuensué*, *Sorgo*)

H: annual or perennial up to 4 m high. D: ST. V: *Paiva 121* (COI).

*** ×drummondii** (Steud.) Millsp. & Chase

H: annual grass. D: P.

SPOROBOLUS R.Br.**molleri** Hack.

H: annual grass up to 0.3 m high. D: STP.

pyramidalis P.Beauv.

H: perennial grass up to 1.6 m high. D: STP. V: *Paiva 170* (COI).

tenuissimus (Mart. ex Schrank) Kuntze

H: annual grass up to 0.9 m high. D: ST.

virginicus (L.) Kunth

H: perennial grass up to 0.6 m high. D: STP.

STENOTAPHRUM Trin.**secundatum** (Walter) Kuntze

H: perennial grass, in coastal areas. D: STP. V: *Oliveira 66/99* (BRLU).

?*TRITICUM L.**?*aestivum** L.

N: recorded by Silva (1958); no specimens known.

ZEA** L.mays** L. (*Mi*, *Milho*)

H: annual grass up to 4 m high. E: fruit. M: 10; 64; 183. D: STP.

ZOYSIA** Willd.matrella** (L.) Merr.

H: perennial grass. D: ST. V: *Lejoly 98/270* (BRLU).

POLYGONACEAE***ANTIGONON** Endl.***leptopus** Hook. & Arn. (*Brinco-de-casamento*, *Rosa-de-casamento*)

H: climber with pink flowers. D: ST. V: *Paiva 1521* (COI).

PERSICARIA (L.) Mill.**decipiens** (R.Br.) K.L.Wilson

Polygonum salicifolium Brouss. ex Willd.

H: annual herb. D: ST. V: *Matos 7500* (LISC).

senegalensis (Meisn.) Soják

Polygonum senegalense Meisn.

H: perennial succulent herb, near water. D: ST.

RUMEX L.**abyssinicus** Jacq.

H: perennial herb. D: ST. V: *Matos 7366* (LISC).

crispus L.

H: herb, ruderal. D: ST. V: *Lejoly 97/236* (BRLU, LISC).

PORTULACACEAE**PORTULACA** L.**oleracea** L. (*Beldroega*, *Bodlega*, *Bodlega-piquina*, *Fia-bodléga*, *Fia-bondlega*)

H: annual succulent herb, ruderal. E: leaves. M: 51; 135; 179. D: ST. V: *Paiva 563* (COI), *1283* (COI).

quadrifida L.

N: recorded by Exell (1973) based on Silva (1958) without specimen citation.

TALINUM** Adans.triangulare** (Jacq.) Willd. (*Bodlega-grande*, *Budelega*)

H: perennial succulent herb with purple flowers. E: leaves. M: 185. D: ST. V: *Paiva 652* (COI).

PROTEACEAE**GREVILLEA** R.Br. ex Knight***robusta** A.Cunn. ex R.Br. (*Grevília*)

H: tree with orange flowers. O. D: ST. V: *Oliveira 85* (BRLU).

PUNICACEAE**PUNICA** Smook***granatum** L. (fruit: *Romã*; tree: *Romanzeira*, *Romeira*)

H: shrub or tree in plantations. E: fruits. M: 61; 136. D: ST. V: *Madureira & Martins 659* (COI).

RANUNCULACEAE**CLEMATIS** L.**hirsuta** Guill. & Perr. (*Matucana*)

H: climber with white flowers. D: ST. V: *Paiva 1057* (COI).

RHAMNACEAE**LASIODISCUS** Hook.f.**mannii** Hook.f.

H: shrub or tree up to 10 m high, in forest. D: P.

mildbraedii Engl.

H: shrub or tree up to 10(–24) m high, in lowland forest. D: ST. V: *Figueiredo 81* (K).

^rrozeirae Exell

H: habit unknown. D: ST.

MAESOPSIS Engl.**eminii** Engl. (*Pau-chuva*, *Pó-suba*)

H: tree, in forest. D: ST.

VENTILAGO Gaertn.**diffusa** (G.Don) Exell

H: liana, in forest. D: ST.

ZIZIPHUS Mill.**abyssinica** A.Rich. (*Chimblom*, *Macã-da-Índia*, *Simblom*, *Zimbrão*)

H: shrub or tree, spiny, in savanna. E: fruits. D: ST. V: *Paiva 1522* (COI).

***mauritiana** Lam. (*Chimblom*, *Maçã-do-Japão*, *Zimbrão*)

H: tree, in savanna. E: fruits. D: ST. V: *Matos 7323* (LISC).

RHIZOPHORACEAE

CASSIPOUREA Aubl.[†]**glomerata** Alston

H: shrub. D: ST.

gummiiflua Tul. var. **mannii** (Hook.f. ex Oliv.) J.Lewis

H: tree. D: ST.

RHIZOPHORA L.**harrisonii** Leechm. (*Mangue-da-praia*, *Mangue-muala*, *Mangue-rosso*, *Mangue-roxo*, *Mangue-vermelho*)H: shrub, in mangroves. M: 60; 150. D: STP. V: *Paiva* 251 (COI).**mangle** L.H: shrub, in mangroves. D: ST. V: *Oliveira* 920 (BRLU).**racemosa** G.Mey. (*Mangue-da-praia*, *Mangue-vermelho*)H: shrub or tree, in mangroves. D: ST. V: *Matos* 7268 (LISC).

ROSACEAE

Note: several cultivated species have been recorded, but it is unlikely that they occur as escapes: **Cydonia oblonga** Mill., **Cerasus vulgaris** Mill. (= *Prunus cerasus* L.), **Prunus domestica** L., **P. persica** (L.) Batsch, **Amygdalus communis** L. (= *Prunus dulcis* (Mill.) D.A.Webb).

ALCHEMILLA L.**cryptantha** Steud. ex A.Rich.H: perennial creeping herb. D: ST. V: *Matos* 7368 (LISC).^{*}**ERIOBOTRYA** Lindl.^{*}**japonica** (Thunb.) Lindl. (fruit: *Nespla*; tree: *Nespereira*)H: tree cultivated for fruit and escaped. M: 99. D: ST. V: *Martins* & *Martins* 668 (COI).^{*}**MALUS** Mill.^{*}**pumila** Mill.

H: tree cultivated for fruit and escaped. D: ST.

PRUNUS L.**africana** (Hook.f.) Kalkman*Pygeum africanum* Hook.f.H: tree, in forest. D: ST. V: *Oliveira* 43 (BRLU).^{*}**ROSA** L.^{*}**chinensis** Jacq.

H: scandent shrub. O. D: STP.

^{*}**laevigata** Michx.

H: shrub. O. D: ST.

^{*}**multiflora** Thunb.

H: shrub. O. D: ST. N: recorded at summit of Pico.

RUBUS L.**pinnatus** Willd. (plant: *Ido-ido*, *Silva*; fruit: *Molango*, *Molango-d'obô*, *Morango-silvestre*)*pinnatus* Willd. var. *afrotropicus* (Engl.) GustafssonH: scandent shrub with white flowers. E: fruits. M: 173. D: ST. V: *Paiva* 1393 (COI).^{*}**rosifolius** Sm. (fruit: *Framboesa*, *Morango*, *Morango-silvestre*, *Tramboesa*)H: scandent shrub with white flowers. E: fruits. D: STP. V: *Paiva* 1506 (COI).

RUBIACEAE

(Alves *et al.* 2005; Figueiredo 2005)**AIDIA** Lour.[†]**quintasii** (K.Schum.) G.Taylor (*Muindo*, *Muindro*)H: tree, in forest. M: 13; 22; 56; 57; 71; 134; 158; 177. D: ST. V: *Martins* & *Martins* 523 (COI).[†]**wattii** G.Taylor (*Inhé-muela*)

H: tree, in forest. D: ST.

AORANTHE Somers**cladantha** (K.Schum.) Somers

H: tree, in forest. D: ST.

AULACOCALYX Hook.f.[†]**pallens** (Hiern) Bridson & Figueiredo subsp. **pallens** (*Teia-teia-pequeno*)H: shrub or tree, in forest. D: ST. V: *Joffroy* 112 (LISC).**BELONOPHORA** Hook.f.[†]**coffeoides** Hook.f. subsp. **coffeoides**

H: tree. D: ST.

BERTIERA Aubl.[†]**pedicellata** (Hiern) WernhamH: shrub, in forest. D: ST. V: *Matos* 7344 (BRLU, LISC).**racemosa** (G.Don) K.Schum. var. **elephantina** N.Hallé (*Café-d'obô*)H: tree or shrub, in forest. M: 94; 124; 165. D: STP. V: *Figueiredo* 65 (K, LISC); *Paiva* 1887, 1914 (COI).**racemosa** (G.Don) K.Schum. var. **racemosa** (*Viro-branco*)H: tree or shrub, in forest. D: STP. V: *Matos* 7274 (LISC), 7763 (LISC).**CHASSALIA** Poir.[†]**doniana** (Benth.) G.TaylorH: shrub, in forest. D: ST. V: *Paiva* 912 (COI).[†]**euchlora** (K.Schum.) FigueiredoH: epiphyte, in forest. D: ST. V: *Oliveira s.n.* (LISC).[†]**hiernii** (Kuntze) G.Taylor var. **glandulosa** G.Taylor

H: shrub, in forest. D: P.

[†]**hiernii** (Kuntze) G.Taylor var. **hiernii**H: shrub, in forest. D: P. V: *Paiva* 592 (COI).^{*}**CINCHONA** L. (*Pau-quina*, *Pó-quina*, *Quina*, *Quineira*)

Note: several species have been recorded as introduced.

^{*}**carabayensis** Wedd.*hasskarliana* Miq.H: shrub, in secondary forest. M: 22; 103; 123; 126; 173. D: STP. V: *Madureira* & *Martins* 132 (COI).^{*}**ledgeriana** (Howard) Bern. Moens ex TrimenH: shrub, in secondary forest. D: ST. V: *Matos* 7377 (BRLU, LISC).^{*}**pubescens** Vahl*succirubra* Pav.H: shrub, in secondary forest. M: 22; 103; 123; 126; 173. D: STP. V: *Madureira* & *Martins* 25 (COI).^{*}**COFFEA** L. (*Café*, *Cafeiro*, *Cafézeiro*)Note: also recorded as cultivated: **C. canephora** Pierre ex A.Froehner (*Café-robusta*), **C. racemosa** Lour. (*Café-de-Inhambane*, *Café-Inhambane*)^{*}**arabica** L. (*Café-arábia*, *Café-arábica*)H: shrub or tree, in secondary forest. M: 27; 52; 55; 61; 64; 79; 81; 102; 150; 164; 173. D: STP. V: *Paiva* 901 (COI).^{*}**liberica** W.Bull ex Hiern (*Café-da-Libéria*, *Café-excelsa*, *Café-excelsior*, *Café-Libéria*)H: shrub or tree, in secondary forest. D: STP. V: *Paiva* 560 (COI).^{*}**stenophylla** G.Don

H: shrub or tree, in secondary forest. D: ST.

CORYNANTHE Welw.^{*}**paniculata** Welw. (*Angue-d'obô*)H: tree, in secondary forest. M: 56; 124. D: ST. V: *Madureira* & *Martins* 663 (COI).**CRATERISPERMUM** Benth.**montanum** Hiern (*Macamblalá*, *Macambrará*)H: tree, in forest. M: 22; 50; 99; 102; 109; 126; 134; 144. D: STP. V: *Madureira* & *Martins* 408 (COI).**DIODIA** L.**serrulata** (P.Beauv.) G.TaylorH: herb, on roadsides and in villages, palm plantations, littoral. D: STP. V: *Matos* 7731 (LISC).**ECPOMA** K.Schum.[†]**cauliflora** (Hiern) N.HalléH: shrub, in forest. D: STP. V: *Joffroy* 207 (BRLU, LISC); *Stévert* 68 (BRLU, LISC).**gigantistipula** (K.Schum.) N.HalléH: shrub, in forest. D: P. V: *Oliveira* 165/98 (LISC).**GAERTNERA** Lam.**paniculata** Benth.H: shrub or tree, in forest. D: P. V: *Oliveira* 157/98 (LISC).**GEOPHILA** D.Don**afzelii** HiernH: herb, in forest, on roadsides. D: P. V: *Paiva* 551 (COI).

GEOPHILA D.Don (cont.)**repens** (L.) I.M.Johnst. (*Olhá-dátô*)

H: herb, in forest, on roadsides. M: 30; 48. D: STP. V: *Matos 7751* (LISC); *Paiva 1364* (COI).

HEINSIA DC.**crinita** (Afzel.) G.Taylor

H: shrub or tree. D: P.

HYMENOCOLEUS Robbr.**neurodictyon** (K.Schum.) Robbr.

H: herb, in forest. D: P.

HYMENODICTYON Wall.**biafranum** Hiern

H: shrub or tree, in forest, lava flows, crater swamp, on stream banks. D: STP. V: *Matos 7508* (LISC); *Stévert 256* (LISC).

IXORA** L.coccinea** L.

H: shrub with red flowers. O. D: ST.

LASIANTHUS Jack**^Eafricanus** Hiern

H: shrub, in forest. D: STP. V: *Joffroy 196* (BRLU, LISC); *Matos 7532* (LISC).

MORINDA L.**lucida** Benth. (*Glicô, Gligô, Grigô, Guico, Guigo, Moindo*)

H: tree or shrub, in forest and plantations. M: 33; 51; 52; 56; 57; 112; 126; 151; 163. D: STP. V: *Paiva 1199* (COI), *1882* (COI).

MUSSAENDA L.**^Etenuiflora** Benth. var. **principensis** G.Taylor

H: woody climber, in forest. D: P.

^Etenuiflora Benth. var. **thomensis** G.Taylor

H: woody climber or liana, in forest. D: ST. V: *Figueiredo 43* (LISC).

OLDENLANDIA L.**corymbosa** L.

H: herb, on roadsides, in plantations. D: STP.

herbacea (L.) Roxb.

H: herb, ruderal. D: ST. V: *Oliveira 505* (LISC).

lancifolia (Schumach.) DC.

H: herb, in wet areas in forest, on roadsides, in plantations. D: ST. V: *Matos 7733* (LISC); *Paiva 1353* (COI).

OTOMERIA Benth.**cameronica** (Bremek.) Hepper

H: herb, in forest. D: P.

OXYANTHUS DC.**speciosus** DC. (*Borracha-do-mato, Café-d'ôbo, Café-do-mato, Clícotô-d'obô, Clocoto-d'obô, Gligô-d'ôbô, Mule-mule, Nonô, Pau-louro*)

H: shrub or small tree, in forest. M: 40; 94. D: STP. V: *Oliveira 209/98* (LISC); *Paiva 1357* (COI).

PAURIDIANTHA Hook.f.**^Ecamposii** (G.Taylor) N.Hallé

H: unknown. D: ST.

floribunda (K.Schum. & K.Krause) Bremek. (*Nicolau, Pau-caixão, Pau-nicolau, Pó-luculá*)

H: tree or shrub, in forest. M: 13; 126; 173. D: STP. V: *Figueiredo 70* (K, LISC).

^Einsularis (Hiern) Bremek.

H: small tree, in forest. D: ST. V: *Matos 7567* (LISC).

rubens (Benth.) Bremek.

H: shrub, in forest or lava flows. D: ST.

PAVETTA L.**monticola** Hiern (*Língua-de-boi*)

H: shrub or tree, in forest. D: ST. V: *Paiva 885* (COI).

PENTAS Benth.**schimperiana** (A.Rich.) Vatke subsp. **occidentalis** (Hook.f.) Verdc.

H: shrub or woody herb, in forest. D: ST. V: *Matos 7367* (LISC).

PENTODON Hochst.**pentandrus** (Schumach. & Thonn.) Vatke

H: herb, in forest and on stream banks. D: ST. V: *Matos 7720* (LISC).

POUCHETIA A.Rich. ex DC.**sp.**; Figueiredo (2005: 100)

H: shrub or tree, in forest and on stream banks. D: STP. V: *Matos 7250* (LISC).

PSYCHOTRIA L.**^Eexellii** R.Alves, Figueiredo & A.P.Davis

H: small tree, in forest. D: ST.

^Egrumilea (Kuntze) E.M.A.Petit

H: shrub or tree, in forest. D: ST. V: *Matos 7502* (BRLU, LISC).

^Eguerkeana K.Schum.

H: shrub or tree, in forest. D: ST. V: *Matos 7557* (BRLU, LISC).

lucens Hiern var. **lucens**

H: shrub or tree, in forest. D: ST. V: *Matos 7483* (BRLU, LISC).

^Emolleri K.Schum. (*Pau-duno*)

H: shrub, in forest. D: ST. V: *Matos 7245* (BRLU, LISC).

^Enubicola G.Taylor

H: shrub or tree, in forest. D: ST. V: *Lejoly 94/563-B* (BRLU, LISC).

peduncularis (Salisb.) Steyer. (*Aio-d'obô, Alho-d'obô, Pó-clusso*)

H: shrub, in forest. M: 62; 98; 103; 124; 158; 174. D: STP. V: *Figueiredo 63* (K, LISC); *Paiva 1917* (COI).

^Eprincipensis G.Taylor (*Café-silvestre*)

H: shrub or tree, in forest. D: P. V: *Paiva 600* (COI).

spathacea (Hiern) Verdc. (*Aio-d'obô, Alho-d'obô, Café-do-mato, Pau-leite, Pó-clusso*)

H: shrub, in forest. M: 62; 71; 94; 98; 103; 124; 158; 174. D: ST. V: *Paiva 1190* (COI), *1919* (COI).

subobliqua Hiern (*Quaco-magueta*)

H: shrub or tree, in forest. M: 22; 131. D: STP. V: *Figueiredo 97* (K, LISC).

^Ethomensis G.Taylor

H: shrub or tree, in forest. D: ST. V: *Matos 7246-4* (BRLU, LISC).

venosa (Hiern) E.M.A.Petit (*Pó-água, Pó-áua*)

H: shrub or tree, in forest. M: 61; 68; 98; 103; 105; 124; 183. D: ST. V: *Madureira & Martins 496* (COI).

PSYDRAX Gaertn.**acutiflora** (Hiern) Bridson (*Códô d'áua, Corda-d'água, Gligô-d'obô*)

H: scandent shrub or climber, in forest. M: 53; 99; 122; 124; 146; 178. D: ST. V: *Madureira & Martins 495* (COI).

parviflora (Afzel.) Bridson

H: tree, in forest. D: ST.

subcordata (DC.) Bridson var. **subcordata** (*Clá-clá, Fiá-nónó, Nonô, Pau-formiga, Pó-flóminga*)

H: myrmecophilous tree with horizontal branches at top, in forest. M: 52; 124; 150. D: ST. V: *Paiva 1053* (COI).

sp. A; Figueiredo (2005: 103)

H: small tree, in forest. D: P.

sp. B; Figueiredo (2005: 103)

H: scandent shrub, in forest. D: P. V: *Matos 7758A* (LISC).

ROTHMANNIA Thunb.**urciliiformis** (Hiern) Robyns (*Mucumba, Teia-teia, Teia-teia-machado*)

H: shrub or small tree, in forest. D: ST. V: *Oliveira 629* (LISC).

RUTIDEA DC.**smithii** Hiern (*Grigo-d'obô*)

H: climber, in forest. D: ST. V: *Lejoly 97/304* (LISC).

RYTIGYNIA Blume**rubra** Robyns

H: shrub, in forest. D: ST. V: *Figueiredo 107* (K).

umbellulata (Hiern) Robyns

H: shrub or small tree, in forest. D: STP. V: *Figueiredo 82* (K, LISC).

SABICEA Aubl.**^Eexellii** G.Taylor

H: in forest, on stream banks. D: ST. V: *Joffroy 146* (BRLU, LISC).

^Eingrata K.Schum. var. **ingrata**

H: woody climber in forest, on stream banks, on roadsides. D: ST. V: *Figueiredo 50* (K, LISC).

ingrata K.Schum. var. **insularis** (Wernham) Joffroy

H: woody climber, in forest. D: ST. V: *Figueiredo 239* (LISC).

thomensis Joffroy

H: woody climber, in forest. D: ST. V: *Lejoly 97/330* (BRLU, LISC).

SACOSPERMA G.Taylor**paniculatum** (Benth.) G.Taylor (*Glígô-d'obô*)

H: woody climber, in forest. M: 53; 99; 122; 124; 146; 178. D: STP. V: *Madureira & Martins 292* (COI).

SPERMACOCE L.**exilis** (L.O.Williams) C.Adams ex W.C.Burger & C.M.TaylorH: herb, in secondary forest, on roadsides and in villages. D: STP. V: *Matos* 7695 (LISC).***verticillata** L. (*Fia-quêsá*, *Fia-quêsá-homem*, *Fiá-quêsá-homé*, *Quezá-homem*)H: herb, on roadsides, in cultivated lands, secondary forest, ruderal. M: 5; 82; 117. D: ST. V: *Paiva* 845 (COI).**TARENNA** Gaertn.**eketensis** Wernham var. **eketensis**H: climber, in forest. D: ST. V: *Figueiredo* 240 (LISC).**[†]nitiduloides** G.TaylorH: shrub or small tree, in forest. D: STP. V: *Matos* 7547 (LISC).**principensis** DegreefH: shrub or small tree, in forest. D: P. V: *Oliveira* 578 (LISC).**TRICHOSTACHYS** Hook.f.**aurea** HiernH: shrub, in forest. D: P. V: *Paiva* 552 (COI).**UNCARIA** Schreb.**africana** G.DonH: climber, in forest, on stream banks. D: ST. V: *Joffroy* 137 (LISC).

RUTACEAE

CITRUS** L.Note: also recorded as cultivated: **Citrus reticulata** Blanco (*Tangilina*) and **C. sinensis** (L.) Osbeck (*Lanza-doce*, *Laranja*).aurantifolia** (Christm.) Swingle (*Laranjeira-silvestre*)H: shrub or tree with white flowers. E: fruits. D: P. V: *Paiva* 627 (COI).***aurantium** L. (*Lanza-azêda*, *Lanza-d'obô*, *Lanza-mato*, *Laranjeira-brava*, *Laranjeira-das-florestas*)H: tree with white flowers. E: fruits. M: 81; 101; 174. D: ST. V: *Madureira & Martins* 212 (COI).***limon** (L.) Burm.f. (*Limom-blabo*)H: shrub or tree with white flowers. M: 79; 136; 146. E: fruits. D: ST. V: *Paiva* 739 (COI).**?*maxima** (Burm.) Merr.*grandis* (L.) Osb.

N: recorded by Exell (1973) based on Silva (1958) without specimen citation.

?*nobilis Lour.

N: recorded by Exell (1944) based on a citation by Moller; no specimens known.

CLAUSENA Burm.f.**anisata** (Willd.) Hook.f. ex Benth. (*Catchina-guessa*)

H: shrub or small tree with white flowers. D: ST.

GLYCOSMIS Corrêa**africana** Hook.f. ex Benth.D: ST. N: not listed in Tropicos (2009) nor AFPD (2009) databases. The type is a collection by Don (*s.n.*, K) from S.Tomé. The material is too poor to be determined (Exell 1944).***RUTA** L.***chalepensis** L. (*Arruda*, *Lurda*)H: perennial herb, in plantations. E: leaves (condiment). D: ST. V: *Oliveira* 202 (BRLU).**ZANTHOXYLUM** L.**gillettii** (De Wild.) P.G.Waterman (*Mampiam*, *Marapião*)*Fagara macrophylla* Engl.H: tree with thorns, in forest. D: STP. V: *Paiva* 792 (COI).**rubescens** Hook.f. (*Malapião*, *Mampiã*, *Marapião*)*Fagara rubescens* (Hook.f.) Engl.H: tree, in forest. M: 14; 21; 22; 27; 33; 80; 99; 126; 150; 173. D: STP. V: *Madureira & Martins* 172 (COI), 454 (COI).**thomense** (Engl.) A.Chev. ex P.G.Waterman (*Malapião*, *Mampiã*, *Marapião*)*Fagara thomensis* Engl.H: habit unknown. M: 14; 21; 22; 27; 33; 80; 99; 126; 150; 173. D: ST. V: *Madureira & Martins* 508 (COI).

SAPINDACEAE

ALLOPHYLUS L.**africanus** P.Beauv. (*Chelala-chelala*, *Fia-pô-tlêche*, *Fia-tlêche*, *Folha-três*, *Pau-três*, *Pau-vala*, *Pó-tlêche*, *Selá-selá*)H: shrub or tree with white flowers, in forest. M: 3; 19; 22; 57; 124; 170; 187. D: STP. V: *Madureira & Martins* 429 (COI).**grandifolius** (Baker) Radlk. (*Pau-três*, *Pó-tlêche*, *Pó-tlêche-d'obô*)H: shrub or small tree, in forest. M: 3; 19; 22; 57; 124; 170. D: STP. V: *Matos* 7335 (LISC).**BLIGHIA** K.D.Koenig**sapida** K.D.Koenig

H: tree with whitish flowers. E: fruits (yellow aril). D: STP.

CARDIOSPERMUM L.**halicacabum** L.

H: climber. D: ST.

CHYTRANTHUS Hook.f.**[†]mannii** Hook.f. (fruit: *Pecego*, *Péssuco*, *Péssugo*; tree: *Pecegueiro*, *Pecegueiro-de-S.Tomé*, *Pessegueiro-de-São-Tomé*)H: shrub or small tree, in forest. E: fruits. M: 22; 53; 61; 67; 78; 81; 124; 173. D: STP. V: *Matos* 7685 (LISC).***PAULLINIA** L.***pinnata** L. (*Códó-qué*, *Corda-qué*, *Corocô*, *Quoroqué*)H: climber with white flowers. M: 13; 22; 67; 124; 134; 170. D: STP. V: *Paiva* 1163 (COI), 1886 (COI).

SAPOTACEAE

CHRYSOPHYLLUM L.**africanum** A.DC. (*Cola-do-obô*, *Umtuem*, *Untué-d'obô*)*delevoyi* De Wild.H: tree with creamy white flowers, in forest. M: 61; 83. D: ST. V: *Madureira & Martins* 665 (COI).**albidum** G.Don (*Untué*, *Untué-do-ôbô*, *Untuen*)H: tree, in forest, secondary forest and plantations. M: 61; 124; 173; 187. D: STP. V: *Madureira & Martins* 664 (COI).**[†]calophyllum** Exell

H: shrub with greenish white flowers, in forest. D: P.

[†]henriquesii Engl.

H: habit unknown. D: P.

MANILKARA Adans.**obovata** (Sabine & G.Don) J.H.Hemsl. (*Azeitona*, *Pau-azeitona*, *Pó-zetona*, *Zetona*)*multinervis* (Baker) DubardH: shrub or tree, near watercourses. M: 124. D: STP. V: *Oliveira* 16/98 (BRLU); *Pagué* 25 (COI).***zapota** (L.) P.Royen (*Sapotilha*)H: shrub with white flowers. D: ST. V: *Oliveira* 877 (BRLU).**SYNSEPALUM** A.DC.**revolutum** (Baker) T.D.Penn. (*Pau-azeitona*, *Zetona*)*Vincentella densiflora* (Baker) Pierre

H: tree, in forest. D: ST.

SCROPHULARIACEAE

ALECTRA Thunb.**sessiflora** (Vahl) Kuntze var. **monticola** (Engl.) Melch.H: parasite annual herb. D: P. V: *Stévert* 250 (BRLU).**LINDERNIA** All.**diffusa** (L.) Wettst.H: herb with whitish flowers in secondary forest. D: STP. V: *Paiva* 993 (COI).***RUSSELIA** Jacq.***equisetiformis** Schltldl. & Cham.

H: shrub with red flowers. O. D: STP.

SCOPARIA** L.dulcis** L. (*Mazenem*, *Quézá*)H: shrubby herb with white flowers, ruderal. M: 5; 110; 170. D: STP. V: *Madureira & Martins* 305 (COI).

THUNBERGIANTHUS Engl.**^Equintasii** Engl. (*Musa-fria*)H: climber with white flowers, in forest and secondary forest. D: ST. V: *Matos 7456* (LISC).**TORENIA** L.**thouarsii** (Cham. & Schltdl.) Kuntze

H: annual creeping herb rooting at nodes with flowers blue or white. D: STP.

SCYTOPETALACEAE

SCYTOPETALUM Pierre ex Engl.**klaineaeum** Pierre ex Engl. (*Pó-capitango*, *Vilo-blanco*, *Viro-branco*) *kamerunianum* Engl.H: tree, in forest. M: 22. D: ST. V: *Madureira & Martins 419* (COI).

*SIMAROUBACEAE

*QUASSIA L.

***amara** L.

N: recorded by Exell (1973) based on Silva (1958) without specimen citation.

SOLANACEAE

*BROWALLIA L.

***americana** L. (*Coidano*)*viscosa* KunthH: herb with purple or blue flowers, in secondary forest and plantations. O. D: ST. V: *Figueiredo 111* (K).

*BRUGMANSIA Pers.

* × **candida** Pers.*Datura candida* (Pers.) Saff.H: shrub or small tree with white flowers. M: 27; 164. O. D: ST. V: *Paiva 1280* (COI).

*BRUNFELSIA L.

***uniflora** (Pohl) D. Don (*Manacá*)

H: shrub with white and purple flowers. O. D: ST.

*CAPSICUM L.

***annuum** L. (*Maglita*)

H: perennial herb. E: fruits (spice). D: ST.

***frutescens** L. (*Jindungo*, *Maglita*, *Maguita-tuá-tuá*, *Malagrita*, *Malagueta-tuatuá*, *Picante*, *Pimenta*, *Piripiri*)H: perennial herb or shrub, ruderal. E: fruits (spice). M: 22; 51; 89; 102; 158; 173. D: STP. V: *Figueiredo 108* (K); *Paiva 529* (COI).

*CESTRUM L.

***laevigatum** Schltdl. (*Coedano*, *Cuedano*, *Pau-febre*, *Pau-fede*)H: shrub or tree. M: 79; 98; 103; 112; 123; 128; 153; 158;. D: STP. V: *Figueiredo 44* (K).

*CYPHOMANDRA Mart.

***betacea** (Cav.) Sendtn. (*Tomate-do-mato*)H: tree. E: fruits. M: 188. D: ST. V: *Madureira & Martins 472* (COI).

*DATURA L.

***metel** L. (*Fia-fitiço*, *Fia-plêto*, *Folha-feitiço*, *Folha-preta*)*fastuosa* L.H: annual herb or undershrub with white flowers, ruderal. M: 5; 27; 35; 39; 56; 87; 124; 150; 167. D: ST. V: *Paiva 1295* (COI).? ***stramonium** L. (*Figueira-do-inferno*)

H: herb with white or purple flowers. M: 139. D: ST? N: recorded by Roseira (1984); no specimens known.

*LYCOPERSICON Mill.

***esculentum** Mill. (*Tomate*)*Solanum lycopersicon* L.H: herb. E: fruits. M: 15; 148. D: STP. V: *Madureira & Martins 666* (COI).

*NICANDRA Adans.

***physalodes** (L.) Gaertn. (*Pupupléila*)H: herb or shrub. D: STP. V: *Paiva 31* (COI).

*NICOTIANA L.

***tabacum** L. (*Tabaco*)H: perennial herb. M: 150; 158. D: ST. V: *Oliveira 218* (BRLU).

*PHYSALIS L.

angulata** L.H: annual herb. D: STP. V: *Oliveira 536* (BRLU).peruviana** L. (*Carapucha*)H: perennial herb or shrub. E: fruits. D: ST. V: *Paiva 1028* (COI).

SOLANUM L.

aculeatissimum** Jacq.H: spiny undershrub with white flowers. D: STP. V: *Lejoly 97/280* (BRLU).aethiopicum** L. (*Batuitui*)*gilo* RaddiH: perennial herb. E: fruits. M: 112; 154; 165. D: ST. V: *Madureira & Martins 340* (COI).***americanum** Mill. (*Dumbú*, *Lossua*)H: annual herb. E: leaves. D: ST. V: *Lejoly 95/077* (BRLU, LISC).**anguivi** Lam.*indicum* sensu auct. non L.

H: shrub. D: ST.

dasyphyllum Schumach. & Thonn.

H: undershrub. D: P.

macrocarpon L. (*Maquequé*, *Maquêquê*)H: undershrub or shrub. E: leaves, fruits. M: 31; 60; 89; 100; 146; 170; 182. D: ST. V: *Paiva 1044* (COI).***melongena** L. (*Beringela-roxa*, *Binzela*)H: perennial herb. E: fruits. M: 73; 112; 142; 162; 170; 174; 188. D: ST. V: *Madureira & Martins 667* (COI).**nigrum** L. (*Lossua*, *Lussua*, *Olossua*)H: annual herb or undershrub, ruderal. M: 60; 185. D: STP. V: *Paiva 1387* (COI).**terminale** Forssk.H: shrub or climber, in secondary forest and on roadsides. D: ST. V: *Joffroy 12* (BRLU).***tuberosum** L. (*Batata*)

H: perennial herb. E: tubers. D: ST.

***wrightii** Benth.H: tree with blue and white flowers. D: ST. V: *Figueiredo 177* (LISC).

STERCULIACEAE

COLA Schott & Endl.**acuminata** (P. Beauv.) Schott & Endl. (*Cola*, *Cola-congo*, *Coleira*, *Pau-cola*, *Pau-de-cola*, *Pó-di-cola*)H: shrub or tree. E: fruits (stimulant). M: 13; 42; 52; 57; 62; 74; 101; 135; 172; 177. D: STP. V: *Paiva 664* (COI).**digitata** Mast. (*Cola-congo*)H: shrub or tree. D: STP. V: *Joffroy 217* (BRLU); *Oliveira 1063* (BRLU).**sphaerocarpa** A. Chev.

H: habit unknown. D: ST. N: doubtful species described from fruits only (Exell 1944); no specimens known.

MELOCHIA L.**corchorifolia** L.

H: annual herb or perennial undershrub. D: ST.

STERCULIA L.**bequaertii** De Wild. (*Bungá*)H: tree. D: ST. V: *Figueiredo 232* (LISC).**tragacantha** Lindl. (*Néspera*, *Néspera-d'obó*, *Néspla-d'obó*, *Popó*)

H: shrub or tree. D: STP.

*THEOBROMA L.

***cacao** L. (*Cacau*, *Cacaueiro*, *Cacauzeiro*, *Cacueiro*)H: tree. E: fruits. M: 51; 94; 98; 173. D: STP. V: *Paiva 723* (COI).

STRYCHNACEAE

STRYCHNOS L.**sp.**H: shrub or small tree in forest. D: STP. V: *Oliveira 571* (BRLU), *145/98* (BRLU).

?TACCACEAE

?**TACCA** J.R.Forst. & G.Forst.

?**leontopetaloides** (L.) Kuntze

N: recorded by Exell (1944, 1973) based on literature citations; no specimens known.

THEACEAE

***CAMELLIA** L.

***japonica** L. (*Cameleira, Camélia*)

H: shrub or small tree. D: ST.

***sinensis** (L.) Kuntze (*Chá, Cházeiro, Pau-chá*)

H: shrub or small tree. D: ST.

MELCHIORA Kobuski

^E**mannii** (Oliv.) Kobuski

Balthasaria mannii (Oliv.) Verdc.

H: small tree, in primary forest. D: ST. N: not collected since 1956.

THYMELAEACEAE

DICRANOLEPIS Planch.

^E**thomensis** Engl. & Gilg

H: shrub with white flowers, in forest. D: STP. V: *Matos* 7679 (LISC).

PEDDIEA Harv.

^E**thomensis** Exell

H: shrub or small tree with white flowers in forest. D: STP. N: was considered a synonym of *P. africana* Hook. by Breteler (1994). V: *Joffroy* 223 (BRLU); *Matos* 7566 (LISC).

TILIACEAE

CORCHORUS L.

aestuans L.

H: annual or perennial herb. E: leaves. D: ST.

olitorius L.

H: annual herb. E: leaves. D: ST.

GREWIA L.

carpinifolia Juss.

H: shrub or small tree with yellow flowers. D: ST. V: *Figueiredo* 248 (LISC).

floribunda Mast.

H: shrub or liana. D: ST.

malacocarpa Mast.

H: climbing shrub or liana. D: ST.

TRIUMFETTA L.

rhomboidea Jacq.

H: perennial herb or undershrub. D: ST. V: *Paiva* 169 (COI).

TRIURIDACEAE

(Daniel 2010)

SCIAPHILA Blume

ledermannii Engl.

H: perennial herb. D: P.

ULMACEAE

CELTIS L.

gompophylla Baker (*Cheque-cheque, Pau-féde, Pó-fédé*)

H: tree. D: ST.

mildbraedii Engl. (*Capitango, Capitão, Gromotu, Pau-capitão, Pó-capitom*)

H: tree, in forest. D: ST. V: *Lejoly* 97/345 (BRLU).

philippensis Blanco (*Quaco-branco*)

prantlii sensu auct. non Priemer ex Engl.

H: shrub or tree, in secondary forest. D: STP. V: *Oliveira* 17/98 (BRLU).

TREMA Lour.

orientalis (L.) Blume (*Cabra, Cheque-cheque, Pau-cabra, Pau-parteira, Pó-cabra, Pó-parteira, Pó-pátela*)

H: shrub or tree. M: 61; 95. D: STP. V: *Madureira & Martins* 239 (COI).

URTICACEAE

BOEHMERIA Jacq.

macrophylla Hornem.

platyphylla Ham. ex D.Don

H: shrub. D: ST. V: *Figueiredo* 176 (LISC).

***nivea** (L.) Gaudich. (*Rami*)

H: perennial herb. D: ST. V: *Matos* 7667 (LISC).

ELATOSTEMA J.R.Forst. & G.Forst.

paivaeanum Wedd.

H: annual or perennial herb. D: P. V: *Joffroy* 224 (BRLU).

^E**thomense** Henriq.

H: herb, in forest, near watercourses. D: ST. V: *Figueiredo* 217 (LISC).

welwitschii Engl.

H: herb, in forest. D: ST. V: *Figueiredo* 216 (LISC).

LAPORTEA Gaudich.

aestuans (L.) Chew (*Fiá-flaquesa, Fiá-lévè*)

H: annual herb. M: 82. D: STP. V: *Paiva* 858 (COI).

ovalifolia (Schumach. & Thonn.) Chew

H: rhizomatous or stoloniferous herb. D: ST. V: *Figueiredo* 233 (LISC).

***PHENAX** Wedd.

***sonneratii** (Poir.) Wedd.

H: herb, ruderal. D: ST. V: *Figueiredo* 36 (K).

PILEA Lindl.

^E**manniana** Wedd.

H: herb, in forest. D: STP. V: *Joffroy* 208 (BRLU); *Matos* 7360 (LISC).

***microphylla** (L.) Liebm.

H: annual herb. D: ST. V: *Lejoly* 97/283 (LISC).

rivularis Wedd.

H: annual herb, in forest. D: ST. V: *Matos* 7525 (LISC).

POUZOLZIA Gaudich.

guineensis Benth.

H: annual or perennial herb. D: ST.

PROCRIS Comm. ex Juss.

crenata C.B.Rob.

H: perennial herb with succulent stems. D: STP. V: *Oliveira* 176/98 (BRLU), 891 (BRLU).

URERA Gaudich.

mannii (Wedd.) Benth. & Hook.f. ex Rendle (*Lutchiga, Urtiga*)

H: liana, climbing shrub or tree, in forest. M: 27; 31; 99. D: STP. V: *Madureira & Martins* 213 (COI).

trinervis (Hochst.) Friis & Immelman (*Lutchica, Urtiga*)

cameroonensis Wedd.

H: liana or climbing shrub, in forest. D: ST. V: *Joffroy* 76 (BRLU).

VERBENACEAE

CLERODENDRUM L.

***chinense** (Osbeck) Mabb.

japonicum sensu auct. non (Thunb.) Sweet

H: shrub. D: ST. V: *Matos* 7258 (LISC).

dusenii Gürke

H: shrub with white flowers. D: ST. V: *Oliveira* 965 (BRLU).

silvanum Henriq.

H: scrambling shrub or liana, with white flowers. D: STP. V: *Matos* 7445 (LISC).

***speciosissimum** C.Morren

H: shrub with red flowers. D: ST. V: *Lejoly* 97/291 (BRLU).

thomsoniae Balf.

H: liana with white and red flowers. D: ST. V: *Paiva* 352 (COI).

volubile P.Beauv.

H: climbing shrub. D: P.

***DURANTA** L.

***erecta** L.

repens L.

H: shrub. O. D: ST. V: *Oliveira* 988 (BRLU).

LANTANA L.**camara** L. (*Lantana, Micóco-campo*)H: shrub, ruderal. O. M: 52; 99; 172; 183. D: ST. V: *Paiva 1146* (COI).**PREMNA L.****angolensis** Gürke (*Pau-ama, Pó-ama*)H: tree or climbing shrub, with white flowers. M: 79; 95; 107; 123. D: ST. V: *Oliveira 125* (BRLU).***PRIVA Adans.*****lappulacea** (L.) Pers.H: perennial herb with violet flowers, ruderal. D: ST. V: *Matos 7632* (LISC).***TECTONA L.f.*****grandis** L.f. (*Teca*)H: tree with large leaves. D: ST. V: *Paiva 829* (COI).

VIOLACEAE

RINOREA Aubl.**angustifolia** (Thouars) Baill. (*Soá-soá*)

H: shrub. D: ST.

^Echevalieri ExellH: shrub, in lowland forest. D: ST. V: *Figueiredo 88* (K).**^Einsularis** Engl.H: shrub with yellow flowers, in forest. D: P. V: *Paiva 618* (COI).**^Ethomensis** Exell (*Tesse*)

H: shrub or tree, in forest. D: ST.

VISCACEAE

VISCUM L.**triflorum** DC.H: parasitic shrub, in forest. D: ST. V: *Oliveira 628* (BRLU).

VITACEAE

CAYRATIA Juss.**debilis** (Baker) Suess. (*Mússua-de-obô*)*Cissus debilis* (Baker) Planch.

H: climber. D: ST.

gracilis (Guill. & Perr.) Suess.H: climber. D: ST. V: *Paiva 1156* (COI).**CISSUS L.****aralioides** (Baker) Planch.

H: climber. D: ST.

barbeyana De Wild. & T.Durand

H: climber. D: STP.

oliveri (Engl.) Gilg

H: climber. D: ST.

producta Afzel.H: climber. D: ST. V: *Figueiredo 214* (LISC).**sp. aff. petiolata** Hook.f.N: recorded by Exell (1944) based on *Quintas 1377*, which could be a new species.**CYPHOSTEMMA** (Planch.) Alston**^Ecurvipodum** (Baker) Desc.*Cissus curvipoda* (Baker) Planch.H: climber. D: ST. V: *Paiva 1174* (COI).***VITIS L.*****vinifera** L. (*Videira*)

H: climber. E: fruits. D: ST.

ZINGIBERACEAE

AFRAMOMUM K.Schum.**daniellii** (Hook.f.) K.Schum. (*Orsame, Órsamo, Ossame, Ossame-d'ôbô, Óssami, Óssamo*)H: herb up to 3 m high, with red and yellow flowers. E: fruit (spice). M: 79; 97. D: STP. V: *Figueiredo 68* (K); *Paiva 536, 1912* (COI).**melegueta** (Roscoe) K.Schum.

H: rhizomatous herb up to 1.5 m high, with pink flowers. M: 57; 146. D: STP.

?*ALPINIA Roxb.**?*zerumbet** (Pers.) B.L.Burt & R.M.Sm.*Zerumbet speciosum* J.C.Wendl.

N: recorded by Silva (1958); no specimens known.

COSTUS L.**afer** Ker Gawl. (*Fia-ipqueté, Úcuêê, Úcuêê-d'áua, Úcuêê-d'obô*)H: perennial herb up to 3 m high, flowers white and yellow with red. M: 51; 124. D: STP. V: *Paiva 982* (COI).**giganteus** Welw. ex Ridl. (*Bordão-de-macaco, Cana-doce-dos-macacos, Pau-macaco, Ucoete, Úcuêê*)H: perennial herb up to 3 m high, flowers yellow with red. M: 95; 124; 176. D: STP. V: *Figueiredo 104* (K).**spectabilis** (Fenzl) K.Schum.H: herb with a rosette of ± 4 suborbicular fleshy leaves, flowers orange or yellow. D: ST.***CURCUMA L.*****longa** L. (*Açafrão-da-India*)*domestica* Valetton

H: perennial rhizomatous herb up to 1.5 m high. E: rhizome (spice). D: P.

?*ELETTARIA Maton**?*cardamomum** Maton*repens* sensu auct. Exell non (Sonn.) Baill.

N: recorded by Exell (1944, 1973) based on literature citations; no specimens known.

HEDYCHUM** J.Koenigcoronarium** J.Koenig

H: perennial herb up to 2 m high, with white flowers with a yellow-green centre. D: P.

NICOLAIA** Horan.elatiar** (Jack) Horan. (*Rosa-de-porcelana*)H: perennial herb, with red flowers. O. D: ST. V: *Paiva 268* (COI).**RENEALMIA** L.f.**cinninata** (K.Schum.) Baker

H: herb up to 1.5 m high, with white flowers. D: P.

^Esancti-thomae I.M.Turner*grandiflora* BakerH: perennial herb with orange-red flowers. D: ST. V: *Figueiredo 98* (K).***ZINGIBER** Mill.***officinale** Roscoe (*Gemgimple, Gengibre, Gigimple*)

H: herb up to 1 m high. E: root (spice). D: STP.

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REFERENCES

- AFPD. 2009. African flowering plants database. <http://www.ville-ge.ch/musinfo/bd/cjb/africa/>
- ALVES, R., FIGUEIREDO, E. & DAVIS, A.P. 2005. Taxonomy and conservation of the genus *Psychotria* in S.Tomé and Príncipe (Gulf of Guinea). *Botanical Journal of the Linnean Society* 147: 469–481.
- BRETELIER, F. J. 1994. Novitates gabonenses (15). The genus *Peddiea* (Thymelaeaceae) present in Gabon. *Bulletin du Jardin Botanique Belgique* 63,3–4: 205–207.
- DANIEL, T.F. 2010. *Sciaphila ledermannii* (Triuridaceae), a biographically significant holosaprophyte newly reported from Príncipe in the Gulf of Guinea. *Proceedings of the California Academy of Sciences* 61: 617–622.
- DANIEL, T.F. & FIGUEIREDO, E. 2009. The California Academy of Sciences Gulf of Guinea Expeditions (2001, 2006, 2008) VII. Acanthaceae of São Tomé and Príncipe. *Proceedings of the California Academy of Sciences* 60: 623–674.
- EXELL, A.W. 1944. Catalogue of the vascular plants of S.Tomé (with Príncipe and Annobon). British Museum (Natural History), London.

- EXELL, A.W. 1956. *Supplement to the catalogue of the vascular plants of S.Tomé (with Príncipe and Annobon)*. British Museum (Natural History), London.
- EXELL, A.W. 1973. Angiosperms of the islands of the Gulf of Guinea (Fernando Po, Príncipe, S.Tomé and Annobon). *Bulletin of the British Museum (Natural History) Botany* 4, 8: 327–411.
- EXELL, A.W. & ROZEIRA, A. 1958. Aditamento à Flora das ilhas de São Tomé e Príncipe. *Conferência Internacional dos Africanistas Ocidentais* 3: 77–91.
- FIGUEIREDO, E. 1994a. Contributions towards a botanical literature for the islands of the Gulf of Guinea. *Fontqueria* 39: 1–8.
- FIGUEIREDO, E. 1994b. Diversity and endemism of angiosperms in the Gulf of Guinea islands. In J.E. Fa, & B.J. Juste, *Biodiversity conservation in the Gulf of Guinea Islands*. Special Issue of *Biodiversity and Conservation* 3,9: 785–793.
- FIGUEIREDO, E. 1998. Pteridophytes of São Tomé and Príncipe (Gulf of Guinea). *Bulletin of the Natural History Museum* 28,1: 41–66.
- FIGUEIREDO, E. 2000. Fern collecting in S.Tomé (Gulf of Guinea). *The Pteridologist* 3,5: 117–122.
- FIGUEIREDO, E. 2001. New findings of pteridophytes from the mountain rainforests of São Tomé and Príncipe. *Fern Gazette* 16,4: 191–193.
- FIGUEIREDO, E. 2002a. Pteridófitos de São Tomé e Príncipe. *Estudos, Ensaios e Documentos* 162: 1–209.
- FIGUEIREDO, E. 2002b. Nomes vulgares da flora de São Tomé e Príncipe. *Garcia de Orta, Sér. Bot.* 15,1: 109–139.
- FIGUEIREDO, E. 2005. The Rubiaceae of São Tomé and Príncipe: taxonomy and conservation. *Botanical Journal of the Linnean Society* 149: 85–114.
- FIGUEIREDO, E. & GASCOIGNE, A. 2001. Conservation of pteridophytes in São Tomé and Príncipe (Gulf of Guinea). *Biodiversity and Conservation* 10: 45–68.
- KLOPPER, R.R., CHATELAIN, C., BÄNNINGER, V., HABASHI, C., STEYN, H.M., DE WET, B.C., ARNOLD, T.H., GAUTIER, L., SMITH, G.F. & SPICHIGER, R. 2006. *Checklist of the flowering plants of sub-Saharan Africa*. Southern African Botanical Diversity Network Report No. 42. SABONET, Pretoria.
- MADUREIRA, M.C.T.M.B. 2006. *Etnofarmacologia e estudo de espécies com actividade biológica da flora de S.Tomé e Príncipe*: 1–483. Coimbra.
- MADUREIRA, M.C.T.M.B., PAIVA, J., FERNANDES, A.F., GONÇALVES, A., CATALÃO, C., FERNANDES, C., ATALAIA, J., VIEIRA, J., GASPAR, V., PONTES, S., GINO, S. & COSTA, S. 2007. *Estudo etnofarmacológico de plantas medicinais de S.Tomé e Príncipe*: 1–217. Lisboa.
- MARTINS, A.P.M.R., 2001. *Etnofarmacologia e óleos essenciais de plantas medicinais de S.Tomé e Príncipe*: 1–342. Coimbra.
- MEVE, U. & OMLOR, R. 2000. The identity of the African genus *Oncostemma* K.Schum. (Asclepiadaceae). *Botanical Journal of the Linnean Society* 133: 195–201.
- MONOD, T. 1960. Notes botaniques sur les îles de São Tomé et de Príncipe. *Bulletin de l'Institut Français de l'Afrique Noire*, ser. A, 22,1: 19–83.
- ROSEIRA, L.L. 1984. *Plantas úteis da flora de S.Tomé e Príncipe. Medicinais e industriais*: 1–100. Lisboa.
- ROZEIRA, A. 1958. Nomes populares de algumas plantas das ilhas de São Tomé e do Príncipe: origem e significado. *Conferência Internacional dos Africanistas Ocidentais* 6a sessão, 3: 169–173.
- SANTO, J.E. 1969. Nomes crioulos e vernáculos de algumas plantas de S.Tomé e Príncipe. *Boletim Cultural da Guiné Portuguesa* 24: 193–211.
- SANTO, J.E. 1970. Aditamento à flora de São Tomé. *Boletim Cultural da Guiné Portuguesa* 25: 489–511.
- SEQUEIRA, V. 1994. Medicinal plants and conservation in São Tomé. In J.E. Fa & B.J. Juste, *Biodiversity conservation in the Gulf of Guinea Islands*. Special issue of *Biodiversity and Conservation* 3,9: 910–926.
- SILVA, H.L. 1958. São Tomé e Príncipe e a cultura do café. *Memórias da Junta de Investigações do Ultramar* 1: 1–450.
- SILVA, H.L. 1959. Nomes vulgares de algumas plantas de São Tomé e Príncipe. *Garcia de Orta* 7,2: 293–323.
- STÉVART, T. & DE OLIVEIRA, F. 2001. *Guide des orchidées de São Tomé et Príncipe*: 1–258. In ECOFAC (ed.), cellule de coordination, Libreville, Gabon.
- STÉVART, T., GEERINCK, D. & LEJOLY, J. 2000. Liste des Orchidaceae de Sao-Tomé et Principe. *Acta Botanica Gallica* 147,2: 165–172.
- THIERS, B. [continuously updated]. Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>.
- TROPICOS 2009. Tropicos. Missouri Botanical Garden. <http://www.tropicos.org>.

APPENDIX—Medicinal properties or symptoms for which plants are used

- | | |
|------------------------------|----------------------------------|
| 1. Abdominal aches | 39. Burns |
| 2. Abdominal colic | 40. Calming |
| 3. Abdominal pain | 41. Carbuncles |
| 4. Abortive | 42. Cardiac diseases |
| 5. Abscess | 43. Carminative |
| 6. Against evil spells | 44. Cervical spinal column aches |
| 7. Against superstition | 45. Chickenpox |
| 8. Against witchcraft | 46. Children, fevers |
| 9. Air disinfectant | 47. Children, tonic |
| 10. Albumin | 48. Children, tooth problems |
| 11. Alcoholism | 49. Chronic bronchitis |
| 12. Allergies | 50. Chronic wounds |
| 13. Anaemia | 51. Cicatrizant |
| 14. Analgesic | 52. Cold |
| 15. Anthrax | 53. Colic |
| 16. Anti-abortion | 54. Constipation |
| 17. Anti-aphrodisiac | 55. Contraceptive |
| 18. Anti-diuretic | 56. Contusion |
| 19. Anti-emetic | 57. Cough |
| 20. Anti-helminthic | 58. Dental cavities |
| 21. Antiseptic | 59. Dermatology |
| 22. Aphrodisiac | 60. Diabetes |
| 23. Aphta | 61. Diarrhoea |
| 24. Appetite inducer | 62. Digestion |
| 25. Arterial hypertension | 63. Disinfectant |
| 26. Asthenia | 64. Diuretic |
| 27. Asthma | 65. Dizziness |
| 28. Backache | 66. Drunkenness |
| 29. Bellyache | 67. Dysentery |
| 30. Bladder inflammation | 68. Dysmenorrhoea |
| 31. Bleorrhagia | 69. Earache |
| 32. Blood pressure | 70. Eczema |
| 33. Body aches | 71. Elephantiasis |
| 34. Body relaxing (children) | 72. Emollient |
| 35. Boils | 73. Enteritis |
| 36. Breathing problems | 74. Eye decongestant |
| 37. Bronchitis | 75. Eye inflammation |
| 38. Bumps | 76. Failing eyesight |

77. Febrifuge
78. Female sterility
79. Fever
80. Flatulence
81. Flu
82. Fortifier
83. Fractures
84. Frigidity
85. Galactogen
86. Ganglia inflammation
87. Haematoma
88. Haemorrhage
89. Haemorrhoids
90. Haemostatic
91. Hair conditioner
92. Hair growth stimulant
93. Hair treatment
94. Headache
95. Helps births
96. Helps children start walking
97. Helps expel placenta
98. Hepatitis
99. Hernia
100. Hiccups
101. Hoarseness
102. Hypertensive
103. Hypotensive
104. Indigestion, indisposition
105. Inflammations
106. Inguinal hernia
107. Insect repellent
108. Insecticide
109. Internal contusion
110. Intestinal problems of nursing babies
111. Intestine infections
112. Intestine colic
113. Itching
114. Jaundice
115. Kidney aches
116. Kidney colic
117. Kidney stones
118. Laryngitis
119. Laxative
120. Laxative (post-birth)
121. Leprosy
122. Liver diseases
123. Malaria
124. Massage
125. Massage (fractured, disjointed bones)
126. Massage (fractures, sprains)
127. Massage (body aches)
128. Measles
129. Menstrual cramps
130. Mouth disinfectant
131. Mouth hygiene
132. Mouth inflammations
133. Nail infections
134. Pain
135. Parasites
136. Parasites (intestine)
137. Parasites (lice)
138. Perfume
139. Poison
140. Post-birth haemorrhage
141. Post-birth treatments
142. Prolapsed colon
143. Protection
144. Protection against drunkenness
145. Protection against poisons
146. Purgative
147. Purgative (for adults only)
148. Refreshing
149. Regulates menstruation
150. Rheumatism
151. River fevers
152. Rubefacient
153. Scabies
154. Sedative
155. Sight
156. Sinusitis
157. Skin allergies
158. Skin diseases
159. Skin rashes
160. Sleep inducer
161. Slimming
162. Spots
163. Sprains
164. Stimulant
165. Stomach ache
166. Stomachic
167. Swelling (oedema)
168. Syphilis
169. Teething
170. Testicular hernia
171. Throat ache
172. Tiredness
173. Tonic
174. Tonsils
175. Toothache
176. Traumatism
177. Tuberculosis
178. Tympanitis
179. Urinary infection
180. Urinary retention
181. Uterus infection
182. Vaginal muscle contraction after birth
183. Venereal diseases
184. Vermifuge
185. Vitamins
186. Vomit inducer (emetic)
187. Vomiting
188. Warts
189. Weakness
190. Whooping cough
191. Wounds

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Systematics of the southern African genus *Ixia* (Iridaceae). 3. Sections *Hyalis* and *Morphixia*

P. GOLDBLATT* and J.C. MANNING**•

Keywords: classification, Iridaceae, *Ixia* sections *Hyalis* and *Morphixia*, morphology, new species, pollination, southern Africa, taxonomy, winter rainfall zone

ABSTRACT

A revised classification is presented for *Ixia* L., a southern African genus restricted to the winter rainfall zone of the western part of the subcontinent, in which the four sections *Dichone* (Salisb. ex Baker) Goldblatt & J.C.Manning, *Hyalis* (Baker) Diels, *Ixia*, and *Morphixia* (Ker Gawl.) Pax are recognized and diagnosed. The circumscription of sect. *Hyalis* is emended to include both short- and long-tubed species, mostly with four or more leaves with the uppermost not sharply differentiated from the lower. This contrast with sect. *Morphixia*, also with short- and long-tubed species, in which the entirely sheathing uppermost leaf (rarely upper two leaves) is distinct from the lower two or rarely three leaves, which have well-developed blades. We revise these two sections, recognizing 18 species in sect. *Hyalis*, including the two new species, *I. linderi* and *I. recondita*, and recognizing 31 species in sect. *Morphixia*, including the 11 new species, *I. alata*, *I. cedarmontana*, *I. dolichosiphon*, *I. ecklonii*, *I. linearifolia*, *I. monticola* (previously included in *I. latifolia* var. *angustifolia*), *I. pavonia*, *I. parva* and *I. ramulosa* (raised from varietal rank as var. *parviflora* and var. *ramulosa* respectively of *I. latifolia*), *I. saundersiana* and *I. stenophylla* (previously *I. fucata* var. *filifolia*). We also provide a new name, *I. mollis* for the illegitimate homonym *I. flaccida*. Lastly, we transfer *I. purpureorosea* from sect. *Ixia* to sect. *Hyalis*. We recognize eight informal series, three in sect. *Hyalis* and five in sect. *Morphixia*. With these changes and additions the genus *Ixia* now comprises 78 species.

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INTRODUCTION

As circumscribed here, the southern African genus *Ixia* L. now comprises 78 species in the four sections *Dichone* (Salisb. ex Baker) Goldblatt & J.C.Manning, *Ixia*, *Hyalis* (Baker) Diels and *Morphixia* (Ker Gawl.) Pax. Sect. *Morphixia* has been the subject of taxonomic studies conducted over the past five years, resulting in the recognition of 11 new species and the reinstatement of one more (Goldblatt & Manning 2008a, b). In G.J. Lewis's (1962) monograph of *Ixia*, sects *Hyalis* and *Morphixia* included just 18 species. These, together with three species described before our study of the sections began (*I. pumilio*, *I. acaulis* and *I. aurea*), 13 new species described in this account, and the transfer of *I. purpureorosea* to sect. *Hyalis*, bring the total species of the two sections to 49. With the accounts of species of sects *Hyalis* and *Morphixia* scattered among several papers published from 1985 to 2008, it now seems useful to produce a summary account of these two sections.

We have also come to reconsider the infrageneric classification that we proposed in 1999 (Goldblatt & Manning 1999) and in which we recognized two subgenera: subgen. *Ixia* with sects *Dichone* and *Ixia*, and subgen. *Morphixia* with sects *Hyalis* and *Morphixia*. We present a revised infrageneric classification here, partly following Lewis (1962) in admitting four sections, *Dichone*, *Ixia*, *Hyalis* and *Morphixia*, but without division into subgenera. In this system the circumscription of sect. *Hyalis* is emended and no longer includes just long-tubed species.

Classification of *Ixia*

Relationships within *Ixia* are difficult to gauge and in the absence of molecular studies we depend on traditional methods of morphological and anatomical comparison. As is often the case, the understanding of broad relationships is reflected in classification systems. While

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we understand that morphology-based infrageneric classifications are provisional, they are always useful to some extent in grouping like species together. Lewis (1962) in her monograph of the genus recognized 44 species in two subgenera. Subgen. *Dichone* (Salisb. ex Baker) G.J.Lewis incorporated species that she transferred from *Tritonia* sect. *Dichone* and included nine species. The remaining 35 species constituted subgen. *Ixia*, in which Lewis recognized three sections: sect. *Ixia*, which included species of J.G. Baker's subgen. *Ixia* and *Eurydice* (Baker 1892, 1896); and sects *Hyalis* and *Morphixia*, which were virtually equivalent to Baker's subgen. *Hyalis* and *Morphixia*.

Lewis distinguished subgen. *Ixia* by the conduplicate, channelled style branches that are stigmatic in the distal part, combined with conventional linear to linear-oblong anthers with narrow thecae, both probably ancestral for Crocoideae and certainly for Ixieae Dumort. (1822) [the tribal name has priority over Croceae Dumort. (1829), the latter used by Goldblatt *et al.* 2006 in error]. In contrast, subgen. *Dichone* included species with involute style branches (thus cylindric and tubular) and consequently stigmatic only at the tips, and usually with what Lewis called subdidymous anthers, with short, broad thecae and a narrow connective. Whereas the style branches of her two subgenera are readily distinguished, the difference in the anthers is less obvious but nevertheless valid. Essentially, the anthers of *Dichone* have reduced, unusually short connectives, and in several species the anthers themselves are extremely short, thus broadly oblong to suborbicular.

Lewis's subdivision of subgen. *Ixia* into three sections reduced Baker's subgenera to sectional rank, not of course including subgen. *Eurydice* (which included only *I. monadelpha*). Lewis, thus reverted in part to the earlier classification of *Ixia* by Pax (1888) in the first edition of *Die natürlichen Pflanzenfamilien*, in which he subdivided *Ixia* (not then including subgen. *Dichone*) into sects *Ixia*, *Eurydice* and *Morphixia*. Bentham & Hooker's (1883) treatment of *Ixia*, however, appears to be the first to include an infrageneric classification of the genus. Not only did they reunite *Ixia* and *Morphixia* but categorically stated that they admit no sections, the distinctions among the species being too weak, although they recognized two series, *Ixia* (including sect. *Eurydice*) and *Morphixia* (the latter including the species of *Hyalis* as well).

Prior to 1883, *Ixia* had been reserved only for the species that we now consider members of Lewis's sect. *Ixia*. The remaining species (Lewis's *Hyalis* and *Morphixia*) had been segregated in the genus *Morphixia* by Ker Gawler (1827). Baker's subgen. *Hyalis* included long-tubed species now referred to four separate genera, *I. paniculata* and one species each of *Thereianthus* G.J.Lewis, *Tritonia* Ker Gawl. and *Tritoniopsis* L.Bolus. *Hyalis* as a genus (Salisbury 1812) was exactly equivalent to *Morphixia* (according to the species assigned to *Hyalis* by Salisbury), a fact noted by Bentham & Hooker, but is invalid in lacking a description. The name was subsequently validated by Baker but at subgeneric rank. Lewis (1962) effectively lectotypified sect. *Hyalis* by citing *I. paniculata* as the type and excluding from the genus the remaining species placed there by Baker.

Sect. (or subgen.) *Morphixia* included species with style branches and anthers of the subgen. *Ixia* type, but a short perianth tube, expanded distally (thus funnel-shaped), with decurrent filaments inserted at the junction of the narrow, lower part of the perianth tube with the wider, upper part. Sect. *Ixia* included species with a largely filiform tube (of the subgen. *Dichone* type), and filaments inserted at the top of the tube, not decurrent, and contiguous or even partly or fully united, thus occluding the mouth of the tube. The practical distinction is that the tube walls in the narrow part of the tube in sect. *Ixia* tightly sheath the style, effectively closing the tube, whereas in sect. *Morphixia*, the tube is hollow as the walls do not touch the style, and the tube contains nectar at the base. Nectar is rarely present in sect. *Ixia* and when it is, e.g. in *I. flexuosa*, it rises by capillary action to the mouth of the tube.

Lewis's remaining section, *Hyalis*, comprised species with an elongate and more or less cylindric or evenly flared perianth tube, usually exceeding 20 mm. We find her distinction between *Morphixia* (tube up to 20 mm long) and *Hyalis* (tube 20 mm long or longer) arbitrary, and Lewis herself noted that populations of *I. longituba* (sect. *Hyalis*) sometimes have a tube 15–18 mm long. We have encountered additional exceptions, notably in a plant allied to *I. paucifolia* which has a tubular perianth tube 15–18 mm long (22–34 mm in typical *I. pauciflora*). Moreover, sect. *Hyalis sensu* Lewis appears to us an artificial assemblage of species of two lineages: species allied to *I. paniculata* with an indeterminate number of leaves (at least four) and outer floral bracts with a single prominent vein and one prominent terminal tooth; and *I. pauciflora* and its allies, which always have with three leaves, two basal with well-developed blades and the upper leaf entirely sheathing, and outer floral bracts with three prominent veins and three subequal terminal teeth. These latter vegetative features exactly match most members of sect. *Morphixia*, including its type.

In our previous classification of the genus (Goldblatt & Manning 1999) we were influenced by the filiform nature of the perianth tube (the walls of which clasp the style) shared by sect. *Ixia* and subgen. *Dichone* to treat the two as sections of subgenus *Ixia*. The remaining species then fell in subgen. *Morphixia*. The latter, based on *Morphixia* Ker Gawl., is here lectotypified by *M. aulica* (Aiton) Ker Gawl. (now *I. latifolia*)—Lewis actually listed *I. latifolia* as the type, the current name for *M. aulica*, technically an error explained below. It is now clear that the development of the filiform perianth tube has occurred independently in several other genera of Crocoideae as part of pollination syndromes in which floral rewards have shifted from nectar to pollen (Goldblatt & Manning 2006). This floral morphology is therefore not necessarily an indicator of relationships.

During our examination of *Ixia* for this revision we have found that the supposed floral distinction between subgenera *Ixia* and *Morphixia* to be weak. Several species assigned to sect. or subgen. *Morphixia*, notably *I. odorata*, *I. orientalis* and *I. tenuifolia* have the lower part of the perianth tube $\pm$ filiform, and the shorter upper part expanded, and in practice they cannot be easily distinguished from *I. flexuosa* of subgen./sect. *Ixia*. The distinction between *I. flexuosa* and *I. orientalis* is especially

problematic, and rests on the insertion of the filaments and secondarily on the length of the perianth tube, a useful but not always reliable criterion. Both have scented, pink or white flowers, style branches dividing below or opposite the base of the anthers, and the upper part of the tube short and flared, and containing traces of sweet nectar. *Ixia purpureorosea*, included by Lewis in sect. *Ixia*, has a perianth tube like that of *I. tenuifolia*, filiform below but expanded in the upper third to quarter and containing nectar, and decurrent filaments: we transfer the species to sect. *Hyalis*.

A simple solution to this inconsistency would be to transfer species of *Morphixia* with a filiform perianth tube to subgen. *Ixia* but the difficulty associated with placing species in these two infrageneric taxa suggests that their subgeneric rank is not merited and that these two taxa are better treated as sections. Sect. or subgen. *Dichone*, however, remains easy to distinguish and although we prefer to regard the taxon as a section, we note its isolation in tribe Ixieae in both anther and style branch characters. *Dichone* does share with *Ixia* a basic chromosome number of $x = 10$ (*Tritonia*, in which *Dichone* was included by Baker, has $x = 11$), transparent to translucent floral bracts, usually the outer with three but sometimes just a single prominent vein and associated three-toothed or one-toothed apices, the inner bract with two prominent veins and two-toothed. Pollen grains examined to date (Goldblatt *et al.* 1991) also show that both subgenera *Dichone* and *Ixia* have a single-banded operculum, in contrast to the two-banded operculum in other genera of subfamily Crocoideae, which is the ancestral condition. Leaf anatomy of both taxa also shows leaf margins with undifferentiated epidermal cells and a subepidermal strand of sclerenchyma (De Vos 1982; Rudall & Goldblatt 1991), apparent reversals to the ancestral state for Crocoideae. As we noted above, however, the ancestral leaf margin condition for Crocoideae is a subepidermal strand of sclerenchyma associated with a marginal vein. The latter, not present in *Ixia*, renders the leaf margin condition in the genus unique in Ixieae but not in Crocoideae—*Melasphaerula* (Gladioleae) has anatomically similar leaf margins (Rudall 1995).

We propose the following infrageneric taxonomy in which we recognize four sections:

***Ixia* sect. *Dichone* (Salisb. ex Baker) Goldblatt & J.C. Manning** in *Bothalia* 29: 63 (1999).

Vegetatively identical to sect. *Ixia*, but flowers with a filiform perianth tube, the tube usually relatively short; anthers short, oblong to suborbicular, usually so-called subdidymous; style branches filiform-tubular and involute, thus stigmatic only at apices. The stamens are unilateral and reclinate in some species and the anthers are then horizontal to pendent; in a few species the anthers are incompletely dehiscent, opening from the base. Flowers are usually shades of pink (rarely white), but blue-mauve in *I. brevītuba*. The subgenus currently has 10 species (Lewis 1962; Goldblatt & Snijman 1985; Manning & Goldblatt 2006) but several more await formal publication. No infrasectional classification has been proposed.

Ixia* sect. *Ixia

Flowers with a filiform perianth tube, usually well developed and sometimes elongate; anthers linear, dehiscent along their entire length; style branches narrowly channelled (Lewis 1962, described the style branches as conduplicate, but they are not folded together, but rather form a narrow channel) and stigmatic along the margins, sometimes only toward the tips. The stamens are always symmetrically arranged with the filaments inserted at the base of the tepals and not decurrent. Leaf number is indeterminate, but usually at least four and up to 10. The upper leaves decrease in size progressively above, becoming partly to largely sheathing, but lack a sharp distinction between basal foliage and upper sheathing leaves. Flowers are usually unscented and often brightly coloured and frequently have a dark central mark, either restricted to the tepal bases or including the filaments and sometimes the anthers and style branches. Nineteen species are currently recognized.

***Ixia* sect. *Morphixia* (Ker Gawl.) Pax** in *Die natürlichen Pflanzenfamilien* 2,5: 154 (1888).

Perianth tube hollow; filaments inserted within the tube and decurrent, not connivent at the base. The style branches are usually fairly short and recurved, but of the same type as in sect. *Ixia*. Although usually central, the stamens are occasionally unilateral (a feature not known to Lewis): horizontal in *Ixia pauciflora*, declinate in *I. reclinata* and $\pm$ arcuate in *I. stenophylla*. The tepals are seldom brightly coloured, more often being muted shades of blue-grey, mauve pink, or white and only rarely with weakly developed markings. Floral scent is common and usually reminiscent of rose to violet but *I. rivulicola* has a rich floral scent with notes of passion fruit and sweet pea. Nectar is always present in the base of the perianth tube, sometimes in substantial quantities. An important feature of the section is that leaf number is determinate, usually three, occasionally more, and the basal leaves with expanded blades are sharply distinct from the uppermost one or two, which are entirely sheathing. We recognize thirty-one species in the section.

***Ixia* sect. *Hyalis* (Baker) Diels** in Engler & Prantl in *Die natürlichen Pflanzenfamilien*, edn 2, 15a: 486 (1930).

A residual group includes species with style and anthers of the sect. *Ixia* type; an indeterminate leaf number, the upper leaves weakly differentiated from the lower, and usually with free blades; and tubular or funnel-shaped perianth tube ranging from hollow throughout to filiform in the lower two thirds and expanded above (thus with decurrent filaments). Nectar is normally produced and the flowers are often scented (depending on the pollination system—those pollinated by long-proboscid flies are unscented). The outer bracts with usually only one prominent central vein are a feature of most species. The circumscription of sect. *Hyalis* adopted here thus differs from Lewis's in that it is not restricted to species with an elongate perianth tube although the type species, *Ixia paniculata*, has the longest tube in the genus. We recognize eighteen species here.

Within sects *Hyalis* and *Morphixia* we recognize eight informal clusters of species sharing one or more derived features, for convenience called series (Table 1). We believe that most of these are monophyletic but some may be paraphyletic. The species of sect. *Hyalis* are distributed among three separate series and those of sect. *Morphixia* among five.

TABLE 1.—Classification of sects *Hyalis* and *Morphixia* (total 49 *Ixia* species). New species are in bold type

1. Sect. <i>Hyalis</i> (18)	<i>ramulosa</i>
1.1. Series <i>Hyalis</i> (8)	<i>ecklonii</i>
<i>pumilio</i>	<i>brunneobracteata</i>
<i>leipoldtii</i>	2.2. Series <i>Brevitubae</i> (5)
<i>longituba</i>	<i>marginifolia</i>
<i>bellendenii</i>	<i>pavonia</i>
<i>splendida</i>	<i>linearifolia</i>
<i>linderi</i>	<i>alata</i>
<i>acaulis</i>	<i>thomasiae</i>
<i>paniculata</i>	2.3. Series <i>Paucifoliae</i> (4)
1.2. Series <i>Fucatae</i> (4)	<i>paucifolia</i>
<i>cochlearis</i>	<i>dolichosiphon</i>
<i>fucata</i>	<i>cedarmontana</i>
<i>stohrii</i>	<i>stenophylla</i>
<i>recondita</i>	2.4. Series <i>Rapunculoides</i> (9)
1.3. Series <i>Angustisiphon</i> (6)	<i>rapunculoides</i>
<i>orientalis</i>	<i>robusta</i>
<i>odorata</i>	<i>rivulicola</i>
<i>esterhuyseniae</i>	<i>lacera</i>
<i>aurea</i>	<i>mollis</i>
<i>tenuifolia</i>	<i>namaquana</i>
<i>purpureorosea</i>	<i>oxalidiflora</i>
2. Sect. <i>Morphixia</i> (31)	<i>sobolifera</i>
2.1. Series <i>Morphixia</i> (8)	<i>contorta</i>
<i>divaricata</i>	2.6. Series <i>Capillares</i> (5)
<i>saundersiana</i>	<i>capillaris</i>
<i>latifolia</i>	<i>exiliflora</i>
<i>monticola</i>	<i>pauciflora</i>
<i>parva</i>	<i>dieramoides</i>
	<i>reclinata</i>

Important taxonomic characters

Corms: provide several valuable taxonomic characters. They are typically $\pm$ globose, but conical in *I. acaulis*. Apart from corm size, which is loosely correlated with plant size, corms vary notably in the position of cormlets (cormels). These propagules are usually sessile and located at the base of the main corm. The presence of slender, flattened stolons, each bearing a terminal cormlet, readily separate *Ixia oxalidiflora* from *I. namaquana* and *I. sobolifera* from several other species of the *I. rapunculoides* group and *I. brunneobracteata* from its close allies. *Ixia purpureorosea* and *I. paniculata* (series *Hyalis*) are the only other species in sects *Hyalis* and *Morphixia* that produce stolons. In sect. *Ixia* only *I. calendulacea* Goldblatt & J.C.Manning, *I. maculata* L. and *I. stolonifera* G.J.Lewis produce stolons. The distribution of this character then, appears to provide no indication of relationship, nor is it correlated with soil preference for it is present in species of sandy or clay habitats. Corm tunics, derived from the bases of cataphylls, range from coarsely to finely fibrous, the latter conspicuous in the *I. capillaris* group (series *Capillares*). Finely fibrous tunics combined with different flower colour and soil preference separate *I. cedarmontana* from the similarly long-tubed *I. paucifolia* in which it has until now been included. In the stoloniferous *I. oxalidiflora* and *I. sobolifera*, the tunics are softly papery rather than composed of a discrete network of

fibres and they do not accumulate to any extent. The semi-aquatic *I. rivulicola* has thin, almost membranous tunics that do not persist, and *I. monticola* has dry, chestnut-brown, onion skin-like tunics that rarely accumulate from one season to the next.

Flowering stem and branching pattern: the stem is terete and comparatively thin, firm and wiry. It is usually branched and branching patterns are often distinctive. The flowering stem and spike are aerial, well developed and terete except in *Ixia acaulis*, in which the flowers are borne on an underground stem. During development of the capsules of this species the stem elongates so that the ripe seeds are displayed at ground level.

The branches of *Ixia contorta*, *I. parva* and some populations of *I. latifolia* are short and twisted, whereas in the closely related *I. divaricata*, the branches are straight, usually relatively long and the flowers are crowded distally. Particularly short, wiry branches (or branchlets) bearing just one to three flowers each characterize the *I. capillaris* group (series *Capillares*), series *Brevitubae* (*I. linearifolia*, *I. marginifolia*, *I. pavonia*) and a few species of other series, notably *I. namaquana*, *I. ramulosa* and several more species. In *I. ecklonii* the branches of the several specimens of the only known collection consistently have a single flower each.

The bracts and prophylls subtending the branches are sometimes distinctive and provide valuable taxonomic characters. They range from short and subacute, obtuse or truncate and 1–2 mm long (e.g. in *Ixia namaquana*, *I. rapunculoides* and *I. robusta* in series *Rapunculoides* and *I. latifolia* in series *Morphixia*), to attenuate and significantly longer, notably in series *Capillares*, a few species of series *Rapunculoides*, notably *I. oxalidiflora* and *I. sobolifera*, and are particularly pronounced in *I. lacera* in which the long, thread-like apices of the bracts and prophylls are spreading to recurved, a feature that makes this species unmistakable. Care should be taken to note this feature, for in the absence of corms, it can be useful in separating otherwise similar species.

Leaves: the bladeless basal cataphylls provide few important characters but in a few species they persist as a collar of fibres around the base of the stem, a feature particularly well developed in *Ixia cochlearis* and *I. robusta*, but weakly expressed in *I. capillaris*, *I. pauciflora* and in some of the southern populations of *I. rapunculoides*. In most populations of *I. capillaris* and *I. pauciflora* the cataphylls are dry and a distinctive, chestnut-brown.

Foliage leaves range in number from several (4–10) in what we consider the less specialized sect. *Hyalis*, to just three, less often four in sect. *Morphixia* with the uppermost leaf sheathing the stem for virtually its entire length. The sharp distinction between the basal leaves with expanded blades and the entirely sheathing upper leaf or leaves is clearly derived. Particularly specialized are the narrow, linear leaf blades of series *Capillares*. When fresh, the blades in the series are leathery to almost fleshy and lack evident veins and margins, though these are visible as areas of paler green when held up to the light. The midvein is usually the only vein present and is always displaced to the adaxial side of

the blade. When dry, the veins and margins often appear raised due to the differential drying of the leaf tissue. *Ixia stenophylla* has superficially similar narrow leaves, but the midvein is $\pm$ central and prominently thickened and raised.

Plane leaf blades are almost universal, occasionally with moderately to heavily thickened margins, notably in *Ixia latifolia* and *I. robusta*. Two species, *I. alata* and *I. thomasiae* stand out in the genus in having winged leaf margins, a specialization not uncommon in some other genera of Crocoideae, especially *Geissorhiza* (Goldblatt 1985) and *Gladiolus* (Goldblatt & Manning 1998). In such leaves the margins are raised at right angles to the blade. The unusual, long, narrow leaves of *I. linearifolia* also stand out in their almost fleshy texture and prominently raised but thick, fleshy margins.

Leaves are usually narrowly sword-shaped to lanceolate and 4–15 mm wide. *Ixia latifolia*, *I. marginifolia* and *I. rapunculoides* typically have broad, falcate leaf blades, sometimes over 20 mm wide. Leaves are often weakly twisted above but strikingly so in *I. aurea*. The narrow, linear leaves of series *Capillares* are mostly 1.0–1.5 mm wide, and always less than 2 mm wide.

Spike: the number of flowers per spike is always variable, but a range is usually constant for a species. The main or terminal spike usually has more flowers than the branches. Particularly robust individuals, usually the result of a good growing season, always have more flowers per spike and confound the taxonomic utility of the character. Consistently few flowers per spike characterize *I. linearifolia*, *I. marginifolia*, *I. ramulosa*, all members of series *Capillares* and most species of series *Rapunculoides*. The several known specimens of *I. ecklonii* have a single-flowered main and lateral spikes.

Floral bracts are membranous and more or less translucent and have one or more prominent veins, often dark in colour. The outer bracts provide several taxonomic characters. They are most often three-veined and terminate in three subequal teeth or lobes. *Ixia lacerata* stands out in having bracts with five $\pm$ equal veins and five attenuate teeth. Most species of sect. *Hyalis* have outer bracts with a single prominent vein and with a single terminal tooth or lobe, or when 3-veined, the central tooth or lobe is more prominent than the laterals. *Ixia paniculata* has obscurely 3-dentate outer bracts with the central tooth vestigial and *I. splendida* and *I. linderi* have $\pm$ truncate outer bracts minutely serrate at the tips. Inner floral bracts are always 2-veined and forked at the tips.

Flowers: shape, always constant in a species, ranges from salver- to bell-shaped and flowers may be held vertically (i.e. erect), ascending (half nodding) or horizontally oriented (nodding). Species of series *Capillares* typically have nodding flowers as do *Ixia namaquana*, *I. rapunculoides*, *I. oxalidiflora* and several more of series *Rapunculoides*. *Ixia sobolifera* has nodding to $\pm$ pendent flowers. An important aspect of the flower is the perianth tube, which ranges from narrowly (most species of series *Hyalis*) to broadly funnel-shaped (series *Morphixia*, most species of series *Capillares*) or $\pm$ cylindric or gradually and uniformly flared from the base (e.g. series *Paucifoliae*, *Ixia ecklonii*, *I. longituba*, *I. pani-*

culata). The perianth is always radially symmetric with subequal tepals, those of the outer whorl slightly broader than those of the inner. The stamens are usually symmetrically arranged around the style, but are unilateral and declinate, with the anthers facing the dorsal tepal in *I. declinata* and at least some populations (possibly all, but this is impossible to determine from pressed specimens) of *I. fucata* and *I. pauciflora*.

Flowers are seldom brightly coloured, more often being muted shades of blue-grey, mauve-pink, or white and only rarely have weakly developed markings. *Ixia tenuifolia* stands out in its yellow to orange perianth often with a dark centre, *I. esterhuyseniae* and most populations of *I. odorata* in their uniformly yellow flowers, and *I. pumilio* in its attractive red perianth. Flowers of *I. leipoldtii* are unique in being pure white with deep purple markings on the lower parts of the tepals and those of *I. pavonia* in their dark red centre on a blue-mauve background.

Floral scent is common and usually reminiscent of rose to violet. Scent is sometimes quite strong, notably in *Ixia odorata* and *I. rivulicola* in which the rich floral scent has notes of passion fruit and pineapple. Flowers of *I. parva* have a strong scent of sweet peas, surprising in so small a bloom.

Shortly exerted filaments are most likely the ancestral condition for stamens, as for example in *Ixia capillaris*, but *I. latifolia* has filaments exerted up to 10 mm, rendering the anthers particularly prominent. We infer that this is a specialized state. All members of series *Rapunculoides* and scattered species of other sections (e.g. *I. dieramoides*, *I. leipoldtii*, *I. stohrae*) have the filaments and the bases of the anthers included in the perianth tube, an unusual specialization. The stamens are fully included in the tube in *I. linderi*, *I. oxalidiflora* and *I. recondita*, and usually so in *I. paniculata* and *I. splendida*. In the last-named two species the tips of the anthers often extend beyond the mouth of the tube and in *I. paniculata* the anthers are occasionally fully exerted.

The subglobose ovary itself offers no variation except size, and is not useful taxonomically. The point of division of the style is somewhat variable within species but nevertheless constitutes a useful character, as does length of the style branches. The style divides between the bases and apices of the filaments in *I. reclinata* and *I. odorata* but in other species, usually opposite the middle to upper third of the anthers, and in a few species it exceeds them. The direct contact between pollen in dehiscent anthers and style branches, common in *Hyalis* and *Morphixia*, does not indicate autogamy: several species with flowers of this type that we have examined (*I. lacerata*, *I. namaquana*, *I. rapunculoides*, *I. sobolifera*) do not produce seeds with their own pollen and we infer that they are self-incompatible. Horn (1962) reported self-incompatibility in *I. odorata* but several species of sect. *Ixia* produced reduced amounts of seed if self-pollinated by hand.

Fruit and seeds: capsules and seeds show little variation in the few species in which they are known. In those in which fruits have been recorded, the capsule walls

are cartilaginous and smooth but show the outline of the seeds. Capsules are loculicidally dehiscent and the seeds are hard, smooth and shiny. Both the ovary and the capsule of *Ixia alata* and *I. thomasiae* of series *Brevitubae* have a conspicuously warty surface. An unusual feature of the seeds is exclusion of the vascular trace to the ovule from the seed body during development (Goldblatt & Manning 1995). The trace persists in the mature seed as a fine thread lying above the raphe. Such seeds are shared with the *Dierama*–*Duthieastrum*–*Sparaxis*–*Tritonia* clade of tribe Ixieae and are derived in Crocoideae (Goldblatt *et al.* 2006).

Chromosome cytology

The relatively few chromosome counts for *Ixia* (Table 2) consistently indicate a basic chromosome number of $n = 10$ (Goldblatt 1971; Goldblatt & Takei 1997). Just 16 species have been counted, but include at least two for each of the four sections of the genus. Sect. *Morphixia* is least sampled and we note that no species of the *I. capillaris* or *I. paucifolia* groups of the section have been counted. The karyotype is uniform across the species examined; *I. orientalis* stands out in being tetraploid, $2n = 40$ and a diploid number of $2n = \pm 42$ [probably $2n = 40$] was noted on a collection of *I. calendulacea*. There are thus single counts for these two relatively widespread species, making it premature to conclude that either is uniformly tetraploid.

The basic karyotype for *Ixia*, described by Goldblatt (1971), consists of two substantially larger, acrocentric chromosome pairs, 3.0–3.3 μm long, one of which bears a terminal satellite in some species. The remaining eight

pairs are ± 1.5 – $2.5 \mu\text{m}$ long and range from acrocentric to submetacentric. Using a different method for chromosome preparation, Goldblatt & Manning (1993) reported a similar karyotype but smaller chromosomes in *I. acaulis*. Species of *Dierama* have a virtually identical karyotype, which has been considered independent evidence for the belief that the two genera are immediately allied. *Sparaxis* (including *Synnotia*) also has $x = 10$ and a comparable karyotype but, as noted by Goldblatt (1971), the chromosome complement is slightly smaller and the distinction between large and small chromosome pairs less pronounced. Among closely related genera, *Duthieastrum* also has $x = 10$ (De Vos 1974), but *Tritonia* has $x = 11$, and most species are diploid with $2n = 22$; three species, however, have $2n = 20$, presumably a derived number.

Pollination

The hollow-tubed flowers of sects *Hyalis* and *Morphixia*, with the exception of *Ixia pavonia*, contain nectar, secreted from septal nectaries through minute pores at the top of the ovary directly into the perianth tube. Nectar is most likely the main reward for pollinating insects, particularly in species in which the anthers are held within the perianth tube or at its mouth, largely concealing the pollen. Pollen on the prominently displayed anthers of *I. latifolia* and its allies, as well as *I. marginifolia*, most likely serve as a pollinator attractant, and pollen is the reward in these species. Nectar is sucrose-dominant in all species examined for the nectar chemistry (Table 3, from Goldblatt *et al.* 2000). Nectar concentrations range from mean values of 23.7 % to 29 % sucrose equivalents except in *I. lacerata*, in which we recorded 43.2 %, an unusually high concentration.

Diurnal, long-proboscid, nectarivorous insects are the recorded pollinators of most species of subgen. *Morphixia* (Goldblatt *et al.* 2000). Pollinators include large-bodied, long-tongued anthophorine bees (Apidae: Anthophorinae) and the native *Apis mellifera* for species with perianth tubes 5–15 mm long. Anthophorine bees visiting *I. capillaris*, *I. latifolia*, *I. odorata*, *I. rapunculoides* and *I. thomasiae* include *Anthophora diversipes*, *A. schulzei*, *Amegilla spilostoma* and *Pachymelus peringueyi*. Observations we report here for *I. divaricata* and *I. rivulicola* expand this pattern. *Ixia rivulicola* is visited by a wide range of female and male bees, including *Amegilla spilostoma* (Apidae), *Melitta capensis* (Melittidae), *Megachile* sp. (Megachilidae), *Plesanthidium calvini* and *Patellapis* sp. (both Halictidae), as well as *Apis mellifera* workers. *Ixia divaricata* exhibits a similar pattern: *Lasioglossum* sp. (Halictidae), *Anthophora diversipes* and *Amegilla spilostoma* have been captured on flowers of this species. The range of long- and short-tongued bees indicates that nectar, as well as pollen, are rewards to floral visitors.

Little is known about pollination by empidid flies (Empididae) but they are reported to be effective pollinators of some northern hemisphere plant species (Proctor *et al.* 1996). We have been struck repeatedly by the presence of these small insects, $\pm 3 \text{ mm}$ long, in flowers of *Ixia rapunculoides*. The flies frequently carried pollen on the frons and dorsal part of the head and thorax, which passively accumulates as they crawl into the nar-

TABLE 2.—Chromosome counts in *Ixia*, with taxonomy corrected. In addition, a collection of *I. calendulacea* (De Wet 00903 PRE) has an annotation indicating a diploid chromosome number of $2n = 42$ [probably $2n = 40$], which is tetraploid and is included below

Species	Diploid chromosome no. $2n$	Reference
Sect. <i>Hyalis</i>		
<i>acaulis</i>	20	Goldblatt & Manning 1993
<i>longituba</i>	20	Goldblatt 1971
<i>odorata</i>	20	Goldblatt 1971
<i>orientalis</i>	40	Goldblatt 1971
<i>paniculata</i>	20	Goldblatt & Takei 1997
Sect. <i>Morphixia</i>		
<i>ramulosa</i>	20	Goldblatt & Takei 1997 (as <i>I. latifolia</i> var. <i>ramulosa</i>)
<i>rapunculoides</i>	20	Goldblatt 1971
Sect. <i>Ixia</i>		
<i>calendulacea</i>	± 42	De Wet, unpublished
<i>campanulata</i>	20	Goldblatt 1971
<i>dubia</i>	20	Goldblatt 1971
<i>flexuosa</i>	20	Goldblatt 1971
<i>polystachya</i>	20	Goldblatt 1971
<i>viridiflora</i>	20	Goldblatt 1971
Sect. <i>Dichone</i>		
<i>trifolia</i>	20	Goldblatt & Takei 1997 (as <i>I. brevituba</i>)
<i>erubescens</i>	20	Goldblatt 1971
<i>scillaris</i>	20	Goldblatt 1971

TABLE 3.—Nectar properties of selected *Ixia* flowers. Nectar sugars analysed by B.-E. van Wyk. Sample size indicates no. different individuals examined at study site (data from Goldblatt *et al.* 2000)

Species	Sample size	Nectar vol. μl (n)	% different sugars			Mean suc/glu	
			% sugar (±SD)	fru	glu	suc	+ fru (n)
Sect. <i>Hyalis</i>							
<i>leipoldtii</i>		–	–	29	30	41	0.69 (1)
<i>longituba</i>							
subsp. <i>macrosiphon</i>	6	2.0–2.4	23.7(3.3)	14–19	12–22	60–75	1.94 (3)
subsp. <i>longituba</i>	2	1.1–2.8	27.0(1.4)	23–31	24–27	45–50	0.90 (2)
<i>paniculata</i>	8	3.9–5.7	26.1(2.7)	16–19	17–23	58–66	1.66 (3)
<i>stohrii</i>	5	0.4–0.9	26.2(1.7)	–	–	–	–
Sect. <i>Morphixia</i>							
<i>lacerata</i>	5	1.8–2.6	43.2(4.6)	–	–	–	–
<i>latifolia</i>	5	1.7–2.9	27.6(2.5)	–	–	–	–
<i>paucifolia</i>	5	1.1–1.6	29.8(1.8)	17–21	20–25	54–63	1.41 (2)
<i>rapunculoides</i>	3	1.1–1.5	28.0(1.0)	27–28	29–37	35–44	0.69 (3)

fru, fructose; glu, glucose; suc, sucrose

row part of the tube in which the anthers are held. For the empidids to be significant pollinators they would need to move from flowers of one plant to another and we have not recorded information on this aspect of their behaviour. As noted above we have often seen large anthophorine bees also visiting *I. rapunculoides* flowers and in the past we considered the species adapted for pollination by large-bodied bees (Goldblatt *et al.* 2000 and unpublished data).

Long-tubed species, including *Ixia dolichosiphon*, *I. longituba* and *I. paucifolia*, are pollinated by long-proboscid horseflies (Tabanidae), *Philoliche gulosa* and *P. rostrata* (Goldblatt *et al.* 2000), and a third long-tubed species, *I. paniculata*, by *Moegistorhynchus longirostris* (Nemestrinidae) (Manning & Goldblatt 1997). *Ixia paniculata* has a perianth tube as long as 75 mm and its pollinator has a proboscis almost as long. The southern and shorter-tubed populations of *I. paniculata* are probably pollinated by *Philoliche rostrata*, the most common long-proboscid fly in the southern Cape Peninsula and nearby. Other likely long-proboscid fly-pollinated species are *I. bellendenii* and *I. splendida*.

Exceptional in *Ixia*, *I. cedarmontana* has white or pale pink, long-tubed flowers with a carnation-like scent that is particularly strong in the evening. The flowers remain open and scented throughout the night. We infer moth pollination for this species.

Another exception, *Ixia acaulis*, which although acaulescent, also has a long perianth tube, is evidently pollinated by the large butterfly, *Cynthia cardui*. These butterflies have been noted by N. Helme (pers. comm. 2010) actively visiting the small yellow flowers of this winter-blooming species.

Other exceptions to the general pattern are *Ixia aurea* and *I. tenuifolia* (both sect. *Hyalis*), which have large, bright yellow (or orange in the latter) flowers. Both are visited by hopliine beetles and nectarivorous tabanid flies with short probosces; *Mesomyia edentula* in the former; and *Philoliche atricornis* in the latter (Goldblatt *et al.* 2000). The only pollinating insect species recorded on *I. esterhuysenii* is also *P. atricornis*. Unique in sect.

Morphixia, *I. pavonia* has dark purple-black filaments and style, and a perianth with an almost black centre edged with bright red, stereotypical adaptations for pollination by hopliine scarabs. One species of the hopliine genus *Kubousa* has been noted visiting flowers of the species (N. Helme pers. comm. 2008); the bodies of several of the dark-coloured beetles visibly carried pollen.

Lastly, *Ixia orientalis* has been reported as being visited by the butterfly *Colias electo* (Goldblatt *et al.* 2000) but subsequent observations, reported here, show that it is also visited by hopliines or a combination of hopliines and large anthophorid bees. *Ixia orientalis* is evidently a generalist, but *I. aurea* and *I. tenuifolia* fit the criteria of a bimodal pollination system (Manning & Goldblatt 2005). Bright yellow to orange perianth colour, and in *I. tenuifolia* a dark central eye, are characteristics of hopliine pollination (Goldblatt *et al.* 1998), but presence of nectar signifies a nectarivorous pollinator as well, in this case species of Tabanidae. We have also noted *Apis mellifera* visiting flowers of *I. marginifolia* to forage for pollen, but these bees also probe the short tube (2–4 mm long) for nectar, traces of which are produced. Both large anthophorine bees, *Anthophora* species, and the fly *Prosoeca* sp. (Goldblatt & Manning 2007, 2008a) visit flowers of *Ixia lacerata*, which has a perianth tube 10–12 mm long. Both bees and flies carry pollen of the species after visiting flowers and thus seem legitimate pollinators. This in turn suggests the species has a functionally bimodal pollination system derived from the ancestral bee pollination system of the series.

Relationships of *Ixia*

A member of Crocoideae, largest of seven subfamilies of the Iridaceae (Goldblatt *et al.* 2008), *Ixia* is currently assigned to Ixieae, a tribe of 14 genera, mostly of southern Africa (Goldblatt *et al.* 2006, as Croceae). Notably *Crocus* L. is restricted to Eurasia and North Africa and *Romulea* Maratti extends through highland tropical Africa to Eurasia. Within the tribe the immediate relationships of *Ixia* are with the southern African genera *Dierama* K.Koch, *Tritonia* and perhaps *Sparaxis* Ker. Gawl. (Lewis 1954, 1962; Hilliard *et al.* 1991; Goldblatt *et al.* 2006). These genera, together with

Duthieastrum, share derived membranous to dry floral bracts and hard shiny seeds with excluded ovular vasculature, but only *Dierama* and *Ixia* (and the acaulescent *Duthieastrum*) have radially symmetric flowers, a specialized condition in this lineage of Ixieae (a few species of *Ixia* have independently evolved zygomorphic flowers, then usually with declinate stamens).

Among these genera only *Dierama*, *Ixia* and *Tritonia delpierrei* and *T. marlothii* have leaves with a strand of submarginal sclerenchyma (possibly a reversal to an ancestral state for the subfamily), but except in *Ixia* the strand is associated with a marginal vein rendering the condition in *Ixia* unique. In contrast, *Duthieastrum*, *Sparaxis* and all but the two species of *Tritonia* mentioned above have leaves without submarginal sclerenchyma or a marginal vein and instead have derived columnar marginal epidermal cells with thickened anticlinal walls. The condition in *Ixia* series *Capillares* (Goldblatt & Manning 2008b), in which the marginal sclerenchyma strand is not associated with a marginal vein (in fact there is no marginal vein in the upper part of the leaf) is an apparently specialized, secondary condition.

Chromosome number in *Ixia*, $x = 10$, is shared with *Dierama*, *Duthieastrum* and *Sparaxis* but *Tritonia* has $x = 11$. Lewis (1954, 1962) and Hilliard *et al.* (1991) regarded *Dierama* as most closely related to *Ixia* on the grounds of similar floral morphology (assuming the ancestral flower in the genus was of the *Morphixia* type with a funnel-shaped tube and decurrent stamens) and the characteristic thin, wiry flowering stem, often nodding above, again with the unstated assumption that the habit of the *Morphixia* group is ancestral. As pointed out by Hilliard *et al.* (1991) the bracts of *Dierama* are quite different from those of *Ixia*, being dry and without the discrete veins of most species of *Ixia*.

Preliminary molecular studies, using just one species each of the genera of Crocoideae, however, show *Ixia* to be immediately related to *Tritonia* (Reeves *et al.* 2001; Goldblatt *et al.* 2006). This pair constitutes a clade sister

to *Dierama* (bootstrap support 81 %) in turn related to *Sparaxis* plus *Duthieastrum* (BS 63 %). The *Sparaxis*–*Duthieastrum* clade has no bootstrap support. This topology is difficult to reconcile with morphology and cytology: *Tritonia* and *Ixia* have similar (and evidently derived) floral bracts; *Dierama* and *Ixia* have radially symmetric flowers (most likely derived) and share a chromosome number (also probably derived) different from that in *Tritonia*; and the leaf margin anatomy of *Ixia* and *Dierama* is similar and unlike that in *Tritonia*. Additional molecular studies of this alliance and using species of all the major morphological types are needed to better understand their relationships and evolution.

SYSTEMATICS

For the sake of brevity we do not mention capsules and seeds in descriptions unless they are known. In most species they are not. Currently we believe that capsules and seeds are remarkably uniform across the genus, vary only slightly in dimensions and have no features of taxonomic significance, except for the warty capsule walls of *Ixia alata* and *I. thomasiae*.

Specimens cited for each species are a selected sample covering its geographical range. For new or rare species we cite all specimens that we examined.

KEY TO SECTIONS AND SPECIES

Notes: care must be taken in measuring floral parts of preserved specimens: depending on the method of drying, the perianth can shrink as much as 30 %. Presence of stolons is difficult to establish as they are often left behind during collection unless corms are removed from the ground with particular care.

Measure filaments from point of insertion on perianth tube to base of anther, not to point of insertion above the anther base. For bracts measure those in the middle portion of the main spike (those at the base and near the apex of the spike are often longer or shorter than normal).

Key to sections of *Ixia*

- 1a Style branches tubular with margins involute and stigmatic surfaces confined to tips of style branches; perianth tube filiform throughout and blocked by style; anthers ovoid and short, sometimes dehiscing incompletely from base; flowers pink to mauve, pale violet (or white) sect. *Dichone*
- 1b Style branches channelled with margins conduplicate below and stigmatic surfaces extending along distal half of style branches; perianth tube either filiform throughout and blocked by style or funnel-shaped to cylindric and hollow above or throughout; anthers $\pm$ linear, dehiscing completely; flowers variously coloured:
 - 2a Perianth tube filiform throughout with filaments inserted at mouth of tube; filament bases often expanded (tepals sometimes connate basally for a short distance); perianth brightly coloured, usually with dark centre sect. *Ixia*
 - 2b Perianth tube funnel-shaped to cylindric and hollow throughout or filiform in lower part with filaments inserted within tube and decurrent; filament bases not expanded; perianth usually shades of pink or pale blue to white, occasionally brilliantly coloured and rarely with dark centre:
 - 3a Leaves 4–6(–10), with upper leaves partly sheathing stem and not sharply differentiated from lower leaves; plants sometimes acaulescent; perianth tube sometimes blocked by style in lower part 1. sect. *Hyalis*
 - 3b Leaves mostly 3 (sometimes 4 or 5, rarely only 2), with upper 1 (or 2) leaves almost or entirely sheathing and usually clearly differentiated from lower leaves; plants never acaulescent; perianth tube always hollow to base 2. sect. *Morphixia*

Key to species of sect. *Hyalis*

- 1a Plants acaulescent with flowers borne at ground level; leaves falcate or prostrate, without evident midrib; flowers bright yellow, salver-shaped with tube 15–20 mm long *I. acaulis*
- 1b Plants with an aerial stem; leaves falcate to upright, usually with evident midrib; flowers usually shades of white or pink to orange, rarely red or yellow but then not as above:
 - 2a Floral bracts with 3(–5) subequal major veins and $\pm$ equally 3-lobed to 3-dentate:

- 3a Anthers and style branches included in lower half of perianth tube; style dividing below or opposite filament bases 12. *I. recondita*
- 3b Anthers and style branches exerted or partly included, tips of anthers usually emerging from tube or at least reaching beyond upper third of tube; style dividing above filament bases:
- 4a Corm tunics extending upward in a short collar of fibres around base; leaves $\pm$ linear and firm-textured; bracts 4–5 mm long; filaments exerted $\pm$ 6 mm from tube 9. *I. cochlearis*
- 4b Corm tunics not extending upward in a short collar of fibres around base; leaves sublinear to sword-shaped and relatively soft-textured; bracts 5–8 mm long; filaments exerted up to 5 mm or included:
- 5a Filaments exerted 2–5 mm from tube; style branches 2.0–2.5 mm long; flowers white with red reverse or pink; stamens (?always) unilateral 10. *I. fucata*
- 5b Filaments included or exerted up to 1 mm; style branches 1.0–2.3 mm long; flowers pink; stamens symmetrically disposed 11. *I. stohrii*
- 2b Floral bracts with one major vein (or no dark veins evident) and either with one prominent lobe or tooth, or 3-toothed with central tooth smaller than lateral teeth, or $\pm$ truncate with apex minutely serrated:
- 6a Perianth tube $\pm$ cylindric, usually elongate, 12–70 mm long:
- 7a Anthers fully exerted from tube:
- 8a Perianth tube 12–33(–35) mm long; flowers pink (rarely white sports present in pink-flowered populations); filaments 4–9 mm long, exerted up to 5 mm from tube 3. *I. longituba*
- 8b Perianth tube 35–40 mm long; flowers beige, flushed pink outside; filaments $\pm$ 15 mm long, exerted 10–11 mm from tube 4. *I. bellendenii*
- 7b Anthers fully to partly included in tube:
- 9a Anthers dark purple-black (rarely pale yellow); perianth tube 35–70 mm long; style dividing between lower third and apex of anthers, rarely shortly beyond anther tips 8. *I. paniculata*
- 9b Anthers yellow to white; perianth tube 18–30 mm long; style dividing below or opposite lower third of anthers:
- 10a Perianth pink to brick-red; perianth tube 27–30 mm long; tepals 15–18 mm long; anthers 5–6 mm long 5. *I. splendida*
- 10b Perianth white or flushed pale pink; perianth tube 18–20 mm long; tepals $\pm$ 10 mm long; anthers $\pm$ 4 mm long 6. *I. linderi*
- 6b Perianth tube widely to narrowly funnel-shaped, narrow and cylindric below, obviously widening at $\pm$ middle or upper third into a flared upper part:
- 11a Filaments and bases of anthers included in perianth tube; flowers white with large purple blotch on lower part of each tepal; bracts large, 7–10 mm long, pellucid, flushed pink or brownish 2. *I. leipoldtii*
- 11b Filament apices exerted from tube; flowers and bracts not as above:
- 12a Perianth tube (12–)15–19 mm long; flowers light purple or yellow to orange or brick-red with dark centre:
- 13a Flowers yellow to orange or brick-red, with a dark centre; bracts dark rust-brown in distal half 17. *I. tenuifolia*
- 13b Flowers light purple; bracts pale-translucent 18. *I. purpureo-rosea*
- 12b Perianth tube 4–12 mm long; flowers white, pink to brick-red or yellow, without a dark central mark:
- 14a Plants 100–250 mm tall; flowers brick-red, facing $\pm$ to side; bracts opaque, brownish, 7–9 mm long 1. *I. pumilio*
- 14b Plants 100–650 mm tall; flowers yellow to orange or white to pink, suberect; bracts pellucid, 5–7 mm long:
- 15a Flowers white or pink to mauve; filaments 5–6 mm long; stem usually 1–4-branched 13. *I. orientalis*
- 15b Flowers yellow to orange, rarely white but then filaments $<$ 3.5 mm long; stem usually unbranched:
- 16a Plants 100–150(–350) mm tall; perianth tube 4.5–6.0 mm long; style dividing between base and middle of anthers 15. *I. esterhuyseniae*
- 16b Plants 180–550 mm tall; perianth tube 7–15 mm long; style dividing below base of anthers:
- 18a Tepals yellow or white, 9–11 $\times$ $\pm$ 5 mm; leaves often linear, barely, if at all twisted distally, 2–10 mm wide; filaments relatively short, up to 3 mm long 14. *I. odorata*
- 18b Tepals orange, 16–23 $\times$ 7–9 mm; leaves $\pm$ lanceolate and loosely twisted distally, (8–)10–16 mm wide; filaments longer, 5–6 mm long 16. *I. aurea*

Key to species of sect. *Morphixia*

- 1a Foliage leaves 2, blades linear-filiform, $<$ 2 mm (and usually $<$ 1.5 mm) wide when alive:
- 2a Leaves with a slightly to prominently thickened main vein $\pm$ in centre of blade:
- 3a Flowers with perianth tube cylindrical throughout, (12–)15–20 mm long and uniformly $\pm$ 2 mm diam.; leaf margins not raised 35. *I. stenophylla*
- 3b Flowers with perianth tube funnel-shaped, $\pm$ 5 mm long; leaf margins raised and fleshy 29. *I. linearifolia*
- 2b Leaves with main vein not evident when alive unless held to the light, lying closer to abaxial margin, when dry, main vein and margins become evident and appear thickened due to collapse of mesophyll between them:
- 4a Perianth tube 4–10 mm long; filaments included or exerted up to 2 mm from tube; anthers symmetrically arranged in a column enclosing style:
- 5a Perianth tube 4–8 mm long; tepals 11–15 mm long, thus $\pm$ twice as long as tube; filaments exerted 1–2 mm and anthers fully exerted; anthers (3–)4–5 mm long 45. *I. capillaris*
- 5b Perianth tube 8–10 mm long; tepals 8–10 mm long, thus $\pm$ as long or slightly longer than tube; filaments included and bases of anthers held within tube; anthers 3.5–4.0 mm long 46. *I. exiliflora*
- 4b Perianth tube 12–22 mm long; filaments included or well exerted from tube; anthers symmetrically arranged or unilateral and facing upward, then style lying below anthers:
- 6a Stamens symmetrically arranged; filaments included, 3–6 mm long; anthers 2.5–3.5 mm long, bases usually included in tube 47. *I. dierramoides*
- 6b Stamens usually (?always) unilateral and horizontal to declinate; filaments 12–15 mm long, exerted 2–10 mm from tube; anthers 4–5 mm long, fully exerted from tube:
- 7a Filaments exerted 2–6 mm from tube; stem simple or with 1 or 2(3) lateral branches, branches subtended by attenuate bracts and prophylls; cataphylls chestnut-brown above ground 48. *I. pauciflora*
- 7b Filaments exerted 8–10 mm from tube; stem with 1–3 lateral branches, branches subtended by truncate bracts and prophylls; cataphylls green with $\pm$ membranous margins 49. *I. reclinata*
- 1b Foliage leaves 1–4, blades linear to lanceolate or falcate, rarely linear-filiform but then with a moderately to prominently thickened central vein, usually $>$ 2 mm wide in mature plants; midvein evident when alive, $\pm$ central or slightly displaced toward abaxial margin:
- 8a Foliage leaves with margins broadly winged, thus H-shaped in cross section; ovary and capsules warty:
- 9a Flowers pale pink with white to pale yellow throat; perianth tube 5–6 mm long; anthers $\pm$ 5 mm long 30. *I. alata*
- 9b Flowers pale blue-mauve, white in throat; perianth tube 8–10 mm long; anthers $\pm$ 6 mm long 31. *I. thomasiae*
- 8b Foliage leaves plane, sometimes with margins heavily thickened but never winged; ovary and capsules smooth, rarely surface obscurely roughened:
- 10a Perianth tube cylindric or subcylindric; tepals usually shorter than tube:

- 11a Perianth tube 15–18 mm long; flowers pale lilac to white flushed lilac 33. *I. dolichosiphon*
 11b Perianth tube (18–)22–34 mm long; flowers pale beige (also described as pale yellow) or white usually flushed mauve to pink outside:
 12a Corm tunics of coarse, woody fibres; flowers pale beige; tepals oblong, 11–15 × 3.0–4.5 mm 32. *I. paucifolia*
 12b Corm tunics of fine, pale fibres; flowers white, sometimes flushed mauve to pink outside, or pale pink; tepals ovate, 10–12 × 5–7 mm 34. *I. cedarmontana*
 10b Perianth tube broadly or narrowly funnel-shaped; tepals usually as long as or longer than tube:
 13a Filaments reaching mouth of perianth tube or exerted (sometimes for only 1 mm); anthers always completely exerted:
 14a Foliage leaf solitary, linear; stem usually unbranched 20. *I. saundersiana*
 14b Foliage leaves 2–4, linear to lanceolate; stem simple or branched:
 15a Perianth tube (2.5–)3.0–5.0 mm long; lateral branches usually several and always short, bearing 1–3(4) flowers:
 16a Filaments pale blue to white, 5–7 mm long; lateral branches mostly 2- or 3-flowered 27. *I. marginifolia*
 16b Filaments purple-black, ± 4 mm long; lateral branches mostly 1-flowered 28. *I. pavonia*
 15b Perianth tube 6–18 mm long; lateral branches various:
 17a Lateral branches mostly 3–6, short and thread-like, each bearing 1 or 2(3) flowers; perianth deep maroon-purple, magenta-pink, blue-mauve or white with yellow cup 24. *I. ramulosa*
 17b Lateral branches mostly 1–3, or plants unbranched, branches typically well developed, straight or twisted, bearing 1–6 or more flowers:
 18a Branches straight and bearing 2–several flowers in distal half or plants unbranched:
 19a Leaves (5–)10–18 mm wide, with moderately to heavily thickened margins; perianth tube 14–23 mm long; tepals 15–18 mm long; bracts 8–10 mm long; perianth usually deep pink to cherry-red 21. *I. latifolia*
 19b Leaves mostly narrowly sword-shaped to falcate, usually < 5 mm wide, with slightly thickened margins; perianth tube 8–11 mm long; tepals 11–14 mm long; bracts 5–7 mm long; perianth white, pale pink or purple:
 20a Branches 0–2, short, wiry and suberect; corm with papery, onion-skin-like, pale brown tunics not persisting; perianth tube ± 10 mm long; tepals 12–17 mm long 22. *I. monticola*
 20b Branches nearly always present, diverging; corm with fibrous, medium to coarse fibres; perianth tube 8–11 mm long and tepals 11–14 mm long:
 21a Branches mostly held at more than 45° from main axis, sometimes nearly horizontally; perianth tube 8–11 mm long; filaments exerted (1–)2 mm or included in tube; anthers 4.0–5.5 mm long 19. *I. divaricata*
 21b Branches ascending; perianth tube 12–14 mm long; filaments exerted ± 4 mm from tube; anthers ± 6 mm long 34. *I. cedarmontana*
 18b Branches and main spike always 1-flowered or branches twisted and flexuose, with flowers not obviously crowded in distal half:
 22a Perianth tube 11–23 mm long; tepals 13–23 mm long; bracts pale and translucent with dark veins evident 21. *I. latifolia*
 22b Perianth tube (5–)6–11 mm long; tepals 10–15 mm long; bract veins ± obscured:
 23a Bracts pale; stem with (1)2 or 3 short, wiry, twisted branches 5–8 mm long, each bearing a solitary flower 25. *I. ecklonii*
 23b Bracts purple to glossy brown and veins obscured; stem branching not as above:
 24a Plants mostly < 100 mm high; bracts 5–6 mm long, flushed purple; cormlets when present borne at base of corm 23. *I. parva*
 24b Plants mostly 250–450 mm high; bracts 7–10 mm long, glossy dark brown; cormlets borne on long, slender stolons 26. *I. brunneobracteata*
 13b Filaments not reaching mouth of perianth tube; anthers partly to entirely included in tube:
 25a Main spike long, straight and erect, lateral spikes ascending to spreading, with upright flowers crowded in distal half 19. *I. divaricata*
 25b Inflorescence not as above:
 26a Plants up to 150 mm high; flowers upright, purple with pale yellow cup; main spike and branchlets twisted and flexuose, inclined to nearly horizontal 44. *I. contorta*
 26b Plants usually taller; flowers not as above:
 27a Perianth tube (12–)13–20 mm long; anthers partially or fully included in perianth tube:
 28a Anthers half exerted from perianth tube; cormlets borne at base of main corm 41. *I. namaquana*
 28b Anthers fully included in perianth tube; cormlets borne at ends of flattened stolons 42. *I. oxalidiflora*
 27b Perianth tube 5–12(–14) mm long; anthers partly included in perianth tube:
 29a Leaf blades of lower two or three leaves 8–15 mm wide (rarely 3–7 mm); filaments 2–4 mm long:
 30a Bracts and prophylls subtending branches attenuate, up to 5 mm long, often deflexed distally; leaves 2(1) with well-developed blades; perianth tube (10–)12–14 mm long; outer bracts with (4)5 major veins, 5-toothed 39. *I. lacerata*
 30b Bracts and prophylls subtending branches short, obtuse to truncate, < 2 mm long; leaves 2 or 3(4) with well-developed blades; perianth tube 5.5–8.0(–10.2) mm long; outer bracts with 3 major veins, 3-toothed or 3-lobed:
 31a Foliage leaves 2(3), blades usually falcate; base of stem rarely with fibrous collar; anthers 2.3–3.5 mm long 36. *I. rapunculoides*
 31b Foliage leaves 3(4); blades usually sword-shaped; base of stem covered by a collar of fibres; anthers 3.5–4.0 mm long 37. *I. robusta*
 29b Leaf blades mostly 2.0–3.5 mm wide; filaments 3–4 mm long:
 32a Plants of streambanks and marshes, often growing in water; perianth tube 8–9 mm long; flowers white with yellow throat 38. *I. rivulicola*
 32b Plants of hillsides and flats; perianth tube 5–10 mm long; flowers white (rarely flushed pale blue), or pale pink, slate-blue with white or yellow throat, horizontal to nodding:
 33a Corm tunics of firm, fine to medium-textured, netted fibres accumulating with age; corms bearing sessile cormlets at base (and rarely a slender stolon); perianth whitish or flushed palest blue with white throat; style dividing opposite middle of anthers, style branches extending beyond them 40. *I. mollis*
 33b Corm tunics of soft, ± papery (not fibrous) layers, not accumulating significantly; corms bearing flattened, ribbon-like stolons; perianth pink, blue-grey, slate-blue or white; style dividing opposite anther tips, rarely beyond them, style branches extending beyond anthers 43. *I. sobolifera*

1. Sect. **Hyalis** (Baker) Diels in Engl. & Prantl, Die natürlichen Pflanzenfamilien edn 2, 15a: 486 (1930); Lewis: 149 (1962). Subgenus *Hyalis* Salisb. ex Baker: 161 (1892); Goldblatt & Manning: 63 (1999). Type: *Ixia paniculata* D.Delaroche, lecto., effectively designated by Lewis 1962: 149.

Leaves usually at least 4, sometimes up to 10, in a loose fan with uppermost leaves not sharply distinct from lower and usually not entirely sheathing but distal portion with a produced blade. Spike with outer bracts usually dry-membranous and opaque, outer with 1(or 3) prominent veins and with 1 or sometimes three teeth,

the central usually longest. *Flowers* variously coloured, rarely pale blue-mauve, usually erect or ascending; perianth tube hollow to base or walls of tube clasping style in proximal half, funnel-shaped to cylindric; tepals subequal, spreading. *Stamens* symmetrically arranged in a ring around central style and contiguous, rarely unilateral, then horizontal or declinate; filaments inserted at base of upper part of tube, decurrent, not expanded below, included to well-exserted; anthers splitting longitudinally, exserted, partly included or rarely fully included. *Ovary* and *capsules* smooth, rarely papillate (*Ixia pumilio*); style slender, central and straight, or when stamens unilateral then displaced to lie beneath filaments.

1.1. Series *Hyalis*

1. *Ixia pumilio* Goldblatt & Snijman in South African Journal of Botany 51: 68 (1985). Type: South Africa, [Western Cape], banks of the Breede River south of Worcester, Farm Reiersrus, 30 Aug. 1983, Snijman 737 (NBG, holo.!; K!, MO!, PRE!, iso.).

Plants mostly 120–160 mm high, simple or with 1, rarely 2 or 3 short branches subtended by dry, attenuate, translucent bracts and prophylls $\pm$ 3 mm long. *Corm* 7–12 mm diam. with tunics of fine netted fibres. *Leaves* 3 or 4, upper 1 or 2 partly sheathing stem; blades narrowly sword-shaped to sublinear, reaching to base or middle of spike, 2–5 mm wide; midrib slightly thickened. *Spike* elongate, mostly 6–10-flowered, branches with fewer flowers; bracts dry-membranous, pale brown, mostly 8–9 mm long, outer with a prominent central vein, acute or obscurely 3-toothed, the inner 2-veined and forked apically, usually slightly exceeding outer. *Flowers* $\pm$ erect, old rose (brick-red), with conspicuously darker veins, unscented; perianth tube funnel-shaped, widening in upper half, 8–10 mm long; tepals subequal, ovate-oblong, 11–13(–16) $\times$ 5.5–6.0 mm, spreading horizontally. *Stamens* with filaments 5–6 mm long, exserted $\pm$ 3 mm from tube; anthers 4.0–5.5 mm long, yellow. *Style* dark purple, dividing opposite middle of anthers, style branches $\pm$ 1.5 mm long; ovary surface minutely warty. *Flowering time*: mid-August to mid-September.

Distribution: an extremely local endemic, *Ixia pumilio* is known only from the Farm Reiersrus, near Moordkuil south of Worcester (Figure 1). Plants grow in alluvial sand close to the Breede River. Because it is so highly localized, the species must be regarded as endangered.

Diagnosis and relationships: discovered by Cape Town botanist Dee Snijman in 1983, this rare species is distinguished by its low stature (the feature for which the species is named), with plants seldom exceeding 150 mm, unusual dull reddish pink flowers and dry, pale brown, opaque bracts. The filaments of *Ixia pumilio* are exserted $\pm$ 4 mm from the perianth tube and the dark purple style divides opposite the middle of the anthers. The ovary and capsule are unusual in the genus in their minutely warty surface.

We offer no suggestions about the immediate relationships of the species. The fan of leaves and outer flor-

al bract with a single prominent vein place the species in sect. *Hyalis* and with its lack of obvious floral specializations, apart from the unusual colour, we place it in the unspecialized series *Hyalis*. *Ixia pumilio* is an attractive plant and is a perfect subject for container culture.

Additional specimens

WESTERN CAPE.—3319 (Worcester): Aan-de-Dooms, Farm Reiersrus, alluvial sand along banks of Breede River, (–CB), 26 Sept. 1983 (fr.), Goldblatt & Snijman 6960A (MO, NBG).

2. *Ixia leipoldtii* G.J.Lewis in Annals of the South African Museum 40: 212 (1954); Lewis: 87 (1962). Type: South Africa, [Western Cape], Eikekraal, east of Prince Albert, 27 Sept. 1935, Leipoldt s.n. (BOL21808, holo.!; SAM, iso.).

Plants mostly 150–200 mm high, simple or with 1 or 2 short branches subtended by dry, translucent brown, attenuate bracts and prophylls 3–5 mm long. *Corm* 1.0–1.4 mm diam., with tunics of medium-textured fibres. *Leaves* usually 3 or 4, lower 2 (or 3) with expanded blades, lanceolate to falcate, $\pm$ half as long as stem, upper leaf sheathing stem in lower two-thirds, free in upper third. *Spike* erect, 2–4(–6)-flowered; bracts dry-membranous, translucent brown with dark veins, 8–9 mm long, outer 3-veined, with 3 subacute teeth, central tooth longest, inner 2-veined and forked at apex, slightly shorter than outer. *Flowers* erect, white with a large dark red-purple centre, unscented; perianth tube funnel-shaped, $\pm$ 11 mm long; tepals ascending below, spreading above, ovate, (17–)20–22 $\times$ 11–13 mm. *Stamens* with filaments 3–4 mm long, included in tube; anthers 4–5 mm long, yellow, bases included in tube. *Style* dividing opposite lower third of anthers, style branches $\pm$ 2 mm long. *Flowering time*: September.

Distribution: *Ixia leipoldtii* is known with certainty only from the heights at the top of Op-de-Tradouw Pass, west of Barrydale in the Little Karoo (Figure 1); plants grow in stony clay loam. Just a few plants are currently known to exist, growing among rocky islands in ploughed land. The type collection is reputedly from the Farm Eikekraal, east of Prince Albert but that locality remains to be confirmed. Despite some searching at Eikekraal it has not been re-collected there (J.H.J. Vlok pers. comm.), a fair distance from Barrydale, and its

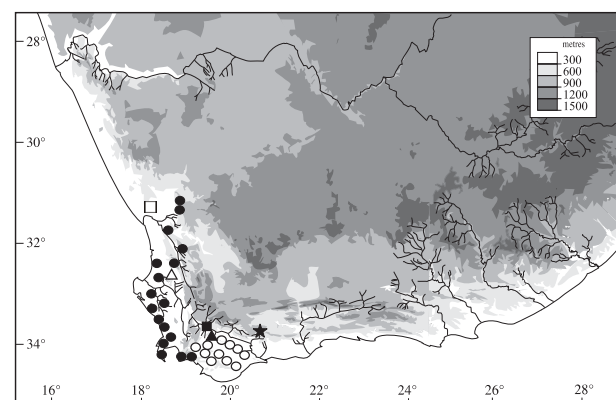


FIGURE 1.—Known distribution of *Ixia pumilio*, ■; *I. leipoldtii*, ★; *I. longituba*, ○; *I. bellendenii*, ▲; *I. splendida*, △; *I. acaulis*, □; and *I. paniculata*, ●.

occurrence near Prince Albert now seems doubtful. The species is, as far as we know, on the verge of extinction in the wild, but plants that we have introduced to cultivation at the South African National Botanic Gardens, Kirstenbosch, are thriving, and seem well suited to container and rock garden culture. It is one of the most seriously endangered species of the genus.

Diagnosis and relationships: a striking plant in full bloom, *Ixia leipoldtii* has large, white flowers with a dark purple central blotch that are eye-catching by themselves but in so small a plant appear remarkable. Apart from the unusual flower colour, *I. leipoldtii* is readily distinguished by the translucent brown bracts, broadly ovate to almost orbicular tepals, and filaments included in the perianth tube. We have no informed opinion about its relationships except that it appears to be an unspecialized member of series *Hyalis*, having a relatively short perianth tube, a weak distinction between lower and upper leaves, and outer floral bracts with a single or dominant central cusp.

Selected specimens

WESTERN CAPE.—3320 (Montagu): fields at top of Op-de-Trouw Pass, (–CC), 12 Sept. 1994, Goldblatt & Manning 9987 (MO, NBG); flats (*vlakke*) near Barrydale, 2300' [700 m], (–CC), Sept. 1923, Levyns 545 (BOL).

3. *Ixia longituba* N.E.Br. in Journal of the Linnean Society, Botany 48: 44 (1928); Lewis: 156 (1962). Type: South Africa, without precise locality, illustration in Ker Gawler in Curtis's Botanical Magazine 16: t. 589 (1802a).

Plants (180–)250–450 mm high, simple or more often 1- or 2-, rarely 3-branched; branches subtended by pale, membranous, attenuate bracts and prophylls 3–5 mm long. *Corm* depressed-globose, with tunics of pale, fine fibres. *Leaves* mostly 4–8, ± sword-shaped to lanceolate, usually reaching to ± base of spike, 5–15 mm wide, firm-textured; margins moderately to heavily thickened, sometimes crisped. *Spike* densely 7–12-flowered, branches, when present, with fewer flowers; bracts pale and ± translucent, often flushed pink distally, outer with a single prominent vein and 1- or obscurely 3-toothed, inner forked at tips, 2-toothed, ± as long or slightly longer than outer. *Flowers* ± suberect to almost horizontal, pale to deep pink (except for rare white sports), darker pink at tepal bases, pale green to yellow in mouth of tube, unscented; perianth tube slender, widening slightly near mouth, (10–)12–33(–35) mm long, 3–4 mm wide at mouth; tepals subequal, spreading horizontally, 16–22 × 7–11 mm, inner narrower than outer. *Stamens* with filaments 5–10 mm long, inserted 2–3 mm below mouth of perianth tube, thus exerted 3–7 mm; anthers 4–6 mm long, yellow. *Style* mostly dividing opposite top of filaments or lower to middle third of anthers, rarely shortly beyond anther tips, style branches 3–5 mm long. *Flowering time*: mid-September to late October.

Distribution: *Ixia longituba* occurs widely across the Caledon District of Western Cape, extending from the Bot River in the west to Swellendam and Bredasdorp in the east and south (Figure 1). A relatively late-blooming species, it occurs at low elevations and usually on heavy clay soils, but the species has also been recorded on dry, stony, sandstone slopes.

Diagnosis and relationships: pink-flowered *Ixia longituba* is distinguished among the longer-tubed species of sect. *Hyalis* by flower colour combined with filaments exerted 5–7 mm, anthers 4–6 mm long and well-developed style branches 3–5 mm long. Perianth tube length is remarkably variable, mostly 12–33 mm long, but as short as 10 mm and occasionally as long as 35 mm.

The species first appeared in the botanical literature in 1802 as a painting in Curtis's *Botanical Magazine*, which John Ker Gawler (1802a) identified as *Ixia aristata* Thunb. Although the type of the latter species is now known to be *I. campanulata* Houtt. (Lewis 1962), the name *I. aristata* remained in use for *I. longituba* throughout the 19th century. Only after N.E. Brown (1929) examined the Iridaceae of the Thunberg herbarium, did the correct identity of *I. aristata* become established and Brown then provided the name *I. longituba* for the plant illustrated in Curtis's *Botanical Magazine*.

De Vos (1999) treated *Ixia bellendenii* as a synonym of *I. longituba*, reducing it to the rank of subspecies because she regarded the two as overlapping in their critical morphological features, especially perianth tube, filament and anther length, and point of division of style. After examining all the available specimens in South African herbaria, we have concluded that *I. bellendenii*, as typified by the white-flowered plant figured in Curtis's *Botanical Magazine* (Ker Gawler 1812b), must be treated as a separate species. It is readily distinguished from *I. longituba* by a perianth tube 35–40 mm long, filaments exerted up to 11 mm, and style branches, 1.5–2.0 mm long, shorter than in long- or short-tubed morphs of *I. longiflora*. Collections of *I. longituba* always have pink flowers (with the exception of white-flowered sports) with an unusually wide range of perianth tube lengths, 10–33(–35) mm. We provisionally recognize two subspecies in *I. longituba*, which we circumscribe slightly differently than De Vos (1999). We reserve subsp. *longituba* for plants with a perianth tube (10–)12–23 mm long and describe subsp. *macrosiphon* for those with a tube 25–35 mm long. With this circumscription, subsp. *macrosiphon* comprises the northern populations of the species, all close to the foot of the Riviersonderend Mtns. We note however, that plants from the south of its range near Bredasdorp, may have a perianth tube 22–23 mm long. This indicates that there is no cline in tube length across the range from south to north.

Observations on the pollination biology of a long-tubed population of *Ixia longituba* show the species is pollinated by the long-proboscid horsefly, *Philolich gulosa* (Goldblatt *et al.* 2000).

Key to subspecies

- 1a Perianth tube (10–)12–23 mm long; filaments 5–9 mm long and exerted 3–6 mm from tube; anthers 4–5 mm long 3a. subsp. *longituba*
- 1b Perianth tube 25–33(–35) mm long; filaments 8–10 mm long and exerted 6–7 mm from tube; anthers 5–6 mm long 3b. subsp. *macrosiphon*

3a. subsp. *longituba*

Flowers with perianth tube (10–)12–23 mm long; tepals 14–18 × 6–9 mm. *Stamens* with filaments 5–9

mm long, exerted 3–6 mm from mouth of tube; anthers 4–5 mm. *Style* dividing opposite middle third to apex of anthers, rarely at apex of filaments.

Distribution: subsp. *longituba* extends from the Bot River in the west to Swellendam in the east, and as far south as Bredasdorp, thus in the central and southern part of the range of *Ixia longituba*.

Selected specimens

WESTERN CAPE.—3419 (Caledon): Van der Stel's Pass, Bot River to Villiersdorp, (–AA), Oct. 1983, *Paine s.n.* (MO); 7.5 miles [11 km] SSE of Eerstehoop, coastal renosterveld, 500' [152 m], (–AA), 15 Oct. 1969, *Acocks 24265* (PRE); Caledon, commonage east of town, (–AB), 9 Oct. 1995, *Goldblatt & Manning 10310* (MO); west of Riviersonderend, (–BB), flowers pink or white, Sept. 1969, *Goldblatt 452* (BOL); 1 km south of Jongensklip, (–BC), 18 Oct. 2001, *Helme 2230* (NBG); vlei between Bredasdorp and Elim, (–DB), 24 Sept. 1933, *Dymond s.n.* (BOL). 3420 (Bredasdorp): Swellendam, (–BB), 5 Oct. 1929, *Van der Merwe s.n.* (Nat. Bot. Gard. 1780/29 in BOL); The Poort, Bredasdorp, (–CA), 3 Sept. 1943, *Van Niekerk 322* (NBG).

3b. subsp. ***macrosiphon*** *Goldblatt & J.C.Manning*, subsp. nov.

Flores tubo perianthii 25–33(–35) mm longo, tepalis 16–22 × 8–11 mm, filamentis 8–10 mm longis ex tubo 6–7 mm exsertis, antheris 5–6 mm longis, stylo usitate inter basem et medium antherarum dividenti.

TYPE.—[Western Cape], 3419 (Caledon): hills 6 km SW of Greyton, (–BA), 8 Oct. 1995, *Goldblatt & Manning 10341* (NBG, holo., MO, iso.).

Flowers with perianth tube 25–33(–35) mm long, tepals 16–22 × 8–11 mm. *Stamens* with filaments 8–10 mm long, exerted 6–7 mm from mouth of tube; anthers 5–6 mm long. *Style* usually dividing between base and middle of anthers.

Distribution: subsp. *macrosiphon* is known from a few populations in heavy clay ground at the foot of the Riviersonderend Mtns, thus in the northernmost part of the range of *Ixia longituba*.

Selected specimens

WESTERN CAPE.—3419 (Caledon): Villiersdorp, (–AA), 2 Oct. 1940, *Leipoldt 3610* (BOL); near Genadendal '*Ixia paniculata* var. *ten-uiflora*', (–BA), without date, *Drège 8375* (MO); foot of Riviersonderend Mtns between Stormsvlei and Bonnievale, stony sandstone, (–BB), 3 Oct. 1980, *Goldblatt 5912* (MO, NBG).

4. ***Ixia bellendenii*** *R.C.Foster* in Contributions of the Gray Herbarium, Harvard University 114: 47 (1936), as replacement name for *Tritonia rochensis* Ker Gawl.: t. 1503 (1812a); Lewis: 155 (1959). *T. rocheana* Sweet: 398 (1826), orth. var. pro *T. rochensis* Ker Gawl. *Waitzia rochensis* (Ker Gawl.) Heynh. 2: 855 (1841). *Montbretia rocheana* (Ker Gawl.) Heynh.: 418 (1847), orth. var. pro '*rochensis*'. *Crocosmia rochensis* (Ker Gawl.) Klatt in Peters: 516 (1864). *Morphixia paniculata* var. *rochensis* (Ker Gawl.) Baker: 97 (1877). *Ixia paniculata* var. *rochensis* (Ker Gawl.) Baker: 166 (1892). *I. rochensis* (Ker Gawl.) L.Bolus: 133 (1929a), illegit. homonym, not *I. rochensis* Ker Gawl. (1803c) (= *Geissorhiza radians* (Thunb.) Goldblatt. *I. longituba* var. *bellendenii* (R.C.Foster) M.P.de Vos: 63 (1999). Type: South Africa,

without precise locality, illustration in Ker Gawler in Curtis's Botanical Magazine 37: t. 1503 (1812a).

Plants 400–550 mm high, simple or with 1–3 branchlets; branches subtended by translucent, deltoid-apiculate bracts 5–6 mm long and long-awned prophylls 7–8 mm long. *Corm* globose 18–22 mm diam., with tunics of fibrous layers. *Leaves* mostly 4 or 5, lower 3 or 4 with fully developed blades, firm-textured, ± sword-shaped to lanceolate, reaching to ± middle of stem, (2–)5–10 mm wide, dry at flowering; margins moderately to heavily thickened, sometimes crisped. *Spike* mostly 6–12-flowered; bracts ± opaque-whitish, tinged pink distally, 6–9 mm long, veins slightly darkened distally, outer with a single prominent vein, subacute or with a short apical tooth, inner forked at tips, 2-toothed, 1–2 mm longer than outer. *Flowers* spreading horizontally, ± white with pink to purple veins outside, veins becoming more pronounced with age, yellow in tube and greenish yellow at tepal bases, unscented; perianth tube slender, widening slightly toward mouth, 35–40 mm long, ± 2.5 mm wide at mouth; tepals subequal, spreading at right angles to tube, 18–22 × 6–10 mm. *Stamens* with filaments ± 15 mm long, exerted ± 11 mm; anthers 5–6 mm long. *Style* dividing opposite upper half of anthers, sometimes up to 6 mm beyond anthers, style branches 1.5–2.0 mm long. *Flowering time*: mid-November to early December. Figure 2.

Distribution: *Ixia bellendenii* is restricted to the northern slopes of the Riviersonderend Mtns. Plants grow in loamy sand among sandstone rocks on the lower and middle slopes, a relatively dry habitat, and flower late in the season by which time the leaves are dry and withered (Figure 1).

Diagnosis and relationships: the species is readily recognized by the almost white flowers suffused pale pink outside, an elongate perianth tube 35–40 mm long, and well-exserted filaments, 15 mm long, bearing prominent anthers 5–6 mm long.

Ixia bellendenii has been known since it was first illustrated in Curtis's Botanical Magazine in 1812 when Ker Gawler named the plant *Tritonia rochensis*. Much confusion has surrounded the species since then for it was not known in the wild, as far as we can determine, until specimens were collected by Worcester naturalist, I.B. Walters, in 1976. This and the few later collections were referred by M.P. de Vos to *I. longituba* subsp. *bellendenii*, in which she also included shorter-tubed, pink-flowered plants. Baker (1877) was the first to realize that *Tritonia rochensis* was misplaced in that genus and he referred it to *Morphixia* (the genus to which species of *Ixia* sects *Morphixia* and *Hyalis* were then referred) as a variety of *M. paniculata* (now *Ixia paniculata*). Even after the union of *Ixia* and *Morphixia* by Baker (1892), *I. bellendenii* remained a variety of the very different *I. paniculata* (which typically has dark-coloured, included anthers and usually a substantially longer perianth tube). H.M.L. Bolus (1929a) once again raised the plant to species rank, but under the combination *I. rochensis*, unfortunately a homonym. R.C. Foster provided the replacement name *I. bellendenii* in 1936.



FIGURE 2.—*Ixia bellendenii*, Manning 3124 (NBG): A, plant; B, half-flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

G.J. Lewis (1962) recognized the species but included shorter-tubed, pink-flowered plants (tube 25–32 mm long) in her circumscription that we believe are better referred to *Ixia longituba*. Her account is easy to understand for at the time, no white-flowered *I. bellendenii* was known in the wild and it was not possible to accurately measure floral parts in the type painting. In De Vos's (1999) account of the genus, *I. bellendenii* was treated as a subspecies of *I. longituba*, distinguished in her key by the longer style (directly correlated with the longer perianth tube (20–)25–35(–45) mm long) and cream-coloured or sometimes pink perianth. We have examined all available collections of *I. longituba* and

find a nearly continuous range of perianth tube length, 10–33 mm, among plants with pink flowers. These plants, without exception, flower from September to mid-October, occur on clay soils south of the Riviersonderend Mtns, and have green leaves at flowering. Details of the flowers include: tepals 16–22 mm long, filaments exserted 5–7 mm, anthers 4–6 mm, and style branches 3.0–4.5 mm long. The four collections of *I. bellendenii* now available, have flowers with tepals 18–22 mm long, filaments $\pm$ 15 mm long and exserted $\pm$ 11 mm, anthers 5–6 mm and style branches 1.5–2.0 mm long. The longer filaments and shorter style branches compared with *I. longituba*, combined with a perianth tube 35–40

mm long and white perianth in plants that are isolated geographically, favour a different substrate (sandy loam vs clay) and flower at least a month or even two months later, indicate to us that a narrowly circumscribed *I. bellendenii* should be regarded as separate from *I. longituba*, to which it is, nevertheless, almost certainly immediately related.

Pollination biology of *Ixia bellendenii* is unknown but the flowers exhibit the hallmarks of long-proboscid fly pollination. The most likely pollinator is the tabanid fly, *Philoliche rostrata*.

Selected specimens

WESTERN CAPE.—3319 (Worcester): near Jonas Kop TV aerial, nearest beacon 44, (–DC), 30 Nov. 1976, Walters 1596 (NBG); Jonaskop, among sandstone rocks on lower slopes, (–DC), 26 Nov. 1989, Snijman 1243 (NBG, PRE); Jonaskop, between 2nd and 3rd gate, (–DC), 9 Dec. 1987, De Vos 2700 (NBG, PRE); Jonaskop, 2nd gate near bottom of mountain (–DC), 30 Nov. 2007, Manning 3124 (MO, NBG).

5. *Ixia splendida* G.J.Lewis in Journal of South African Botany 4: 9 (1938); Lewis: 153 (1962). Type: South Africa, [Western Cape], 3218 (Clanwilliam): Piketberg, Zebrakop, near stream, (–DA), 10 Nov. 1934, Pillans 7183 (BOL, lecto.! [as ‘holo.’], designated by De Vos 1999: 65; BOL!, PRE!, SAM!, iso.).

Plants 300–600 mm high, simple or with a single short branch subtended by acute, translucent bracts and prophylls $\pm$ 1 mm long. *Corm* 14–18 mm diam., with tunics of fine, netted fibres. *Leaves* 5–7, all with expanded blades, narrowly sword-shaped to sublinear, 2–5 mm wide, reaching to $\pm$ middle of stem, upper 2 leaves sheathing stem for half to two thirds their length. *Spike* densely 5–7-flowered; bracts membranous and translucent, evidently dry and turning brown near tips, 6–7 mm long, outer weakly 3-veined, truncate or obscurely 3-lobed, inner 2-veined and forked apically, $\pm$ as long as outer. *Flowers* pale brick-red or pink, evidently unscented; perianth tube subcylindric, slightly expanding from base to apex, 27–30 mm long; tepals subequal, oblong, obtuse to emarginate, 15–18 $\times$ 6–8 mm, spreading horizontally. *Stamens* with filaments 4–5 mm long, included in tube; anthers 5–6 mm long, included or tips exerted. *Style* dividing opposite lower third of anthers, style branches $\pm$ 1.5 mm long. *Flowering time*: mid-October and November.

Distribution: *Ixia splendida* remains known from just two collections from along a stream on the upper slopes of Zebrakop, highest peak of the Piketberg (Figure 1). We assume the habitat is the stony sandstone soil, typical of the Cape Fold Mountains but this remains to be established.

Diagnosis and relationships: *Ixia splendida* was discovered in 1934 by the Cape Town botanist, N.S. Pillans, and was described in 1938 by G.J. Lewis. It has been re-collected only once, close to the type locality, in 1973 by botanist H.P. Linder. The species is readily recognized by its slender perianth tube 27–30 mm long, expanding gradually and uniformly from base to apex, dull reddish or deep pink perianth, and fully included stamens. The floral bracts are also unusual: the outer of the pair is truncate and obscurely three-veined, whereas

the inner is fairly typical in having 2 veins and is shallowly forked at the tip. Lewis assumed that *I. splendida* was most closely related to the more widespread *I. paniculata*, which also has a long perianth tube and included stamens. Like the latter, the flowers are very likely adapted for pollination by long-proboscid nemestrinid and tabanid flies (Goldblatt *et al.* 2000). The flowers of *I. paniculata* are pale yellow to beige, sometimes almost white, and also have partly to fully included stamens, but the anthers are usually dark-coloured, almost black, and the perianth tube is cylindric and usually longer, up to 75 mm but only 35–50 mm at the southern end of its range, compared to the gradually flared tube 27–30 mm long and yellow anthers of *I. splendida*. In addition, the outer floral bracts of the two differ substantially. Whereas those of *I. paniculata* are elongate and attenuate, with a single prominent vein, those of *I. splendida* have 3 veins and are truncate or obscurely 3-lobed apically. The bract differences suggest to us that the two species may not be immediately related. The flowers of *I. splendida* resemble those of other species of *Ixia* that are adapted for pollination by long-proboscid flies and we assume that it has the same pollination system.

Also from Zebrakop are two collections of a long-tubed, white-flowered species, the perianth flushed pink on the outside, which like *I. splendida*, have included anthers. The tube, 18–20 mm long, and a fairly slender habit, makes it seem very different from *I. splendida*, but it also has short, truncate floral bracts, such a distinctive feature that this plant must be seen as immediately allied to *I. splendida*. Differences in flower colour, perianth tube and bract length, plus small differences in the length of the stamens and style branches suggest that the collections represent a novel taxon, which we describe below as *I. linderi*.

Additional specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, Zebrakop, gentle south-facing slopes in moist sand, often near water, $\pm$ 1 100 m, (–DA), 7 Nov. 1973, Linder 105 (BOL).

6. *Ixia linderi* Goldblatt & J.C.Manning, sp. nov.

Plantae 300–450 mm altae, foliis 3–4 linearibus 1.3–3.0 mm latis, caule eramoso, spica 2–6-flora, bracteis $\pm$ 5 mm longis bractea exteriore truncata sine venis fuscatis, floribus albis extra carneis suffusis, tubo perianthii subcylindrico 18–20 mm longo, tepalis $\pm$ 10 $\times$ 4 mm patentibus, staminibus inclusis filamentis $\pm$ 1.5 mm longis antheris $\pm$ 4 mm longis, ramis styli $\pm$ 1 mm longis.

TYPE.—Western Cape, 3218 (Clanwilliam): Piketberg, Zebrakop, east-facing ledges near water, $\pm$ 1 100 m, (–DA), 7 Nov. 1973, Linder 103 (BOL, holo.).

Plants 300–450 mm high, unbranched, base surrounded by persistent cataphylls forming a poorly developed collar around stem base. *Corm* 8–10 mm diam., with tunics of fine fibres. *Leaves* 3 or 4, $\pm$ linear, 1.5–3.0 mm wide, central vein prominent; margins slightly thickened. *Spike* 2–6-flowered; bracts membranous, evidently dry near tips, $\pm$ 5 mm long, outer without dark veins, truncate, inner 2-veined, veins pale, forked apically, slightly longer than outer. *Flowers* suberect, white

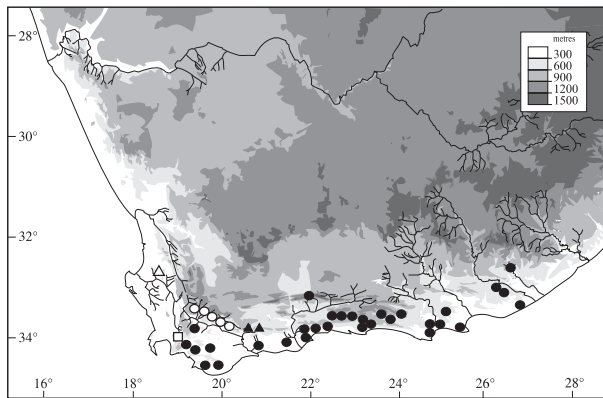


FIGURE 3.—Known distribution of *Ixia stohrii*, ▲; *I. linderi*, △; *I. cochlearis*, □; *I. fucata*, ○; and *I. orientalis*, ●.

or faintly pink, tepals flushed pale pink outside, presence of scent unknown; perianth tube subcylindric, gradually expanding from base to apex, 18–20 mm long; tepals subequal, oblong, obtuse, $\pm 10 \times 4$ mm, spreading horizontally. *Stamens* with filaments ± 1.5 mm long, inserted ± 6 mm below mouth of tube; anthers ± 4 mm long, apices just reaching mouth of tube. *Style* dividing shortly below anther bases, style branches ± 1 mm long, reaching lower third of anthers. *Flowering time*: November.

Distribution: *Ixia linderi* is known from just two collections from Zebrakop, highest peak in the Piketberg Range. Plants grow on moist sandstone slopes and rock ledges near water (Figure 3).

Diagnosis and relationships: the white flowers with a relatively long perianth tube, 18–20 mm long, with the stamens and style included in the tube, immediately set *Ixia linderi* apart in sect. *Morphixia*. The filaments, only 1.5 mm long, are inserted ± 6 mm below the mouth of the tube and the anthers, ± 4 mm long, just reach the mouth of the tube. The style divides just below the anther bases and the short style branches ± 1 mm long are retained within the tube. The species most closely resembles a second Piketberg endemic, *I. splendida*, but this species is a more robust plant with leaves up to 5 mm wide and larger, brick-red to pink flowers with a perianth tube 27–30 mm long. Like *I. linderi*, the flowers of *I. splendida* have the stamens and style included in the tube. Both species have distinctive, translucent, $\pm$ truncate floral bracts with minute terminal teeth.

Additional specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, Zebrakop, south slopes often near water, 3600' [± 1 200 m], (–DA), 7 Nov. 1973, *Linder 105* (BOL).

7. *Ixia acaulis* Goldblatt & J.C.Manning in Novon 3: 152 (1993). Type: South Africa, [Western Cape]: 3118 (Vanrhynsdorp): Knersvlakte, Farm Rooiberg, low limestone ridge, (–BC), 19 May 1992, *Snijman & Manning 1249* (NBG, holo.; MO!, PRE!, iso.).

Plants acaulescent, leaves and flowers reaching 20–30 mm above ground, often in small clumps, occasionally branched. *Corm* narrowly cone-shaped, ± 3 –4 mm wide near base, tapering above, ± 15 mm long, tunics moderately to finely fibrous, accumulating with age in a dense

covering. *Leaves* 3–5; blades linear to narrowly lanceolate, 1.5–2.0 mm wide, prostrate or inclined, leathery, without thickened margins or midrib. *Spike* 1- or 2-flowered; bracts membranous, ± 10 mm long, reaching up to 5 mm above ground, outer with upper margin slightly fringed, inner 2-veined and shallowly forked apically. *Flowers* yellow, whitish in tube, unscented or faintly sweet-scented; perianth tube 15–20 mm long, arising below ground level, extending ± 10 mm above ground, cylindric; tepals subequal, obtuse to emarginate, 6 – 7×3 mm, spreading horizontally. *Stamens* with filaments arising at top of tube, ± 1.5 mm long, decurrent; anthers ± 2 mm long. *Style* dividing at or just beyond mouth of tube, style branches short, ± 1 mm long, apices emerging between filaments. *Flowering time*: May and June, rarely in April. Figure 4.

Distribution: *Ixia acaulis* is restricted to the arid Knersvlakte of southern Namaqualand (Figure 1). Until 2009, just a single population is known from limestone ridges on the Farm Rooiberg. Then in 2010, during a survey of limestone outcrops in the Knersvlakte, Nick Helme found three more populations, one of them extensive, 20 km to the northwest of the type locality at Wolwenes. Corms are wedged in rock crevices and are very difficult to extract undamaged. Other limestone outcrops in the Knersvlakte, an area of predominantly fine clay soils often covered by a superficial layer of white quartz pebbles, remain to be examined for the presence of the species. The Knersvlakte has extremely low rainfall, less than 100 mm annually, normally falling in the late autumn and winter months, and is known for its diversity of habitats and extreme local endemism, particularly among Aizoaceae–Mesembryanthemoideae. Iridaceae are not well represented here, but other Knersvlakte endemics in the family include *Babiana carminea*, which grows at the same site as *I. acaulis*, *Moraea deserticola* and *M. knersvlaktensis* (both Iridoideae), and *Lapeirousia angustifolia* (if this is regarded as distinct from the related *L. pyramidalis*). Helme noted that at the Wolwenes site, flowers were being visited by numbers of *Cynthia cardui* butterflies, and butterflies, not exclusively *C. cardui*, are likely pollinators, as they have probosces long enough to access nectar in the base of the perianth tube.

Diagnosis and relationships: when first collected, the appropriate genus for the tiny, acaulescent species was in doubt. The smooth, red-brown seeds with an excluded ovular vascular trace placed the species in tribe Ixieae (sensu Goldblatt *et al.* 2006, as Croceae) which included genera such as *Ixia*, *Sparaxis*, and *Tritonia*. Leaf anatomy and pollen morphology provided the primary evidence for its assignment to *Ixia*: this is the only genus among several in the tribe that has leaf margins with unmodified marginal epidermis and a submarginal sclerenchyma trace associated with marginal veins and pollen grains with a single band of exine in the aperture. The immediate relationships of *I. acaulis* within *Ixia* are uncertain, but it obviously belongs either in sects *Hyalis* or *Morphixia* because of the decurrent filaments. We favour sect. *Hyalis* because of the membranous bracts without prominent veins. Similar fringed outer bracts are found in *I. linderi* and *I. splendida*, both of which also have an elongate perianth tube but have well-devel-



FIGURE 4.—*Ixia acaulis*, Perry 3732 (NBG): A, flowering plants; B, flower and bracts; C, detail of stamen insertion; D, c/s floral tube showing decurrent filaments; E, outer bract; F, inner bract. Scale bar: A, B, E, F, 10 mm; C, D, 2.5 mm. Artist: J.C. Manning.

oped aerial stems and anthers included in the perianth tube. The capsules, described by Goldblatt & Manning (1993), are typical of the genus, but are borne at ground level.

Selected specimens

WESTERN CAPE.—3118 (Vanhynsdorp): Knersvlakte, Farm Rooiberg, low limestone ridge, (–BC), June 1991, *Perry s.n.* (NBG); 27 Aug. 1991 (fr.), *Goldblatt & Manning 9132* (MO, NBG, PRE); Wolwenes, 20 km NW of Kwaggaskop, (–BC), 24 June 2010, *Helme 6550, 6551* (BOL, NBG); Rooiberg, 2 km west of Kwaggaskop, (–BC), 23 June 2010, *Helme 6552* (BOL, NBG).

8. *Ixia paniculata* D.Delaroche, *Descriptiones plantarum aliquot novarum*: 26, t. 1 (1766); Lewis: 149 (1962). *Morphixia paniculata* (D.Delaroche) Baker: 97

(1877). *Tritonia paniculata* (D.Delaroche) Klatt: 358 (1882). Type: South Africa, without precise locality or collector, Herb. Burman (G-DEL, holo!).

I. longiflora P.J.Bergius: 7, 360 (1767), illegit. superfl. name for *I. paniculata* D.Delaroche. *Tritonia longiflora* (P.J.Bergius) Ker Gawl.: 228 (1804). *Gladiolus longiflorus* (P.J.Bergius) Jacq. (1794), illegit. homonym, not L.f. (1782). *Hyalis longiflora* (P.J.Bergius) Salisb.: 318 (1812). *Babiana longiflora* (P.J.Bergius) Steud.: 683 (1821). Type: South Africa, without precise locality, cultivated in Holland, *Kallstrom s.n.* (HBT, holo.–scanned image!).

Houttuynia capensis Houtt.: 448 (1780). *Tritonia capensis* (Houtt.) Ker Gawl.: t. 618 (1803b). *Montbretia capensis* (Houtt.) Voigt: 611 (1845). *Waitzia capensis* (Houtt.) Reichb.: 6 (1856). *Acidanthera capensis* (Houtt.) Benth. ex Baker: 187 (1892). Type: South Africa, without precise locality, cultivated in Holland, illustration in Houttuyn, *Natuurlijke historie* 12: t. 85, f. 3 (1780).

I. longiflora Lam.: 342 (1789), hom. illegit. non P.J.Bergius. Type: uncertain, P (Herb. Lamarck or Herb. Jussieu).

I. tenuiflora Vahl: 66 (1805). *Tritonia tenuiflora* (Vahl) Ker Gawl.: sub t. 1275 (1810). *Waitzia tenuiflora* (Ker Gawl.) Heynh. 2: 855 (1841). *Montbretia tenuiflora* (Ker Gawl.) Voigt: 611 (1845). *Crocosmia tenuiflora* (Ker Gawl.) Klatt in Peters: 516 (1864). *Morphixia paniculata* var. *tenuiflora* (Vahl) Baker: 97 (1877). *Ixia paniculata* var. *tenuiflora* (Vahl) Baker: 166 (1892). Type: evidently unknown, possibly Herb. Vahl: C.

Gladiolus ixioides Thunb.: 208 (1811). Type: South Africa, without precise locality, *Thunberg s.n.* (UPS-THUNB 1035, holo.!).

Tritonia concolor Sweet: 398 (1826). *Waitzia concolor* (Sweet) Heynh. 2: 854 (1841). *Montbretia concolor* (Sweet) Voigt: 611 (1845). Type: South Africa, without precise locality or collector, illustration in Ker Gawler in Curtis's Botanical Magazine 37: t. 1502, var. γ , *corolla ochroleuca concolor* (1812b).

Plants 500–650 mm high, simple or often with 1 or 2 ascending to horizontal branches, these subtended by dry, cuspidate, brown-flecked bracts and prophylls 1.5–3.0 mm long. *Corm* 15–20 mm diam., with tunics of medium-textured, wiry netted fibres, often bearing cormlets on short, thick stolons. *Leaves* 5 or 6 in a loose fan, lower leaves becoming dry and brown at flowering; blades lanceolate, often slightly twisted in upper half, mostly 4–7 mm wide, reaching to middle or to near top of stem; margins and midrib slightly thickened. *Spike* crowded, 8–16-flowered, branches mostly 3–8-flowered; bracts membranous, translucent below but sparsely to closely flecked with rust-brown distally, (7–)9–15 mm long, outer with 1 prominent vein, acute or obscurely 3-lobed with a prominent central tooth, inner 2-veined, $\pm$ as long as outer or slightly longer or shorter, 2-veined, forked apically. *Flowers* pale yellow to creamy beige, lower fifth of tepals sometimes darker coloured, unscented; perianth tube cylindrical, 35–65(–75) mm long, widened in upper 3–5 mm; tepals oblong-elliptic, 16–25 mm long, outer $\pm$ 6 mm, inner $\pm$ 4 mm wide. *Stamens* with filaments 5–6 mm long, included, inserted 8–10 mm below mouth of tube, rarely fully exerted; anthers 4.5–7.0 mm long, dark purple (rarely pale), half to fully included with tips $\pm$ 1 mm below mouth of tube, rarely fully exerted. *Style* dividing opposite lower to upper third of anthers, rarely opposite anther tips or up to 3 mm beyond them, style branches $\pm$ 2 mm long. *Flowering time*: mid-November to early December.

Distribution: *Ixia paniculata* extends from the Bokkeveld Mtns, north of Nieuwoudtville in Northern Cape, to the coast of Western Cape near Kleinmond, thus throughout the western half of Western Cape (Figure 3). Plants occur both in montane habitats and on the coastal plain and favour sandy or stony sandstone ground in seasonally wet situations, either in seeps, drainage lines or along streams. In habitats that become overgrown with scrub and reeds, plants flower only after fire or when the surrounding vegetation has been cleared. Numerous records (e.g. Lewis 1962) indicate that the species was once common on the Cape Peninsula and Cape Flats, where it is rare today, a reflection of rapid urban development and growth of the human population in the vicinity of Cape Town. The species is naturalized as a weed of damp places and roadside ditches in parts of Western Australia.

Diagnosis and relationships: *Ixia paniculata* is distinctive in its fairly tall habit and remarkably long-tubed

flowers, the tube usually 40–65 mm long, with the darkly coloured anthers at least half included in the tube (very rarely just exerted). The perianth is pale yellow to pale beige, the undersides of the tepals often flushed with pink or red.

The species is moderately variable in floral features, most obviously in perianth tube length, which shows a weak geographic pattern. Plants from inland areas in the north of the range, from Piketberg to the Bokkeveld Mtns have tubes 45–65 mm long, but those from the coast north of Cape Town are consistently long-tubed, 65–75 mm (*Goldblatt & Manning 10051*, from Modder River south of Darling). Plants from the Cape Peninsula and the False Bay coast have shorter tubes 35–55 mm long. Collections from the Cape Flats (*Esterhuysen 32349*) stand out in their pale anthers and style dividing $\pm$ 2 mm beyond the anther tips. In other collections we have examined the style divides between the lower and upper third of the anthers, exceptionally opposite the anther tips. The anthers, usually dark brown or almost black, are typically 5.0–6.5 mm long and half exerted, but are fully included in *Porter s.n.* from Hangklip Estates. The plants of the Cape Flats are particularly unusual, not only in the short tube and long style but the pale anthers are only 4.5 mm long. We have seen no examples of the style dividing below the base of the anthers, as mentioned by Lewis (1962) and suspect she may have examined immature flowers. The style elongates late during floral maturation and only reaches its full length on the second day of anthesis. Lewis discussed the floral variation in her account of the species and reached much the same conclusions as we have, that no infraspecific taxa merit recognition.

The flowers are adapted for pollination by long-proboscid flies (Manning & Goldblatt 1997) and along the west coast are pollinated by *Moegistorhynchus longirostris*. The species, at least in the Bokkeveld Mtns, sets seed in the absence of its pollinator, and is thus facultatively autogamous. Several other species pollinated by *M. longirostris* also have this adaptation, including *Babiana tubiflora* and *Lapeirousia anceps*, both of which co-occur with *Ixia paniculata* along the Cape west coast (Goldblatt & Manning 1997). We lack information on self-compatibility in other populations of the species.

A surprising hybrid, represented by a single clump of plants (*Mostert 393 NBG*; *Manning 3122 NBG*), was discovered by local plant enthusiast, Mr Louis Mostert, near Kleinmond. It represents a cross between *Ixia paniculata* and *I. dubia*, a short-tubed species of sect. *Ixia*. Hybrids in *Ixia* are rare in the wild and we know of no other records of intersectional hybrids in the genus.

History: described by D. Delaroche in 1766, *Ixia paniculata* was nevertheless known for the next 50 odd years as *I. longiflora*, a plant described by P.J. Bergius in 1767. Bergius himself realized that *I. paniculata* was the same species and included it as a synonym in the Addendum to his *Descriptiones plantarum ex capite bonae spei* but later authors, including Jacquin, Ker Gawler and Steudel, ignored this action. The species, transferred to *Gladiolus* by Jacquin (1794), to *Tritonia* by Ker Gawler (1812a) and to *Babiana* by Steudel (1821),

consistently bore the epithet *longiflora*. Additional synonyms in the early literature include *Houttuynia capensis* (Houttuyn 1780), *Ixia tenuiflora* (Vahl 1805) and *Gladiolus ixioides* (Thunberg 1811). The epithet *paniculata* was finally revived by Baker (1877) in the genus *Morphixia*, who treated Vahl's *Ixia tenuiflora* as var. *tenuiflora* of *Morphixia paniculata*. The species was returned to *Ixia* by Baker (1892, 1896) when he united *Ixia* and *Morphixia*. Variants of *I. paniculata* were illustrated together as early as 1812, in Curtis's *Botanical Magazine* under the name *Tritonia longiflora*. In this account, Ker Gawler regarded the form with included stamens and dark purple anthers as the 'typical' var. α , while treating a smaller-flowered plant with sulphur-coloured flowers as var. β and a plant with yellow anthers, partly included in the tube and a long style with the style branches remote from the anthers as var. γ . Robert Sweet named var. γ as *I. concolor* in 1826. These named taxa represent nothing but minor variants of *I. paniculata*.

Selected specimens

NORTHERN CAPE.—3119 (Calvinia): river bank close to Nieuwoudtville waterfall, (–AC), 18 Nov. 1995, *Goldblatt & Manning* 10429 (MO); Bokkeveld Mtns, Keyserfontein, in marsh, (–AC), 20 Nov. 1992, *Bean & Trinder-Smith* 2854 (BOL).

WESTERN CAPE.—3218 (Clanwilliam): St Helena Fontein, (–BB), Nov. 1943, *L. Bolus* 22298 (BOL); roadside N of Citrusdal turn-off on Clanwilliam road, (–DB), 14 Nov. 1979, *Goldblatt* 5117 (MO); Piketberg, Zuurvlakte, wet to swampy stream bank in sand, 2400' [730 m], (–DC), 3 Dec. 1973, *Linder* 138 (BOL). 3318 (Cape Town): Hopefield, (–AA), Oct. 1912, *Pattison* s.n. (BOL13674); Bokbaai, vlei ground, (–AD), 19 Sept. 1986, *De Vos* 2664 (PRE); 13 Oct. 1960, *Thomas* s.n. (NBG61139); $\pm$ 10 km N of Malmesbury, local in wet site, (–BC), 6 Nov. 1982, *Goldblatt* 6715 (MO); Wynberg, Cape Town, below 100' [30 m], (–CD), Nov. 1904, *Bolus* 4513 (BOL, MO); Kenilworth Race Course, (–CD), 4 Dec. 1969, *Esterhuysen* 32349 (BOL, MO). 3319 (Simonstown): Cape Peninsula, west of Buffels Bay and south of Groot Blaauwberg, (–AD), 22 Nov. 1921, *Pillans* 4565 (BOL); Hangklip Estate, (–BD), Oct. 1942, *Porter* s.n. (BOL26897). 3419 (Caledon): Kleinmond, 5 km E of town on edge of Botrivier Lagoon, (–AC), 6 Nov. 2003, *Manning & Mostert* 2911 (NBG); Kleinmond, Rooisand parking ground near Bot River vlei, floodplain in fynbos, (–AC), 15 Nov. 2007, *Manning* 3120 (NBG).

I. paniculata $\times$ *I. dubia* hybrid

WESTERN CAPE.—3419 (Caledon): Kleinmond, Rooisand parking, Bot River vlei, (–AC), 3 Dec. 2002, *Mostert* 393 (NBG); 15 Nov. 2007, *Manning* 3122 (NBG).

1.2. Series *Fucatae*

9. *Ixia cochlearis* G.J.Lewis in *The Flowering Plants of Africa* 25: t. 969 (1945); Lewis: 90 (1962). Type: South Africa, [Western Cape], Jonkershoek, Nov. 1943, *Wicht* s.n. (PRE27196, holo.!; BOL39125, iso!).

Plants mostly 200–300 mm high, unbranched, remains of old cataphylls and leaf bases persisting as a collar of fibres around base. *Corm* 14–20 mm diam., with tunics of fine netted fibres. *Leaves* 4–7, upper 1–3 partly sheathing; blades narrowly sword-shaped to sublinear, reaching at least to base, or sometimes exceeding spike, 1.5–3.0 mm wide; midrib slightly thickened. *Spike* elongate, mostly 6–12-flowered; bracts membranous with dark veins, 4–6 mm long, outer 3-veined and 3-toothed, inner 2-veined and forked apically, slightly exceeding outer. *Flowers* deep pink, presence of scent unknown; perianth tube narrowly funnel-shaped, widening

in upper third, (10–)12–18 mm long, $\pm$ 3 mm wide at mouth; tepals subequal, oblong, 14–17 $\times$ 6–8 mm, spreading horizontally but remaining concave. *Stamens* with filaments $\pm$ 10 mm long, usually exserted $\pm$ 6 mm; anthers $\pm$ 4 mm long, yellow. *Style* dividing opposite anther tips, style branches $\pm$ 1.5 mm long. *Flowering time*: November, sometimes lasting into early December.

Distribution: restricted to the mountains immediately east of Stellenbosch in Western Cape, *Ixia cochlearis* occurs at elevations of 305–550 m (Figure 3). Plants grow on rocky slopes, at least sometimes on granite substrate. Some records indicate that plants were flowering well after a burn the preceeding summer, and it is likely that flowering is stimulated by fire and that blooming occurs rarely if at all except in the years immediately after wildfires.

Diagnosis and relationships: *Ixia cochlearis* is distinctive in sect. *Hyalis* in the deep pink flowers with a narrowly funnel-shaped perianth tube mostly 12–18 mm long, at least four, and up to seven, narrow, fairly firm leaves, and in the presence of a fibrous collar around the stem base. The relatively long and narrow perianth tube is reminiscent of *I. fucata* and *I. stohrii*, also montane species, but occurring to the east, in the Langeberg. These two species have broader, soft-textured leaves and shorter stamens, the filaments exserted only 2–5 mm in *I. fucata* and up to 1 mm in *I. stohrii*, compared with the longer filaments of *I. cochlearis*, which are exserted up to 6 mm. Although she did not say so explicitly, Lewis (1962) evidently named the species for the concave, more or less spooned tepals, a feature shown in the painting accompanying the protologue. The first record of this rare and very localized endemic was made by C.L. Wicht in 1938 in the mountains at Jonkershoek near Stellenbosch.

Selected specimens

WESTERN CAPE.—3318 (Cape Town): Stellenbosch, Banhoek, burnt ground, (–DD), 24 Nov. 1938, *Martley* s.n. (BOL39127, SAM53175); Jonkershoek, Biesiesvlei, granite slope, 1100' [335 m], (–DD), 30 Nov. 1938, *Wicht* s.n. (PRE), 8 Nov. 1940, *Levyns* 7505 (BOL); Jonkershoek, Tierkloof, (–DD), Nov. 1944, *Wicht* s.n. (PRE, SAM55837); Jonkershoek, dry stony ridge, (–DD), 18 Nov. 1943, *Borchardt* s.n. (BOL39128).

10. *Ixia fucata* Ker Gawl. in Curtis's *Botanical Magazine* 34: t. 1379 (1811); Lewis: 98 (1962). Type: South Africa, without precise locality, illustration in Curtis's *Botanical Magazine* 34: t. 1379 (1811); epitype, here designated, [Western Cape], Worcester Dist., Hex River Mtns, Milner Ridge Peak, west slopes, 5000–6000' [1 525–1 830 m], (–AD), 11 Nov. 1943, *Esterhuysen* 9326 (BOL).

Plants (150–)250–400 mm high, usually with a weakly developed collar around base, usually unbranched, sometimes with a single short, erect branch subtended by translucent, membranous, attenuate bracts and prophylls 2–3 mm long, these present even when branch not produced. *Corm* globose, 7–9 mm diam., with tunics of fine, soft, netted fibres. *Leaves* (3)4 or 5, narrowly sword-shaped to sublinear, 1.5–3.0 mm wide, central vein and margins usually slightly thickened, uppermost (1)2 leaves largely or entirely sheathing. *Spike* flexuose, (2–)4–7(–14)-flowered; bracts 5–8 mm long, outer 5-veined and acutely 3-toothed,

inner bracts as long or slightly longer than outer, 2-veined and forked apically. *Flowers* suberect, sometimes with unilateral stamens, white to pale or deep pink, darker at mouth of tube and lined or uniformly pink or red outside; perianth tube 10–15 mm long, straight, slightly flared, ± 2 mm diam.; tepals subequal, $12\text{--}14 \times \pm 6$ mm, spreading at right angles to tube. *Stamens* with filaments 3–6 mm long, exerted $\pm 2\text{--}5$ mm from tube; anthers 3.5–4.0 mm long, shortly tailed, often purple; pollen yellow (brown). *Style* dividing opposite lower third to middle of anthers, style branches 2.0–2.5 mm long, gently recurved. *Flowering time*: mainly late September to early November, occasionally in early September.

Distribution: a plant of mountain slopes and rock outcrops, *Ixia fucata* extends from the higher elevations of the Hex River Mtns through the Keeromsberg to the western Langeberg as far east as Montagu (Figure 3). It is likely that plants flower well only in the years immediately following a wildfire, but this has not been documented to date. The Saunders & Saunders sub Manning collection cited below was made in unburned veld.

Diagnosis and relationships: based on a plant of unknown provenance grown in Great Britain, *Ixia fucata* was described by John Ker Gawler in 1811 in *Curtis's Botanical Magazine*. The accompanying illustration shows what appears to be an *Ixia* with a white flower, pink on the outside and with small red streaks at the base of the tepals. The yellowish tube is narrow, but well developed, and there are five narrowly sword-shaped ($\pm$ sublinear) leaves, the uppermost of which sheaths the stem for about two thirds of its length. Unfortunately, no associated preserved material is known. Ker Gawler thought the plant might be an accidental garden hybrid but Lewis (1962) unequivocally associated the illustration with plants from the western Langeberg and Hex River Mtns, most of them collected in the decades before her revision was published. We accept Lewis's conclusion about the identity of *I. fucata* but in order to stabilize the nomenclature we designate an epitype, thus fixing the application of the name.

Ixia fucata is still relatively poorly known but it is, nevertheless, obvious that plants referred by Lewis (1962) to *I. fucata* var. *filifolia*, do not belong here. This plant, from the Riviersonderend Mtns and nearby, to the south of the main range of *I. fucata*, consistently has only three leaves, the lower two with filiform blades no more than 1.2 mm wide, a straight and unusually wide perianth tube, ± 2 mm in diameter. We regard var. *filifolia* as a separate species, *I. stenophylla*, possibly most closely allied to the *I. paucifolia* group of sect. *Morphixia*.

Even with the removal of var. *filifolia*, *Ixia fucata* remains somewhat variable: plants from the Langeberg have pink flowers, with the bases of the tepals red, the outside of the tube and tepals are dark pink, and unusual for *Ixia*, the stamens are unilateral and declinate. The parallel anthers thus lie in one plane and face upward toward the top of the spike. This feature was first mentioned by De Vos (1999) for specimens from the Montagu and Robertson Districts and we noted unilateral stamens in a population from Orangeberg near Koo (M. Hansford pers. comm.). The feature is evident in *Levyns*

4374 and *Esterhuysen* 29110, for example. In contrast, plants from the Hex River Mtns have white flowers and evidently do not have declinate stamens, nor do those from the Du Toitskloof Mtns. The type plant is presumably also from here because it too has symmetrically arranged stamens.

Plants from further north in the Great Winterhoek Mtns, sometimes identified as *Ixia fucata* in herbaria (e.g. *Marloth* 1725), are not this species, but *I. cedar-montana*, the flowers of which have a substantially longer tube.

Selected specimens

WESTERN CAPE.—3319 (Worcester): Hex River Mtns, Mt Brodie, rocky north slopes, (–AD), 1 Nov. 1953, *Esterhuysen* 22229A (BOL); Hex River Mtns, traverse west of Milner Peak, north-facing slopes of Shale Peaks, (–AD), 19 Oct. 2009, *Saunders & Saunders sub Manning* 3234 (NBG) (fls pale pink with dark red markings); Worcester, Keeromsberg, (–DA), 7 Nov. 1943, *Esterhuysen* 9248 (BOL, K, NBG) (fls pink with dark maroon markings); Robertson Dist., Langeberg, Dassieshoek, shallow soils in damp places, rocky south slope near kloof, 1000–2000' [305–610 m], (–DD), 2 Sept. 1961, *Esterhuysen* 29110 (BOL, MO) (fls pink, red outside); Robertson, Langeberg, near stream in kloof, (–DD), 6 Oct. 1929, *Levyns* 4374 (BOL39137). 3320 (Montagu): Montagu, Donkerkloof, (–CA), 26 Sept 1946, *Compton* 18477 (NBG, SAM) (fls white, pink outside).

11. *Ixia stohrii* L.Bolus in South African Gardening 21: 281 (1931a); Lewis: 96 (1962). Type: South Africa, [Western Cape], Swellendam, Tradouw Pass, 14 Sept. 1931, *Smith s.n.* (BOL19879, lecto!, designated by Lewis 1962: 97; K, iso!).

Tritonixia conferta Klatt: 356 (1882), non *I. conferta* R.C.Foster (1936). Type: South Africa, [Western Cape], Voormansbosch, Oct. $\pm$ 1830, *Zeyher* 4014 (SAM, lecto!, designated by De Vos 1999: 29; K!, PRE!, Z, iso.).

Plants 180–400 mm high, usually 1–3-branched, sometimes simple; branches subtended by pale, membranous, darkly keeled bracts and prophylls 2–4 mm long. *Corm* globose, 9–12 mm diam., with tunics of fine, netted fibres, bearing small cormlets at base. *Leaves* (4)5 or 6(–8), lower with well-developed blades grading to partly to almost entirely sheathing above; blades narrowly sword-shaped to sublinear, usually reaching to $\pm$ base of spike, (2–)3–5(–6) mm wide, relatively firm-textured, central vein slightly raised, when dry a pair of secondary veins evident. *Spike* usually erect, spiral, 5–10-flowered; bracts membranous, pale and translucent, ± 5 mm long, outer 3-veined and shortly 3-toothed, inner 2-veined and 2-toothed, slightly shorter than outer. *Flowers* erect, pale pink, dark pink on reverse of tepals, tube dark red-purple outside, unscented; perianth tube widening very gradually from base to apex, (12–)14–22 mm long; tepals subequal, ovate, 12–14 mm long, spreading at right angles to tube. *Stamens* symmetrically arranged; filaments 1.5–3.0 mm long, inserted 2–4 mm below mouth of tube, included or exerted up to 1 mm; anthers 2–3 mm long, exerted or partly to entirely included in tube; pollen yellow. *Style* dividing 0.5–1.0 mm below anther bases or reaching to mid-anther level, style branches 1.0–2.3 mm long, tips reaching at least to anther bases, rarely shortly exceeding anther tips (*Ruiters* 19). *Flowering time*: late August to mid-September.

Distribution: the species is evidently a narrow endemic of the central Langeberg, and has been recorded from

Protea Valley above Swellendam and at Voormansbosch nearby, as well as in Tradouw Pass and in Grootvadersbos to the east (Figure 3) but it almost certainly occurs between these sites, and possibly even more widely. There are surprisingly few collections of this conspicuous species, which grows among other places, along the roadside in the well-travelled Tradouw Pass, south of Barrydale. The reason for this became clear in the spring of 2000 when mass flowering occurred there after a wildfire the previous summer. Plants were found in full bloom from one end of the pass to the other, in many places so plentiful that they coloured the rocky slopes pink. The following year the species seemed rare, no more than a handful of plants were found in bloom; in fact very few plants were evident even in leaf. Like a fair number of geophytes of the Cape sandstone mountains, *I. stohrii* is a true pyrophyte. Plants flower well only the season after a fire and then disappear until another fire stimulates their flowering response.

Diagnosis and relationships: the first collection of the species was made by C.L. Zeyher in the 1820s at Voormansbosch, near Swellendam. The collection was described by F.W. Klatt as *Tritonixia conferta*, the identity of which was only determined by Lewis (1962). The name cannot be transferred to *Ixia* as the epithet *conferta* is preoccupied: *I. conferta* R.C.Foster is now regarded as a synonym of *I. abbreviata* Houtt. (Goldblatt & Manning 2010).

Well-grown specimens of *Ixia stohrii* can reach up to 400 mm in height and produce masses of flowers on spikes of up to 8 flowers on the main stem. The pale pink blooms have a slightly darker ring around the base of the tepals, and the yellow anthers are barely exerted or are partly to fully included in the tube, thus occluding the mouth, features clearly illustrated in the protologue (Bolus 1931a).

Ixia stohrii appears to be most closely allied to *I. fucata* of the western Langeberg and Hex River Mtns to the west and they are virtually identical vegetatively. *Ixia fucata* has either white or pink flowers, the filaments are exerted 2–5 mm from the tube, and the style branches are consistently longer than in most collections of *I. stohrii*, 2.0–2.5 mm long. The stamens are reported to be unilateral and declinate in some populations, a condition we have confirmed in living plants from Dassieshoek above Robertson. Unilateral stamens are not shown in the type illustration and the species may be polymorphic for the condition. Nevertheless, the longer, well-exserted filaments and consistently exerted anthers readily separate *I. stohrii* from *I. fucata*. De Vos (1999) included the only known collection of the new *I. recondita* in *I. stohrii* but we regard this as a separate species, easily distinguished by the stamens and style branches included well within the perianth tube (see more detailed discussion under that species).

Selected specimens

WESTERN CAPE.—3320 (Montagu): Swellendam hiking trail, below Protea valley, (–CD), 30 Dec. 1987, Esterhuysen 36684 (K, MO, NBG); Swellendam, forest path below 10 O’Clock Mtn, (–CD), 20 Sept. 1952, Wurts 357 (NBG); Langeberg Mtns, Tradouw Pass, after fire, sandstone rocks, (–DC), 26 Aug. 2000, Goldblatt & Nänni 11438A (K, MO, NBG, PRE); 7 miles [10.5 km] from Barrydale into

Tradouw Pass, ± 1000' [305 m], (–DC), 18 Sept. 1968, Marsh 686 (K); Grootvadersbos, Oskloof, east of tar road, 2 years after fire, 500 m, (–DD), 20 Sept. 1988, Ruiters 19 (NBG, PRE).

12. *Ixia recondita* Goldblatt & J.C.Manning, sp. nov.

Plantae *Ixiae fucatae* et *I. stohrii* similes sed caule usitate eramoso, foliis ± mollibus, antheris styloque in tubo inclusis, filamentis ± 3 mm longis, antheris 2.0–2.5 mm longis, stylo ± 1–2 mm longo, ramis styli 1.5–2.0 mm longis.

TYPE.—[Western Cape], 3320 (Montagu): kloof at base of Leeuriviersberg [Grootberg], on sparsely vegetated sloping ledges, pale pink, (–DD), 1 Sept. 1958, Esterhuysen 27870 (BOL, holo.; K, MO, iso.).

Plants 250–750 mm high, erect or inclined, rarely with 1 branch subtended by membranous, darkly keeled attenuate bracts and prophylls 2–4 mm long. *Corm* globose, 10–12 mm diam., with tunics of fine, netted fibres, bearing small cormlets at base. *Leaves* 4, rarely 3, lower 3 with well-developed blades, uppermost partly to almost entirely sheathing; blades narrowly sword-shaped to sublinear, usually longer than stem but trailing above, (2–)3–4(–6) mm wide, soft-textured; midrib slightly raised, when dry a pair of secondary veins evident; margins not thickened. *Spike* subsecund, crowded, suberect or inclined, 4–8-flowered, branches with fewer flowers; bracts membranous, pale translucent with dark veins, flushed pink distally, 5–6 mm long, outer 3-veined and 3-toothed, inner 2-veined and 2-toothed, ± as long to slightly longer or shorter than outer. *Flowers* salver-shaped, pale pink, with a small, dark purple mark at tube apex between tepal bases, flushed red outside, unscented; perianth tube 10–12 mm long, subcylindric, widening gradually from base to apex, ± 1.5 mm diam. at mouth; tepals subequal, oblong-elliptic, 10–13 × 4–5 mm, spreading at right angles to tube. *Stamens* included in tube; filaments 2–3 mm long, inserted ± 3 mm above tube base, shortly decurrent; anthers 2.0–2.5 mm long, tips reaching 3.5–5.0 mm below tube mouth, white; pollen yellow. *Style* 1–2 mm long, dividing shortly below or opposite filament bases, style branches 1.5–2.0 mm long, reaching to base or middle of filaments. *Flowering time*: late August to mid-October. Figure 5.

Distribution: *Ixia recondita* is a narrow endemic of the Leeuriviersberg, now Grootberg, section of the Langeberg west of Swellendam (Figure 6). The species was first collected in 1958 by Elsie Esterhuysen and again only in 2007 when Di Turner and fellow CREW (Custodians of Rare and Endangered Wildflowers) members rediscovered plants at our prompting after an extended exploration of the southern slopes of the Langeberg from Grootvadersbos to Grootberg. Plants were found on stony, well-vegetated, south-facing slopes that had not been burned for many years. Nothing is known of the floral biology of the species but the salver-shaped, unscented, pink flowers with dark marks at the mouth of the tube are the hallmarks of long-proboscid fly pollination (Goldblatt & Manning 2006).

Diagnosis and relationships: distinctive in having not only the filaments but also the anthers, style and style branches included within the narrow perianth tube,

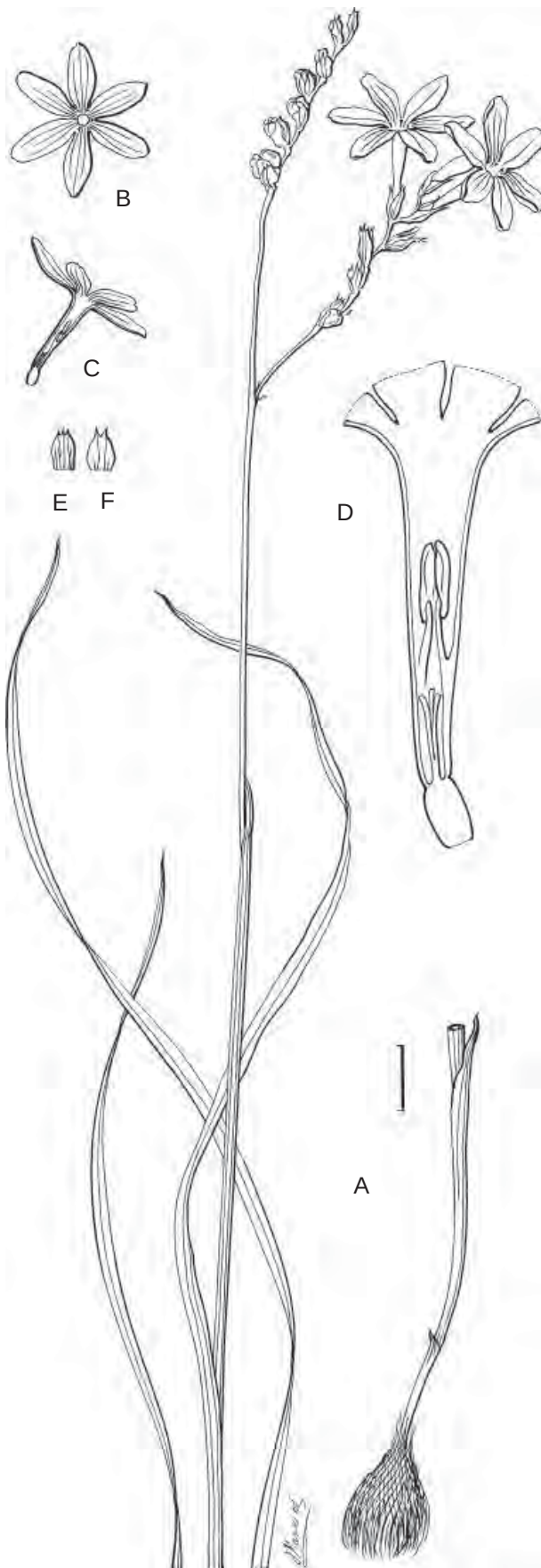


FIGURE 5.—*Ixia recondita*, Turner s.n. (NBG): A, plant; B, flower from above; C, half-flower; D, l/s perianth tube; E, outer bract; F, inner bract. Scale bar: A–C, E, F, 10 mm; D, 2.5 mm. Artist: J.C. Manning.

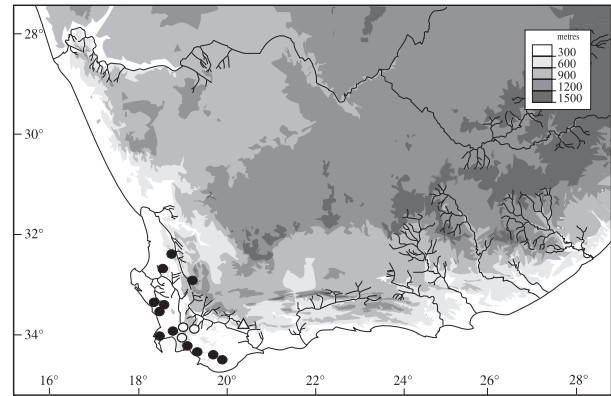


FIGURE 6.—Known distribution of *Ixia recondita*, △; *I. odorata*, ●; and *I. esterhuysenae*, ○.

that is additionally unusual in the soft-textured leaves, *Ixia recondita* is a remarkable species. It was evidently unknown to Lewis although it was collected in 1958, thus before her monograph of *Ixia* was published (Lewis 1962). De Vos (1999) referred the specimen at the Bolus Herbarium to *I. stohrii*, which it broadly resembles, treating it simply as an unusual population of that species with included anthers. *Ixia stohrii* does have short filaments, either included in the perianth tube, or shortly exerted up to 1 mm, and the bases of the anthers are sometimes partly included in the tube but it is otherwise a more robust plant and most collections consist of plants with sturdy, erect stems with at least one branch (rarely up to five branches). The style in *I. stohrii* reaches at least to the middle of the anthers and sometimes exceeds them, thus always reaching the mouth of the perianth tube. This contrasts starkly with the condition in *I. recondita*, in which the style, just 2–3 mm long, divides opposite the filament bases in the lower half of the perianth tube and the style branches barely reach the middle of the filaments.

Like *Ixia stohrii* and closely related *I. fucata*, *I. recondita* usually has four leaves, sometimes three or five, the lower two or three with well-developed blades and the upper one or two partly to almost entirely sheathing. In the length of the perianth tube, ± 12 mm long, *I. recondita* is intermediate between its two relatives: the tube of *I. stohrii* is (12–)14–22 mm long, and that of *I. fucata* 10–15 mm long. Both *Ixia fucata* and *I. stohrii* are Langeberg endemics, the latter recorded from the mountains between Grootvadersbos and Swellendam, while *I. fucata* occurs further west from Montagu to Keeromsberg, as well as in the Hex River Mtns. The range of *I. recondita* thus lies between that of its two relatives.

Selected specimens

WESTERN CAPE.—3320 (Montagu): Swellendam hiking trail, base of Leeuriviersberg just past 9.5 km footbridge, rocky sandstone slope, 441 m, (–CD), 10 Oct. 2007, Turner s.n. (NBG).

1.3 Series *Angustisiphon*

13. *Ixia orientalis* L.Bolus in South African Gardening 19: 27 (1929); Lewis: 100 (1962). Type: South Africa, [Eastern Cape], Albany, between Seven Foun-

tains and Sidbury, Nov. 1928, *Dyer 1684* (BOL, holo.; GRA, K!, PRE!, iso.).

I. alba Eckl.: 27 (1827), illegit. homonym not *I. alba* L. [= *Sparaxis bulbifera* (L.) Ker Gawl.]. Type: South Africa, [Western Cape], Ecklon & Zeyher 70.10 (PRE!, S, syn.).

I. scariosa var. *longifolia* Baker: 165 (1892). Type: South Africa, [Western Cape,] mountains at Avontuur, Nov. 1870, *H. Bolus 2487* (K, lecto.), designated by De Vos 1999: 33; BOL, iso.).

Plants usually 400–600 mm high, rarely up to 80 mm, 1–3(4)-branched, occasionally unbranched; branches subtended by membranous, attenuate bracts and prophylls mostly 3–5 mm long. *Corm* with tunics of fine to medium-textured fibres, with sessile cormlets at base. *Leaves* (3)4–6, narrowly sword-shaped to sublinear, 1.5–6.5(–8.0) mm wide, upper 1 or 2 leaves partly sheathing. *Main spike* erect, flexuose, (2–)7–12(–16)-flowered, lateral spikes 2–8-flowered; bracts membranous, 5–8 mm long, usually about 1 internode long, occasionally longer, outer with 1 prominent vein and prominent central cusp, sometimes with a shorter tooth either side of central cusp, inner bract 2-veined and forked apically, slightly shorter to slightly longer than outer. *Flowers* upright, pink or white, presence of scent unknown; perianth tube narrowly funnel-shaped, (8–)9–12 mm long, proximal half filiform; tepals ovate, 10–14(–16) × 5–8 mm, spreading horizontally. *Stamens* with filaments 5–6 mm long, exerted 2–4 mm; anthers 4–5 mm long. *Style* dividing opposite base to lower third of anthers, rarely shortly below apex of filaments, style branches mostly 4–5 mm long, ascending, emerging between anthers. *Flowering time*: mainly mid-September to late October, but as late as early December at high elevations.

Distribution: the most widespread species of the genus, *Ixia orientalis* has a geographic range that extends from Caledon in Western Cape to Bathurst and the Amatola Mtns in Eastern Cape (Figure 3); it is one of only two species of the genus that extend outside the Greater Cape Floristic Region (Born *et al.* 2006), the other being *I. marginifolia*. Plants occur in a remarkably varied range of habitats, including seasonally marshy sites, stony coastal grassland, clay hills, and fairly dry sandstone slopes. Typically late flowering, *I. orientalis* is seldom seen before the middle of September, although there are some records of plants in flower as early as August.

Diagnosis and relationships: a relatively unspecialized species, *Ixia orientalis* lacks any outstanding features, making it somewhat difficult to diagnose. It can be identified by the combination of branched stems, spikes often with seven or more flowers, four to six leaves (rarely only three), none of them completely sheathing the stem, and moderate-sized, pink or white flowers. The perianth tube, 8–12 mm long, is narrowly funnel-shaped with the proximal half to two thirds always extremely narrow and filiform. Well-grown specimens have stems with 2–4 branches and the main spike usually bears 7–12, rarely up to 16 flowers, although in plants from the mountains of the southern Cape the stems may be unbranched and the spikes have fewer flowers. Typical plants from Eastern Cape have the largest flowers, with the tube 12 mm and tepals ± 14 mm long, but to the west, particularly in the Caledon District, flowers

are smaller, sometimes with a tube only 8 mm long and tepals ± 10 mm long (e.g. Goldblatt & Manning 1978), but we see no other differences and the pattern of variation lacks clear discontinuities so that it is impossible to recognize infraspecific taxa.

We suspect that the closest allies of *Ixia orientalis* are the largely montane Western Cape species, *I. odorata*, and *I. tenuifolia* of the Malmesbury District north of Cape Town. *Ixia odorata* typically has slightly smaller flowers, usually yellow, rarely white, with a strong sweet scent. It is also distinctive in the relatively short filaments up to 3 mm long (measured to the base of the anthers), and the style divides between the base and apex of the filaments. This contrasts with longer filaments, up to 6 mm long, and a style usually dividing between the base and middle of the anthers (rarely shortly below the filaments) in *I. orientalis*. *Ixia tenuifolia* differs in the slightly longer perianth tube, (12–) 15–19 mm long, yellow to orange or brick-red perianth, frequently with a dark central mark, and consistently narrow, very firm-textured leaves, and the stem is seldom branched. Curiously, we have found it difficult to distinguish *I. orientalis* from *I. flexuosa* (sect. *Ixia*) without careful dissection. Both may have a perianth tube of similar length [4–6 mm in *I. flexuosa* according to Lewis (1962)], with a relatively short, wider distal portion, a style dividing opposite the bases of the anthers, and many-flowered spikes. The filaments, inserted at the base of the wider part of the tube are uniformly narrow and shortly decurrent in *I. orientalis* and although similarly positioned in *I. flexuosa*, its filaments are flattened and broader toward the bases, the feature that confirms its place in sect. *Ixia* rather than sect. *Hyalis*.

Although *Ixia orientalis* was only formally recognized in 1929, it was known long before this, but was confused with one of several other species. Ecklon (1827) named specimens of the species *I. alba*, but the name is a homonym for *I. alba* L. [a synonym of *Sparaxis bulbifera* (L.) Ker Gawl.]. Lewis regarded Ecklon's name as invalid, lacking a description or diagnosis, but Nordenstam (1972) maintained that the brief diagnosis was sufficient to validate the name. We concur. *Ixia scariosa* var. *longifolia* Baker (1892), based on a collection each of *I. orientalis* and *I. divaricata*, is now a synonym of *I. orientalis* following designation of the specimen of the latter species as the lectotype (De Vos 1999). De Vos also suggested that *I. schlechteri* (Baker 1904) may be conspecific with *I. orientalis* and, if so, it would be an earlier name. The type, *Schlechter 5609* from the Swartberg at Caledon, is in the Zurich Herbarium but currently cannot be found. Images of the types (there are two sheets, only one with flowers) on the worldwide web are insufficient for firm identification. The species is alternatively *I. flexuosa*.

Our observations on the pollination of *Ixia orientalis* indicate that it is a generalist. The first published study recorded the butterfly, *Colias electo*, as sole visitor (Goldblatt *et al.* 2000). Subsequently we have noted hopliine beetles in the flowers (Goldblatt & Porter 12577), and at another site both hopliines and large anthophorine bees (Goldblatt & Porter 12366A). In all cases the insects' bodies brushed against anthers and style branches, effecting pollen transfer.

Selected specimens

EASTERN CAPE.—3226 (Grahamstown): Amatola Mtns, below Gaika's Kop, roadside next to waterfall marsh, (–DB), 3 Dec. 1982, *Furness & Phillipson 88* (MO, PRE). 3323 (Willowmore): Lauterwater, (–DC), Oct. 1933, *Fourcade 5025* (PRE); grassland near Plettenberg Bay, (–DD), 11 Sept. 2003, *Goldblatt & Porter 12270* (MO). 3324 (Steytlerville): poort between Patensie and Cambria, (–DA), 11 Sept. 1973, *Oliver 4511* (PRE); 5.5 km N of Hankey, cleared bush on clay loam, (–DD), *Goldblatt 4936* (MO). 3325 (Port Elizabeth): Cape Golf Course, (–DC), 12 Oct. 1932, *Long 811* (PRE). 3326 (Grahamstown): Alicedale road west of Grahamstown, (–AD), 28 Sept. 1974, *Bayliss 6812* (MO); Southwell, Bathurst Dist., (–DB), 25 Oct. 1961, *Bayliss 5007* (MO). 3423 (Plettenberg Bay): west end of Robberg, (–AB), 12 Aug. 1960, *Acocoks 21496* (PRE). 3424 (Humansdorp): Humansdorp, Pietersgat, well-drained calcrete sand, (–BB), 2 Oct. 2001, *Brand 409* (MO).

WESTERN CAPE.—3319 (Worcester): between Worcester and Villiersdorp, (–CC), *Lewis 2902* (SAM63500). 1921 (Ladismith): Swartberg Mtns, burnt slope on road to Gamkakloof near Kliphuisvlei, (–BD), 22 Oct. 1986, *Goldblatt 7972* (MO). 3322 (Oudtshoorn): Perdepoort north of Kamfer, burned sandstone slope, (–CD), 28 Sept. 2004, *Goldblatt & Porter 12577* (MO, NBG); burned slope 34.5 km from Dysveldorp on Laudina road, (–DA), *Goldblatt & Porter 12290* (MO). 3419 (Caledon): Mr du Toit's farm, Elgin, (–AA), 27 Sept. 1966, *Dahlstrand 1159* (MO, NBG); Caledon, east end of Caledon Swartberg in marsh, (–BA), 11 Oct. 1993, *Goldblatt & Manning 9789* (MO); between Stanford and Baardscheedersbos on Elim road, (–DA), 5 Sept. 1985, *De Vos 2597* (PRE). 3420 (Bredasdorp): Bontebok National Park, Swellendam, (–AB), Sept. 1962, *Liebenberg 6479* (PRE). 3421 (Riversdale): Albertinia commonage, (–BA), Oct. 1911, *Muir 5481* (PRE); burnt slopes between Mossel Bay and Herbertsdale, (–BB), 26 Sept. 2003, *Goldblatt & Porter 12371* (MO). 3422 (Mossel Bay): 6.4 km E of Great Brak River, (–AB), 21 Sept. 1959, *Lewis 5579* (PRE).

14. *Ixia odorata* Ker Gawl. in The botanists register 7: Notes [3] (1821) and Iridearum generum 101 (1827); Lewis: 92 (1962). *Morphixia odorata* (Ker Gawl.) Baker: 97 (1877). *Ixia erecta* var. *lutea odorata* Ker Gawl.: t. 1173 (1809). Type: South Africa, without precise locality or collector, cultivated in Britain, illustration in Curtis's Botanical Magazine 29: t. 1173 (1809).

I. erecta Thunb.: 16 (1783), illegit. homonym not P.J.Bergius (1767). *I. avellana* R.C.Foster: 47 (1936), as replacement name for *I. erecta* Thunb. Type: South Africa, without precise locality, *Thunberg s.n.* (S, UPS-THUNB, syn.).

I. flavescens Eckl.: 26 (1827), nom. nud. *I. polystachya* var. *flavescens* (Eckl.) Baker: 90 (1877).

Agretta pallidiflavens Eckl.: 24 (1827), genus invalid.

I. odorata var. *hesperanthoides* G.J.Lewis: 96 (1962). Type: South Africa, [Western Cape], Piketberg, top of ridge south of Zebrakop, 9 Nov. 1934, *Pillans 7184* (BOL!, (two sheets), PRE!, SAM!, syn.).

Plants (200–)400–550 mm high, usually tall and slender, simple, rarely 1-branched; branches subtended by short, acute bracts and prophylls $\pm$ 1 mm long. *Corm* 6–8 mm diam. with tunics of fine netted fibres. *Leaves* (3)4–6(–10), lower 2–4 with expanded blades, reaching to $\pm$ middle of stem, narrowly sword-shaped to lanceolate, often slightly twisted distally, 2–10 mm wide, upper 1 or 2 partly sheathing. *Spike* erect, crowded, mostly 10–16-flowered; bracts membranous, translucent, rarely flushed pink, 6–7 mm long, usually 1.5–2.0 internodes long, sometimes longer, outer usually with a single prominent vein and 1 central cusp, or obscurely 3-lobed with central cusp prominent, inner $\pm$ as long as outer, 2-veined and shallowly forked at apex. *Flowers* clear yellow (often appearing whitish when dry), rarely white,

outer tepals sometimes flushed red to brown outside, sweetly scented; perianth tube filiform below, flared in upper third, (7–)8–12 mm long, 3–5 mm wide at mouth; tepals subequal, 9–11 $\times$ $\pm$ 5 mm, spreading horizontally. *Stamens* with filaments 2.5–3.0 mm long, exserted 1.5–2.0 mm; anthers 5–6 mm long, yellow. *Style* dividing between base and apex of filaments, thus within tube up to $\pm$ 2 mm above mouth of tube, style branches (3–)4–6 mm long, arching outward below or between bases of anthers. *Flowering time*: mid-September to early November.

Distribution: a largely montane species, *Ixia odorata* extends from the Piketberg and Olifants River Mtns near Citrusdal to the Cape Peninsula and thence eastward to Hermanus and Elim (Figure 6). Plants are usually found on sandstone slopes but also grow on granite-derived soils in the vicinity of Darling.

Diagnosis and relationships: *Ixia odorata* has been known to science since at least 1809 when it was illustrated in Curtis's Botanical Magazine, named therein *I. erecta* var. *lutea odorata* by John Ker Gawler. Later Ker Gawler (1821, 1827) reconsidered his decision and renamed the plant *I. odorata*. The species is well named for its particularly sweetly scented, yellow flowers crowded at the top of the short spike, a strong scent being unusual in *Ixia*. Typical *I. odorata* has the following characteristics: bracts 6–7 mm; perianth tube 7–12 mm long; tepals 9–11 $\times$ $\pm$ 5 mm; filaments 2.5–3.0 mm long, exserted 1–2 mm; anthers 5–6 mm long; and style branches 3–5 mm long.

As circumscribed by Lewis (1962), *Ixia odorata* included populations of short, few-flowered plants from middle and upper elevations in the Hottentots Holland-Jonkershoek Mtn complex that are now treated as a separate species, *I. esterhuyseniae* (De Vos 1988, 1999). This montane species is very different in stature from the taller, fairly small-flowered *I. odorata* but they share outer floral bracts with a single main vein and usually a single tooth, in contrast to the more common 3-veined and 3-dentate outer bracts of the genus. Apart from its low stature, *I. esterhuyseniae* has style branches dividing above the bases of the anthers, usually opposite the middle third of the anthers, thus unlike *I. odorata* in which the style divides below the anthers, sometimes within the tube and opposite the bases of the filaments. We include *I. odorata* in sect. *Hyalis* because of the leaf number, usually 4–6, with no obvious differentiation between the lower and upper, partly sheathing leaves. The single-veined outer bracts are likewise consistent with sect. *Hyalis*.

Ixia odorata is sometimes mistaken for the southern Western Cape and Eastern Cape *I. orientalis* and the two can be confused when flower colour is not known, although the latter is almost always branched, whereas *I. odorata* is rarely so. White- or pink-flowered *I. orientalis* has a perianth tube of similar dimensions, and with a filiform lower portion but the style typically divides opposite the base of the anthers (rarely just below them), and it has longer filaments 5–6 mm long (vs 2.5–3.0 mm) exserted 2–4 mm (vs 1–2 mm), and only weakly scented flowers. The flowers are pollinated by

large anthophorine bees (Goldblatt *et al.* 2000) that are believed to visit the flowers to forage for nectar.

Plants treated as *Ixia odorata* var. *hesperanthoides* by Lewis (1962) and De Vos (1999), including *Barker 7561*, *Pillans 7184* and *Ecklon 438*, remain puzzling to us. The type collection, *Pillans 7184*, has white flowers with a perianth tube only ± 5 mm long, tepals ± 8 mm long, and anthers, 3.5–4.5 mm long, all smaller than in typical *I. odorata*. The style dividing at the base of the anthers and style branches ± 3 mm long conform reasonably well to typical *I. odorata*, although the length of the style branches is also shorter than the normal 4–5 mm that we find in other collections of the species. The observation by Pillans on his collection that the flowers open in the late afternoon, unlike $\pm 11:00$ for typical, yellow-flowered *I. odorata*, suggests that some white-flowered populations, at least the Pillans collection, represent a separate race, possibly even a separate species. Before an informed decision can be made about its status, we need additional collections of the small-flowered, evening blooming plants. Other collections included in var. *hesperanthoides* could equally well be included in *I. odorata* as other white-flowered populations are known. Typical, yellow-flowered *I. odorata* also occurs in the Piketberg, providing support for separate species status for var. *hesperanthoides*. Provisionally, however, we include the Pillans collection in *I. odorata* but have not expanded our description to include measurements of the floral parts of the population.

Selected specimens

WESTERN CAPE.—3218 (Clanwilliam): Olifants River and Villa Brakfontein (76.10), (–BD?), Oct. 1830, *Ecklon & Zeyher s.n.* (*Ixia albo-flavens* Eckl.) (PRE); Piketberg, clay slopes at east base of Kapteinskloof Mtn, (–DC), 20 Oct. 1935, *Pillans 7801* (BOL); Piketberg Mtn, (–DC), 3 Nov. 1951, *Barker 7561* (NBG). 3219 (Wupperthal): Olifants River Mtns, Grootfontein, pass down from Dasklip, dry west slope on shale, (–CC), 27 Oct. 1972, *Oliver 4068* (MO, PRE). 3318 (Cape Town): Darling, (–AD), Sept. 1929, *Letty 127* (PRE); near Riebeek-Kasteel, (–BD), 26 Oct. 1941, *Leipoldt 3818* (BOL); Mamre, (–CB), 17 Sept. 1959, *Lewis 5541* (PRE); Constantia Nek, (–CD), Oct. 1950, *Pillans 10506* (MO); Farm Joostenbergkloof, near Oostenberg, sandstone ridge, (–DD), 4 Nov. 1996, *Goldblatt 10585* (MO). 3418 (Simonstown): Cape Peninsula, near Hout Bay, (–BA), 14 Oct. 1941, *Salter 8686* (BOL); Rooi Els, (–BD), 2 Oct. 1945, *Leipoldt 4157* (BOL); Palmiet River mouth, sandy soil, after fire, (–BD), 18 Sept. 1969, *Boucher 700* (PRE), 29 Sept. 2001, *Goldblatt & Nanni 11935* (MO, NBG). 3419 (Caledon): Hermanus, rocky mountainside, (–AD), 6 Oct. 1955, *Van Niekerk 660* (BOL); Farm Paardeberg, near Papiessvlei, (–BC), 25 Sept. 1962, *Taylor 4052* (PRE); ± 6 km NW of Elim, wet, sandy ground, (–DA), 3 Oct. 1986, *Vlok 1636* (MO, PRE).

15. *Ixia esterhuyseniae* M.P.de Vos in South African Journal of Botany 54: 600 (1988). Type: South Africa, [Western Cape], 3418 (Simonstown): peaty slope along Panorama trail, after fire, 3000' [915 m], (–BB), 9 Jan. 1973, *Esterhuysen 33089* (BOL, holo.!, MO, iso.!).

Plants mostly 100–150(–200) mm high, rarely with 1 short, suberect branch subtended by attenuate, brown-tipped bracts and prophylls; bracts 4–8 mm long and prophylls 2–3 times longer, up to 18 mm long. *Corm* depressed-globose, 8–10 mm diam., with tunics of fine fibres. *Leaves* 5 or 6, all with expanded blades or uppermost largely sheathing, sword-shaped, reaching to between middle and top of stem, 4–6 mm wide; midrib slightly raised. *Spike* crowded, closely 2–4(–6)-flowered; bracts membranous, ± 4.5 mm long, outer with a

prominent central vein, inner 2-veined and bidentate. *Flowers* erect, yellow; tepals flushed red to purple outside, lily-scented; perianth tube funnel-shaped, flared in upper half, 4.5–6.0 mm long, ± 4.5 mm wide at mouth; tepals subequal, 10–11 $\times$ 5–6 mm, spreading horizontally. *Stamens* with filaments ± 3.5 mm long, exerted ± 1.5 mm; anthers 3.5–4.0 mm long, yellow. *Style* dividing opposite lower to middle third of anthers, style branches 2.0–2.5 mm long, extending between upper third of anthers. *Flowering time*: December and January.

Distribution: *Ixia esterhuyseniae* is a montane species, restricted to the Jonkershoek-Hollentots Holland Mtn complex (Figure 6). Plants occur at relatively high elevations, usually over 1 000 m, in seeps and along drainage lines and flower in mid-summer, only in the years following a fire.

Diagnosis and relationships: until 1988 when it was described by M.P. de Vos, *Ixia esterhuyseniae* was included in a second Western Cape species, *I. odorata*, normally a taller plant with multi-flowered spikes. As noted by De Vos, *I. esterhuyseniae* has a shorter and sometimes wider perianth tube, 4–5 mm long and ± 4.5 mm wide at the mouth (vs (7–)8–12 mm long and 3–5 mm wide at the mouth in *I. odorata*), the tepals thus about twice as long as the tube. The style divides opposite the middle of the anthers into branches ± 2.5 mm long, another difference with *I. odorata* in which the style divides below the anther bases (sometimes opposite the bases of the filaments), and the style branches are up to 5 mm long.

Preliminary observations of the pollination of *Ixia esterhuyseniae* (Goldblatt *et al.* 2000) indicate that the only insect visitors are the short-proboscid horsefly, *Pholliche atricornis*, which is the presumed pollinator. The reward for these insects is nectar held within the short perianth tube.

Selected specimens

WESTERN CAPE.—3418 (Simonstown): Hottentots Holland Mtns, Pic Sans Nom, (–BB), 6 Jan. 1944, *Esterhuysen 9957* (BOL); Nuweberg Reserve, slopes of Sneeuberg, (–BB), 17 Jan. 2000, *Manning 564* (NBG); Somerset Sneekop, shale band, (–BB), Dec. 1940, *Stokoe 8093* (BOL); Hottentots Holland, Landrostkop, 1 340 m, (–BB), 6 Jan. 2000, *Oliver & Oliver 11461* (NBG, PRE). 3419 (Caledon): Jonkershoek, Dwarsberg, contour path, $\pm 4000'$ [1 220 m], (–AA), 9 Jan. 1973, *Kerfoot 6613* (PRE).

16. *Ixia aurea* J.C.Manning & Goldblatt in Goldblatt & Manning in Bothalia 29: 61 (1999). Type: South Africa, [Western Cape], Farm Wolwefontein west of Darling, rocky slope among granite boulders, 22 Sept. 1998, *Goldblatt & Manning 11029* (NBG, holo.!, K!, MO!, PRE!, S!, WAG!, iso.).

For description see *Bothalia* 29: 61 (1999).

Distribution: apparently rare, *Ixia aurea* occurs in granitic, sandy gravel at isolated sites between Darling, Piketberg and Porterville (Figure 7).

Diagnosis and relationships: striking when in flower, *Ixia aurea* has bright yellow-orange flowers in crowded spikes that make a bright splash among the late spring flora. Yet it has rarely been collected. Plants have been

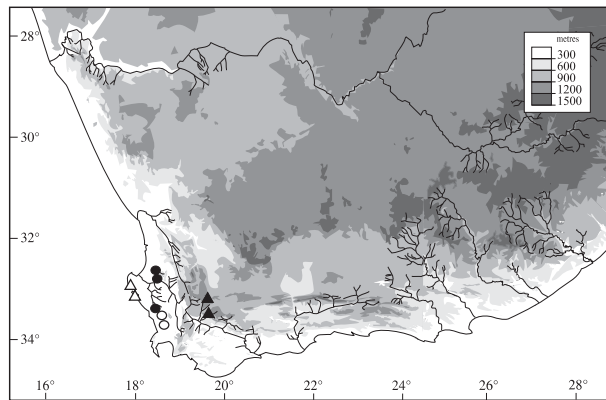


FIGURE 7.—Known distribution of *Ixia aurea*, ●; *I. tenuifolia*, ○; *I. purpureorosea*, △; and *I. saundersiana*, ▲.

confused with *I. dubia* (sect. *Ixia*), (e.g. Goldblatt *et al.* 1998) because of the general resemblance to that species, despite the lack of a dark central mark to the flowers. Careful examination has shown that *I. aurea* does not belong in sect. *Ixia* as it has flowers with a narrowly funnel-shaped tube, tightly enclosing the style in the cylindrical lower half, but containing nectar in the upper third, unlike sect. *Ixia* in which the perianth tube is cylindrical and closely clasping the style almost to the apex, does not contain more than minute traces of nectar, and the filaments are basally coherent or connate, thus occluding the mouth of the tube. In *I. aurea* the filaments diverge from the base and do not block the tube. We suspect that records of this species are seldom made because even from a short distance the plants may be confused with *I. maculata* or *I. dubia*, both common species in the rolling wheatlands between Darling and the Olifants River Mtns, and hence not collected. The relationships of *I. aurea* lie with the short-tubed species, in particular *I. odorata*, flowers of which are sweetly scented, smaller, pale yellow or white and have tepals up to 15 mm long (vs 16–23 mm in *I. aurea*).

The flowers of *Ixia aurea* are pollinated by a range of insects, mainly hopliine beetles (Scarabaeidae: Hopliini). At the type locality, Goldblatt & Manning (1999) recorded the hopliines *Heterochelus arthriticus*, *Lepithrix ornatella* and *Pachycnema crassipes*, and the horsefly *Mesomyia edentula* (Tabanidae). At a second site, Steiner (Steiner 3022) recorded the hopliine, *Lepithrix gentilis* visiting the flowers. The beetles use the flowers as sites for assembly and mating, and the horsefly as a source of nectar. Both the beetle species and the horsefly become covered in pollen after visiting several flowers. *Ixia aurea* is thus another example of a species with a bimodal pollination system (Goldblatt *et al.* 1998).

Selected specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, sandy slope near Farm Weltevrede near Kapteinskloof road, (–DA), 19 Sept. 2007, Goldblatt & Manning 13081 (MO, NBG, PRE); Farm Modderfontein, edge or parking area along N7, 4.2 km N of turn-off to Paleisheuvel, clay-loam, (–DB), 29 Sept. 1995, Steiner 3022 (NBG); Farm Groenewei, flats at eastern base of Piketberg, 150 m, (–DD), 15 Oct. 1972, Bremer 338 (BOL). 3318 (Cape Town): Porterville, (–BB?), Oct. 1956, Loubser 412 (BOL).

17. *Ixia tenuifolia* Vahl, Enumeratio plantarum 2: 62 (1805). Type: South Africa, without locality or collector, (C-Herb. Vahl, holo.–scanned image!).

I. pulcherrima Eckl.: 25 (1827). Type: none known but Zeyher s.n., from near Klipfontein (PRE), annotated '*Ixia* sp. (*I. pulcherrima* Ecklon)', possibly by P. MacOwan, appears to authenticate the identity of the species; Ecklon & Zeyher Irid 81 (SAM) '*Ixia pulcherrima*' Groenekloof, and '*Ixia pulcherrima* Eckl.' from Klipfontein, Zwartland likewise authenticate the name.

Freesea mineatolateritia Eckl.: 30 (1827), genus illegit.

I. framesii L.Bolus: 368 (1931b); Lewis: 91 (1962). Type: South Africa, [Western Cape], near Darling, Sept. 1928, flowered in Cape Town, Sept.–Oct. 1931, Ross-Frames s.n. (BOL19896, holo.!; K, iso.).

Plants 120–240 mm high, unbranched. *Corm* 10–18 mm diam.; tunics of fine, soft netted fibres. *Leaves* mostly 3(4), reaching or shortly exceeding spike, firm-textured, linear, 1.3–2.0 mm wide, main vein ± central or displaced abaxially, uppermost leaf sheathing in lower half. *Spike* densely 3–8(–14)-flowered; bracts dry-membranous, 6–8 mm long, opaque, pale below, rust-brown distally, outer with 1 prominent vein, acute, inner 2-veined and 2-toothed, ± as long as outer. *Flowers* salmon-pink or yellow to orange, dark red-brown in centre, unscented; perianth tube filiform below, narrowly funnel-shaped in upper third, (12–)15–19 mm long, 3–5 mm wide at mouth; tepals subequal, 15–19 × 8–10 mm, spreading horizontally. *Stamens* with filaments 4–5 mm long, exserted 1.0–1.5 mm; anthers ± 5 mm long, yellow. *Style* dividing just below or shortly above anther bases, style branches 2.5–3.0 mm long. *Flowering time*: mainly mid-September to mid-October.

Distribution: *Ixia tenuifolia* is a plant of seasonally moist, loamy flats on the rolling plain between Cape Town and Malmesbury (Figure 7), where it was common until the 1950s. Intense agricultural development since the 1960s has eliminated it from almost its entire range. The only viable population occurs in the Nature Reserve at Riverlands, near Mamre Road Station where we hope it will remain protected from both agriculture and invasive alien plants, especially Australian *Acacia* species, that thrive in its sandy habitat. A 1916 collection from the Cape Town Wild Flower Show, and said to be from Vredenburg, expands the range of the species substantially if that locality is correct, but as it has not otherwise been re-collected in the area, this seems unlikely.

Diagnosis and relationships: long known as *Ixia framesii*, a species described by H.M.L. Bolus in 1931, *I. tenuifolia* must have been encountered repeatedly by botanical explorers travelling between Cape Town and Malmesbury into the southern African interior. Nevertheless, it seems largely to have been overlooked or confused with other species. It is not at all surprising that the species was known in Holland in the 18th century, and was likely cultivated there. A specimen from the Van Royen collection at Leiden found its way to Copenhagen where, in 1805, Martin Vahl described it as *I. tenuifolia* (De Vos 1988), the identity of which was unknown to Lewis. Later, in 1827, C.F. Ecklon provided a brief diagnosis for a plant he called *I. pulcherrima* (flowers bright red, glistening), that has remained unidentified. Lewis (1962) regarded the name as invalid, attributing it to either *I. framesii* or *I. campanulata*. Nordenstam (1972),

however, considered the diagnosis to be sufficient for legitimate publication, but did not know of any type material. A specimen in PRE, collected by C.L. Zeyher near Klipfontein (now Malmesbury) and annotated in an unknown hand (not Zeyher's) '*Ixia* sp. (*I. pulcherrima* Eckl.)' appears to authenticate the name, although it is not a type. On this basis, we provisionally treat *I. pulcherrima* as a synonym of *I. tenuifolia*.

Ixia tenuifolia is readily identified not only by the relatively long perianth tube, (12–)15–19 mm, particularly narrow in the lower half, and short floral bracts, 6–8 mm long, but by the unbranched stem and firm, leathery, straight leaves. The floral bracts are distinctive in being $\pm$ opaque, pale in the lower half and rust-brown in the upper half. The flowers, either deep salmon-pink (also described brick-red) or yellow to orange, usually have a dark brown or reddish centre. We have not seen plants with mature capsules, but partly developed capsules appear unusually short, 2.5–3.0 mm long (Lewis Grant 3426).

Pollination studies have shown that *Ixia tenuifolia* has a bimodal pollination system (Goldblatt *et al.* 1998, 2000). Flowers are visited by the hopliine beetle, *Lepithrix ornatella* (Scarabaeidae: Hopliini), which use the flowers for sites of assembly and also by the horsefly *Philoliche atricornis* (Tabanidae), which we presume feeds on nectar retained in the perianth tube.

Selected specimens

WESTERN CAPE.—3318 (Cape Town): Riverlands Reserve, sandy soil, (–BC), 28 Sept. 2005, *Snijman 2028* (NBG); between Darling and Malmesbury, (–BC), 23 Sept. 1932, *Salter 2711* (SAM); Malmesbury, (–DA), 26 Sept. 1927, *Lewis Grant 3426* (MO); N7 at turn-off to Camphill Village south of Malmesbury, (–DA), 13 Oct. 1974, *Goldblatt 3022* (MO), 27 Sept. 1995, *Goldblatt & Manning 10333* (MO, NBG); near Green River, $\pm$ 42 km N of Cape Town, sandy flats, (–DA), 30 Sept. 1961, *Lewis 5749* (NBG, PRE); near Klipfontein, (–DA), October, *Zeyher s.n.* (PRE, SAM); Kalabaskraal, (–DA), 29 Sept. 1958, *Werdermann & Oberdieck 293* (PRE). Without precise locality: Vredenburg, ex Cape Town Wild Flower Show, Oct. 1916, *Anon.* (BOL13918).

18. *Ixia purpureorosea* G.J.Lewis in *Journal of South African Botany* 28: 126 (1962). Type: South Africa, [Western Cape], Saldanha Bay, Postberg, 8 Sept. 1957, *Lewis 5243* (NBG, holo.!).

Plants mostly 400 to 600 mm high, simple or with 1 short branch subtended by acute bracts and prophylls. *Corm* up to 20 mm diam., with broad, fasciated stolons up to 60 mm long, branching distally and each branch with a small terminal cormlet. *Leaves* 4 or 5, sword-shaped, often laxly twisted distally, main vein thickened, margins not raised, upper 2 leaves sheathing stem, uppermost often entirely sheathing. *Spike* fairly crowded, mostly 15–20-flowered; bracts translucent white turning pale straw-coloured above with age, mostly $\pm$ 8 mm long, $\pm$ reaching node above, outer obscurely 3-veined, central vein more prominent, 3-lobed, central lobe longest, acute, outer lobes $\pm$ obtuse, inner 2-veined and 2-cusped. *Flowers* pink-purple, dark purple in throat, bases of tepals white sometimes edged with pale pink, tube dark red-purple to brown outside, unscented; perianth tube $\pm$ filiform, 13–15 mm long, flaring in upper 3 mm, with nectar held in upper

part; tepals ovate, 20–22 $\times$ 10 mm long, spreading but remaining $\pm$ spooned. *Stamens*: filaments erect, contiguous, white, $\pm$ 4 mm long, exserted $\pm$ 2.5 mm from tube; anthers diverging, 6–8 mm long, yellow. *Style* dividing opposite or shortly above base of anthers, branches arching outward, between anthers, white, $\pm$ 5.5 mm long. *Capsules* and *seeds* unknown. *Flowering time*: September to early October. Figure 8.

Distribution: *Ixia purpureorosea* is a true edaphic endemic, restricted to areas of limestone and calcrete in the vicinity of Saldanha Bay (Figure 7). Plants grow in pockets of peaty sand in crevices in rocky pavement. Plants were only known to Lewis from Postberg on the Langebaan Peninsula but the species has since been collected at Jakobsbaai, north of Saldanha, and on the limestone hills east of Saldanha.

Diagnosis and relationships: according to Lewis (1962) who described the species, *Ixia purpureorosea* was first collected by C.P. Thunberg, and a collection in the Van Royen collection at Leiden likewise attests to its early discovery. Lewis considered the species as intermediate between sects *Ixia* and *Morphixia* but believed its affinity lay with the former. We disagree, not only is the perianth tube expanded in the upper quarter but the tube contains nectar, not normally present in species of sect. *Ixia*, the filaments are decurrent, and the perianth does not have a dark central area of pigmentation, almost universal in the section. The flowers are purple-pink with the tepals white, sometimes edged with pale pink, at base, not dark at base as described by Lewis. The perianth tube is dark red-purple to brown outside and this imparts to the mouth of the tube a dark colour when viewed from above.

Ixia purpureorosea is most likely allied to species of sect. *Hyalis* such as *I. tenuifolia* and *I. aurea*, which have a similarly narrow perianth tube, clasping the style in the lower half to two thirds. The broad leaves, somewhat twisted in the distal half are particularly reminiscent of *I. aurea*. A feature of *I. purpureorosea* not before recorded is the presence of one or more stolons produced from the corm base. The stolons, unique in the genus, are broad and fasciated, up to 60 mm long, branching distally with each branch bearing a small terminal cormlet.

Selected specimens

WESTERN CAPE.—3217 (Vredenburg): Saldanha, Farm Holvlei, shallow sand with calcrete rocks, (–DD), 2 Oct. 1996, *Rode 665* (NBG); Trekossenkraal Farm, exposed limestone and shallow sand, (–DD), 28 Sept. 2002, *Boucher 6988* (NBG); Jakobsbaai, limestone pavement, (–DD), 30 Sept. 2009, *Goldblatt & Porter 13481* (MO, NBG). 3317 (Saldanha): Saldanha, Prospect Hill, (–BB), 18 Sept. 2005, *Raimondo CR1698* (NBG); Saldanha, limestone hill east of the town, sandy slope among limestone rocks, (–BB), 5 Sept. 2009, *Goldblatt & Porter 13261* (MO, NBG). 3318 (Cape Town): Postberg, (–AA), 12 Sept. 1988, *De Vos 2707* (NBG).

2. Sect. *Morphixia* (Ker Gawl.) Pax in *Die natürlichen Pflanzenfamilien* 2,5: 154 (1888); Lewis: 66 (1962), as *Morphixia* (Ker Gawl.) Diels. Subgenus *Morphixia* (Ker Gawl.) Goldblatt & J.C.Manning: 63 (1999). Type species: *Morphixia aulica* (Aiton) Ker Gawl., here designated (= *Ixia latifolia* D.Delaroche).

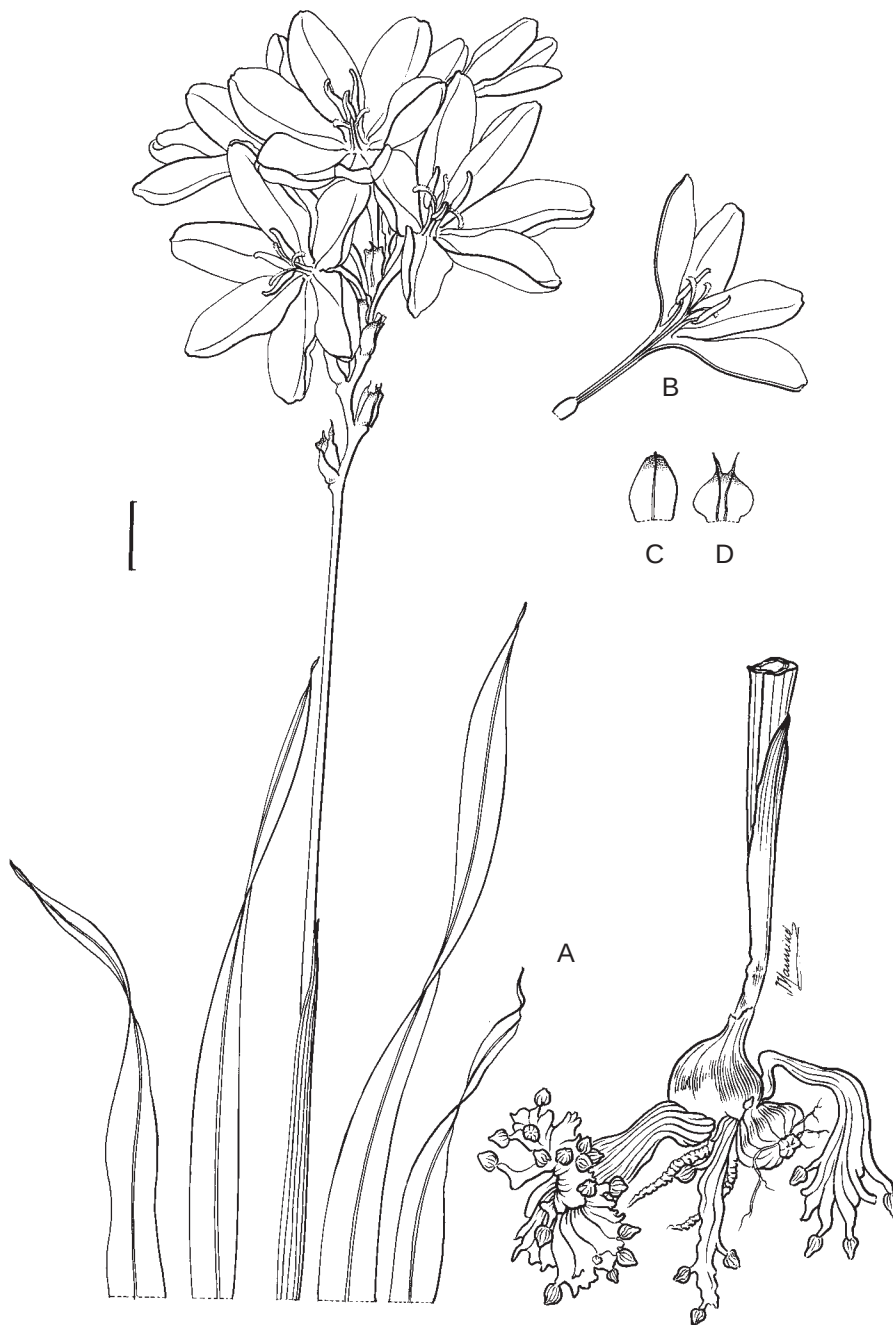


FIGURE 8.—*Ixia purpureorosea*, Goldblatt & Porter 13261 (NBG): A, plant with corm showing fasciated stolons; B, l/s flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

Leaves usually 3, sometimes up to 5, but always dimorphic, lower foliage leaves with well-developed blades and uppermost 1 (rarely 2 when basal foliage leaves more than 2) entirely sheathing. *Spike* with bracts usually membranous and translucent, rarely flushed with purple and opaque, outer with 3(5) prominent veins and 3-lobed to 3-toothed (or 5-toothed when 5-veined). *Flowers* usually actinomorphic, rarely bilateral, mostly pale blue-mauve, sometimes pink or white, occasionally deep purple, white to yellow in throat, erect, ascending or nodding, often scented; perianth tube always hollow to base, funnel-shaped to cylindric; tepals subequal, spreading. *Stamens* symmetrically arranged around central style and contiguous, rarely unilateral and then horizontal or declinate; filaments inserted at base of upper part of tube, decurrent, not expanded below, included to well exerted; anthers dehiscing longitudinally, exerted, partly included or rarely fully included. *Ovary* and capsules usually smooth, rarely warty (*Ixia alata* and *I. tho-*

masiae); style slender, central and straight, or when stamens unilateral then displaced to lie beneath filaments.

The first listing of a type for *Morphixia* at any rank is Lewis's (1962: 66) designation of *Ixia latifolia* as the type of sect. *Morphixia*. That species was never included in *Morphixia* by name and is thus not available as a type. To preserve the current circumscription of *Morphixia* we designate *M. aulica* as the type, a later synonym of *I. latifolia*.

2.1. Series **Morphixia**

19. ***Ixia divaricata*** Goldblatt & J.C.Manning in *Bothalia* 38: 18 (2008a) as nom. nov. pro *I. latifolia* var. *angustifolia* G.J.Lewis: 86 (1962). Type: South Africa, [Western Cape] Witzenberg, middle east face opposite Farm Rosendal, 26 Nov. 1941, *Pillans* 9790 (BOL, holo.).

I. rapunculoides var. *rigida* G.J.Lewis: 77 (1962). Type: South Africa, [Western Cape], Hex River Valley, 1 Oct. 1893, P. MacOwan in Herbario Normale Austro-Africana 1653 (BOL! [as Hex River Pass, Bolus s.n. in Guthrie 3077], G, K! [as near Hex River East, 1500 ft ($\pm$ 460 m)], MO! [as Hex River Valley, De Doorns, Oct. 1893, H. Bolus s.n.], SAM!, Z, syn.).

I. rapunculoides var. *subpendula* G.J.Lewis: 77 (1962). Type: South Africa, [Western Cape], between Groot River and Elands Kloof, Oct. 1939, Leipoldt 3026 (BOL, holo!).

?*Ixia capitata* var. *stellata* Andrews, The botanist's repository 4: t. 232 (1802). *I. stellata* (Andrews) Klatt: 396 (1882). *I. ovata* var. *stellata* (Andrews) Baker: 164 (1892). Type: South Africa, without precise locality or collector, illustration in Andrews l.c. (1802).

See Goldblatt & Manning (2008a) in Bothalia 38 for description and illustration.

Distribution: *Ixia divaricata* is scattered through the mountains of the southwestern Cape, from Elandskloof, east of Citrusdal, through the Cold Bokkeveld to Tulbagh and the Hex River Valley, where it most likely no longer occurs (Goldblatt & Manning 2008a: fig. 10). Plants favour seasonally wet, stony sandstone flats and rocky sites. *Ixia divaricata* is still common in the Cold Bokkeveld, where it is found in sites presently protected from agriculture. Below Gydo Pass in the Warm Bokkeveld it is now actively threatened by the expansion of orchards that extend from Ceres and Prince Alfred Hamlet to the foot of the pass.

Diagnosis and variation: *Ixia divaricata* is unmistakable in its unusual branching pattern; the distinctive, stiff, straight lateral branches are held at angles of 30–50° to the main axis and bear mostly 3–5 flowers crowded in the distal half. The white or pale pink (rarely deep pink or purple) flowers are held erect, with the tepals spreading but not fully patent. That this plant was treated as var. *subpendula* of *I. rapunculoides* is puzzling, for not only is it distinctive in its branching pattern but the flowers are upright, not inclined or drooping, and the anthers, 4.0–5.5 mm long, are usually fully exserted from the tube or rarely with the bases included. Specimens with anthers exserted 1–2 mm were often included in *I. latifolia* by De Vos (1999) but typical *I. latifolia* has larger, deep pink flowers with a perianth tube 14–17 mm long, filaments $\pm$ 10 mm long, and broad basal leaves, mostly 10–18 mm wide. The reason for the adoption of a new name at species rank and the synonymy of *I. divaricata* are explained elsewhere (Goldblatt & Manning 2008a).

The immediate relationships of *Ixia divaricata* are most likely with *I. latifolia*. Confusion with that species is due in part to some collections with a longer tube, 12–14 mm (e.g. De Vos 2693 and Leipoldt 4070), that also have relatively short, broad leaves, up to 18 mm wide (also found in *I. latifolia*) but fairly slender branches (characteristic of *I. divaricata*). These are almost certainly hybrids between the two species, which sometimes grow within sight of one another, although on different soils, *I. latifolia* favouring heavy clay or loam.

Ixia divaricata was associated historically with *I. latifolia*, and one of the two specimens cited by Baker (1892) under var. *longifolia* of *I. scariosa*, the name by which *I. latifolia* was then known, is *I. divaricata* (the other specimen is *I. orientalis* and is the lectotype of the

name). The type of *I. latifolia* var. *angustifolia*, from the Witzenberg is also *I. divaricata*, but several other specimens assigned here by Lewis (1962) and De Vos (1999) are a different species, *I. monticola*, described here. Although these two taxa have been confused in the literature, they may not be particularly closely allied. The most important differences are that *I. monticola* has a corm with membranous, non-accumulating tunics, few or no branches, and four or five leaves. *I. divaricata*, in contrast, has fibrous tunics of medium texture and a distinctive branching pattern, and plants from high elevations typically have two or three leaves in most specimens, although sometimes more in those from middle elevations.

Plants from upper Moraine Kloof in the Hex River Mtns (Helme 2864), flowering in January, were provisionally included in *Ixia divaricata* by Goldblatt & Manning (2008a). They have a similar branching pattern but somewhat smaller, purple flowers with a tube $\pm$ 5 mm long, tepals $\pm$ 10 mm long, and anthers $\pm$ 3.2 mm long. The style divides at the top of the anthers and has branches $\pm$ 1.3 mm long that extend above the anther tips, whereas in typical *I. divaricata* the style divides opposite the middle of the anthers. The specimens lack corms and leaves without which a fair decision about the status of this late-flowering population cannot be made.

Pollination of *Ixia divaricata* accords with that for other species of series *Rapunculoides*. Plants are pollinated by a range of medium-sized and large bees including *Lasioglossum* sp. (Halictidae) and *Anthophora diversipes* and *Amegilla spilostoma* (Apidae) (Goldblatt & Manning 2008a).

Selected specimens

WESTERN CAPE.—3219 (Wuppertal): Cedarberg, valley between Sneeuberg and Tafelberg, wet sandy flats, (–AC), 19 Oct. 1923, Pocock 408 (NBG); Elandskloof, Ceres, (–CA), 30 Sept. 1944, Barker 3094 (BOL, NBG); Cold Bokkeveld, Waboomsriver, sandy flats (*vlakke*), (–CC), 4 Oct. 1966, Hanekom 776 (K, PRE); Cold Bokkeveld, 3 miles [4.8 km] S of Leeurivier, (–CD), Sept. 1952, Lewis 2512 (PRE, SAM). 3319 (Worcester): Great Winterhoek, Sneeuat, (–AA), Nov. 1916, Phillips 1874 (NBG); Steindaal, Tulbagh, Oct.–Nov. 1858, Pappé s.n. SAM20937 (NBG); Tulbaghskloof (Nieuwekloof), Tulbaghsthal, foot of Winterhoeksberg, Witsenberg and Vogelvalei, (–AA), Nov. 1830, Ecklon & Zeyher Irid. 94 (BOL, K, PRE); Cold Bokkeveld, roadside at Farm Wadrif, in rocky sandstone ground, (–AB), 30 Sept. 2004, Goldblatt & Porter 12604 (MO, NBG); stony flats at foot of Gydo Pass, (–AB), 4 Oct. 2004, Goldblatt & Porter 12610 (MO, NBG, PRE); Witzenberg Mtns, Visgat Valley, Farm Wakkerstroom, (–AC), 5 Nov. 2003, Low 9376 (NBG); near Ceres Nature Reserve in wet ground, (–AD), 8 Oct. 1986, De Vos 2675 (NBG, PRE) Matroosberg, near Lakenvlei, (–AD), without date, Phillips s.n. SAM11876 (NBG); Hex River Mtns, upper Moraine Kloof Amphitheatre south of Milner Peak, 1 050 m, (–AD), 4 Jan. 2004, Helme 2864 (NBG).

Putative hybrids with *Ixia latifolia* are listed by Goldblatt & Manning (2008a).

20. *Ixia saundersiana* Goldblatt & J.C.Manning, sp. nov.

Plantae 150–200 mm altae, eramosae, cormo ovoideo-conico $\pm$ 8 mm diam., tunicis fibris tenuibus, foliis 2 folio inferiori basali lineari 1.0–2.5 mm lato, spica 2- vel 3-flora, floribus caeruleo-malvinis fauce flavo, tubo perianthii infundibuliforme $\pm$ 5 mm longo, tepalis ovatis $\pm$

11 × 5.5 mm, filamentis ± 3 mm longis, antheris ± 4 mm longis ex tubo exsertis, ramis styli ± 1.5 mm longis.

TYPE.—Western Cape: 3319 (Worcester): Milner Peak, rock cracks in humus with restios (–CD), 7 Dec. 2008, *Saunders & Saunders sub Manning 3237* (NBG, holo.).

Plants 150–200 mm high, usually unbranched, rarely with up to three short, ascending branches. *Corm* ovoid-conic, ± 8 mm diam., with tunics of fine netted fibres. *Leaves* 2, lower basal, linear, 1.0–2.5 mm wide, sometimes shortly exceeding stem, central vein strongly and margins slightly thickened, pale when dry, upper sheathing the lower half to two thirds of stem, with a short free blade. *Spike* 2- or 3(–5)-flowered; bracts membranous, translucent, outer with 3 main veins and 2 smaller lateral veins, shortly 3-toothed, inner 2-veined and 2-toothed. *Flowers* blue-mauve, yellow in throat; perianth tube funnel-shaped, ± 5 mm long; tepals ovate, ± 11 × 5.5 mm. *Stamens* with filaments ± 3 mm long, reaching mouth of tube; anthers ± 4 mm long, yellow; pollen yellow. *Style* dividing opposite base to lower third of anthers, style branches ± 1.5 mm long. *Flowering time*: late October to December.

Distribution: *Ixia saundersiana* is known from just two collections, the first made in December 2008 at high elevation on Milner Peak in the Hex River Mtns, where plants were found growing in rock cracks in damp humus among restios. A second collection extends the range of the species to the Swartruggens, some distance to the northeast. Figure 7.

Diagnosis and relationships: a recent and surprising discovery, the high altitude *Ixia saundersiana* is immediately recognized by the single linear foliage leaf and a second, largely sheathing leaf, together with a mostly unbranched stem and spike of 2 or 3(–5) small, blue-mauve flowers yellow in the throat. Well-grown plants may have up to three, short, straight, ascending branches with up to four flowers per branch. The flowers are unremarkable and have a funnel-shaped perianth tube ± 5 mm long, spreading tepals, and relatively short filaments only 3 mm long, that reach only to the mouth of the perianth tube. We suspect that the species is most closely allied to *I. divaricata* but that species has a longer perianth tube, 8–11 mm long, filaments 4.0–5.5 mm long, usually exserted 1–2 mm from the tube and the stem is typically branched, with the long, straight branches diverging strongly from the main axis.

Additional specimen

WESTERN CAPE.—3319 (Worcester): Swartruggens, Farm Knollfontein, 1 220 m, (–AB), 22 Oct. 2009, *Jardine & Jardine 1219* (NBG).

21. ***Ixia latifolia*** D.Delaroche, *Descriptiones plantarum aliquot novarum*: 22 (1766); Lewis: 81 (1962). *Hyalis latifolia* (D.Delaroche) Salisb.: 317 (1812), genus invalid. *Geissorhiza latifolia* (D.Delaroche) Baker: 94 (1877). *Tritonia latifolia* (D.Delaroche) N.E.Br.: 135 (1929). Type: South Africa, without precise locality or collector (G-DEL, holo.).

I. aulica [Soland, in] Aiton: 57 (1789). *Ixia capillaris* var. *aulica* (Aiton) Ker Gawl.: t. 1013 (1807). *Hyalis aulica* (Aiton) Salisb.:

318 (1812), genus invalid. *Morphixia aulica* (Aiton) Ker Gawl.: 107 (1827). Type: South Africa, ‘Cape of Good Hope’, cultivated in Britain, without precise locality, illustration in Curtis’s Botanical Magazine 25: t. 1013 (1807).

I. incarnata Jacq.: t. 282 (1795b); Jacq.: 13 (1796). *Ixia capillaris* var. *incarnata* (Jacq.) Ker Gawl.: t. 617 (1803a). *Morphixia incarnata* (Jacq.) Ker Gawl.: 107 (1827). *M. capillaris* var. *incarnata* (Jacq.) Baker: 97 (1877). Types: South Africa, without precise locality or collector, illustration in Jacq. (1795b); South Africa, [Western Cape], Ceres, Theronberg Pass, 20 Oct. 1983, *Snijman 779* (NBG, epitype!, here designated; PRE, iso.).

I. scariosa Thunb.: 243 (1811). Type: South Africa, [Western Cape], probably in the Cold Bokkeveld, Sept. 1773, but not stated, *C.P. Thunberg s.n. UPS-THUNB990* (UPS-THUN—digitally scanned image!, specimen on right of sheet, lecto., here designated).

I. phlogiflora Delile in Redouté: t. 432 (1814a). Type: South Africa, [Western Cape], without precise locality or collector, illustration in Delile in Redouté, *Les Liliacées* 8: t. 432 (1814a).

I. latifolia var. *curviramosa* G.J.Lewis: 86 (1962), syn. nov. Type: South Africa, [Western Cape], 3320 (Montagu): Laingsburg Div., Tweedside, on flats, (–BB), 27 Sept. 1951, *Barker 7469* (NBG, holo.!: NBG!, PRE!, iso.).

Plants mostly 150–350 mm high, usually 1–3-branched, rarely simple; branches either ascending, fairly long and straight or shorter and ± twisted, subtended by obscure, obtuse bracts and prophylls ± 1 mm long. *Corm* subglobose, mostly 15–25 mm diam., with tunics of firm, often coarsely wiry, netted fibres, bearing small cormlets at base. *Leaves* usually 3, lower 2 lanceolate to sword-shaped, oblong or falcate, (5–)10–18 mm wide, ± one third as long as stem; margins moderately to strongly thickened, sometimes slightly crisped; uppermost leaf sheathing lower half to two thirds of stem. *Main spike* mostly 3–7-flowered, lateral spikes (1–)3–6-flowered, either ± straight or twisted; bracts translucent sometimes tinged brown, especially in fruit, outer with three dark veins, mostly 7–11 mm long, acutely 3-toothed, inner ± as long or slightly longer, with two dark veins, 2-toothed at apex. *Flowers* facing to the side, deep pink, pale mauve or blue-mauve, white or yellow in throat, sometimes edged darker pink or purple, unscented or with a faint rose or sour odour; perianth tube (7–)10–18(–23) mm long, narrowly funnel-shaped, flaring in upper third, slightly curved near base; tepals subequal, ovate, 13–20(–23) × (6–)7–10 mm, spreading at right angles to tube distally. *Stamens* with filaments 8–12 long, exserted 6–8 mm; anthers 3–5 mm long before splitting. *Style* dividing between base and middle of anthers, style branches 1.8–3.0 mm long, extending between anthers. *Flowering time*: mainly mid-September to mid-October. Figure 9.

Distribution: as circumscribed here, *Ixia latifolia* is a species of clay, clay loam and sandy soils in renosterveld, or occasionally dry fynbos habitats. The species is fairly common at higher elevations in the interior southwestern part of Western Cape. It extends from the Cold Bokkeveld and Worcester eastward to Karoo Poort at the edge of the Tanqua Karoo and southeast through the Witteberg Karoo and northern foothills of the Klein Swartberg. Isolated populations also occur locally in the Little Karoo on the southern slopes of the Gamkaberg, a small but surprising disjunction (Figure 10). Lewis’s (1962) vague description of the habitat of *I. latifolia* as sandy flats and slopes must then be extended to include clay soils as well.

Diagnosis and relationships: in our revised and narrower circumscription, *Ixia latifolia* is recognized by the relatively large, deep pink, purple, mauve-pink, blue-mauve or violet flower usually with a relatively



FIGURE 9.—A, B, *Ixia latifolia*, Goldblatt & Porter 12969: A, plant; B, l/s flower. C, D, *Ixia latifolia*, Goldblatt & Porter 12813: C, plant; D, half-flower. Scale bar: 10 mm. Artist: J.C. Manning.

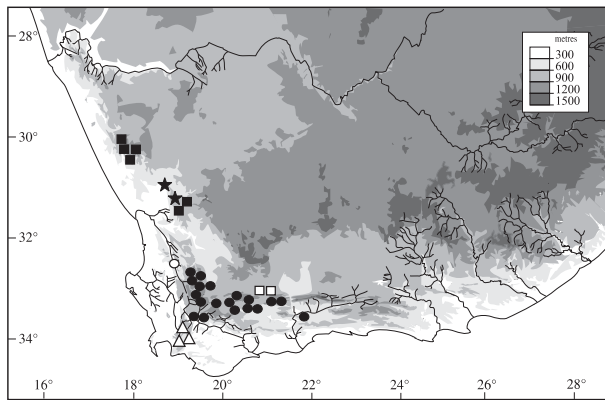


FIGURE 10.—Known distribution of *Ixia latifolia*, ●; *I. ecklonii*, ○; and *I. monticola*, △; *I. parva*, □; *I. ramulosa*, ■; and *I. brunneobracteata*, ★.

well-developed perianth tube, (7–)10–18(–23) mm long that gradually widens toward the mouth, and spreading tepals 13–20(–23) long. The long stamens have filaments exserted 6–8 mm from the tube and anthers 3–5 mm long. The floral bracts are mostly 8–10 mm long and distinctive in having narrowly acute teeth. The two broad basal leaves are usually fairly broad, 10–18 mm, but occasionally only 5 mm wide. The third leaf sheathes the stem for its entire length, as is typical of sect. *Morphixia*.

Lewis (1962) recognized five varieties of *Ixia latifolia*, three of which are here treated as four separate species. Small-flowered var. *parviflora*, now *I. parva*, is a plant of low stature, a twisted spike, purple floral bracts, and filaments exserted 5–6 mm. Var. *ramulosa*, from Namaqualand, now *I. ramulosa*, comprises plants with several, short lateral branches bearing one or two, rarely three, flowers. Lastly, var. *angustifolia* included two species, one of them is now *I. divaricata* and the other is a high elevation species, described here as *I. monticola*, and distinguished by soft-textured leaves and dry-membranous, brown, onion-skin-like corm tunics. The remaining var. *curviramosa* was distinguished by Lewis by the short, somewhat twisted, rather than straight, lateral branches and slightly smaller flower. The ample material of *Ixia latifolia* collected since Lewis's revision has made the distinction between var. *curviramosa* and var. *latifolia* arbitrary and we do not recognize var. *curviramosa*. The degree of twisting and length of the branches is not consistently correlated with any other character, and is often difficult to determine because plants with shorter, ± straight branches, conform to neither taxon.

Flower size in *Ixia latifolia* is unusually variable. Both the northernmost populations of *I. latifolia* in the arid Tanqua Basin and the easternmost near Oudtshoorn are exceptional and we considered that they possibly represented separate species. The Tanqua populations (Goldblatt & Porter 12969), growing in perhaps the most arid habitat for the species, have the largest flowers with a tube 20–23 mm long and tepals up to 21 × 10.5 mm. In contrast, the Gamkaberg populations have flowers with a tube 7–8 mm long and tepals 13–15 × ± 7 mm, among the smallest in the species. But plants from several other localities, e.g. Goldblatt & Nänni 11184 from the Voet-

padsberg near Touws River and Oliver 5104 from Long Acres in the Cold Bokkeveld have flowers almost as small. The plants from the Tanqua Karoo reverse the usual trend for smaller stature and flower size in the driest habitats and merit further study. We prefer not to formally recognize any of these variants because of the existence of populations intermediate between these extremes.

Ixia latifolia is probably most closely related to *I. divaricata*, a plant of wet, sandstone habitats in the Cold Bokkeveld and surrounding mountains, which has long, slender, straight lateral branches with flowers crowded in the upper half, a feature sometimes found in *I. latifolia*, but always a smaller perianth with a tube 8–11 mm long, tepals 11–14 mm long, and filaments 4–5 mm long reaching 1–2 mm beyond the mouth of the perianth tube or sometimes only to the mouth of the tube. *Ixia divaricata* typically has pale pink or white flowers and narrow leaves, thus very different from the larger, deep pink mauve or purple flowers with well-exserted filaments, and broad, fairly short leaves of *I. latifolia*. Plants with broader leaves may be the result of crossing with *I. latifolia*, and plants of that species with particularly long branches may be the result of occasional crosses with *I. divaricata* at sites where the habitats of the two are close together.

Taxonomic history and typification: *Ixia latifolia*, described by Daniel Delaroche in 1766, has a complex synonymy. It was long known as *I. scariosa*, described by Thunberg in 1811, and both this and the earlier *I. aulica* Aiton (1789), which was based on a plant cultivated in England and evidently preserved only as a painting, match the straight-branched form of *I. latifolia* from the Cold Bokkeveld. The type sheet of *I. scariosa* in the Thunberg Herbarium (UPS-THUNB990), is actually a mixture of two species. There are two tall specimens of *I. latifolia* and one short plant in the centre of the sheet, which may be *I. contorta* (but with a flower of *I. latifolia* mounted at the top of the main spike). Our identification of this specimen as *I. contorta* is provisional, because the included filaments in the single flower that belongs to the plant, are not visible in the digital image we have available. Because of the mixture on the sheet, we designate as lectotype the single plant on the right-hand side.

A third synonym, *Ixia incarnata* Jacq. (1795b), is today typified by an illustration not entirely representative of the species as the stem is unbranched. We have designated an epitype for the species so that the application of this name is fixed, should future doubt arise about its identity. Lastly, *I. phlogiflora* Delile (1814a), also based on a painting, testifies to the widespread cultivation of *I. latifolia* in Europe in the early 19th century. During the later 18th and early 19th centuries the species remained known as *I. scariosa*, even as late as 1896 in Baker's account of the genus in *Flora capensis*. The circumscription of *I. scariosa* remained fluid well into the 20th century and often included other species, such as *I. rapunculoides* Delile and its immediate relatives. The identity of Delaroche's *I. latifolia* remained uncertain throughout this period and was finally established by Lewis (1962) after she examined the type material at the Burman Herbarium in Geneva and then placed *I. scariosa* in synonymy.

Lewis also included *Ixia stellata* (Andrews) Klatt as a synonym of *I. latifolia*, a plant based on *I. capitata* var. *stellata* Andrews (1802). The only type material known is a painting in *The botanist's repository* and does not appear to us to represent *I. latifolia*, but possibly the related *I. divaricata* (Goldblatt & Manning 2008a). The correct identity of the plant is of secondary significance as the name *I. stellata* Roem. & Schult. (1817), probably a named hybrid of *Sparaxis* (Goldblatt 1969), renders use of Andrews's epithet at species rank in *Ixia* illegitimate.

Selected specimens

WESTERN CAPE.—3219 (Wuppertal): Cold Bokkeveld, Helpme-kaar, red gravelly, stony loam, (–CC), 16 Oct. 1975, *Hanekom 2471* (K, MO, PRE); Cold Bokkeveld, NW of Tafelberg, dry shale slopes, 3100 ft [$\pm$ 960 m], (–CD), 2 Oct. 1972, *Thompson 1550* (MO, PRE); summit of Tafelberg, (–CD), Oct. 1921, *Pillans s.n.* (BOL14141). 3319 (Worcester): Klip Koppies, north ridge of Gydoberg, dry sandy slope, 1 050 m, (–AB), 11 Oct. 1974, *Oliver 5096* (PRE); top of Gydob Pass, (–AB), 13 Oct. 1960, *Lewis 5750* (K, NBG, PRE); Long Acres, N of Gydoberg, on flats, 1 000 m, (–AB), 11 Oct. 1974, *Oliver 5104* (K, MO, NBG, PRE); Tanqua Karoo, north of Karooport near Inverdoorn, (–BB), 9 Sept. 2007, *Goldblatt & Porter 12969* (K, MO, NBG, PRE); Theronberg Pass, east of Ceres, (–BC), 20 Oct. 1983, *Snijman 779* (NBG, PRE), 31 Oct. 1974, *Goldblatt 3227* (MO); Lakenvlei, (–BC), 19 Oct. 1941, *Compton 12061* (NBG); $\pm$ 2 km south of N1 on road to Montagu, sandstone cutting, (–BD), 9 Sept. 2006, *Goldblatt & Porter 12813* (MO, NBG, PRE); Worcester commonage, (–CB), 16 Sept. 1975, *Van Breda 4283* (K, PRE); Rabiesberg, Worcester, (–DA), 26 Sept. 1935, *Lewis s.n.* (BOL26910); Eendracht, Montagu, (–DB), 23 Sept. 1946, *Compton 15826* (NBG). 3320 (Montagu): between Konstabel and Tweedside, (–AB), 21 Sept. 1985, *De Vos 2602* (NBG, PRE); near Pietermeintjies Siding, (–AB), 2 Oct. 1999, *Goldblatt & Nänni 11184* (MO); foot of Voetpadsberg, 21.5 km E of Touws River, in sandy ground, (–AC), 3 Oct. 1999, *Goldblatt & Nänni 11202* (MO, PRE); Elandsfontein, Witteberg, (–AD), 21 Sept. 1931, *Compton 3810* (BOL, NBG); flats SW of Bantamskop, Witteberg, 980 m, (–BC), 23 Sept. 1990, *Oliver 9753* (NBG); between Ouberg Pass and Touws River, (–CA–CB), 29 Sept. 1933, *Dymond s.n.* (*Nat. Bot. Gard.* 1965/33 in BOL, K, PRE). 3321 (Ladismith): northern foothills of Klein Swartberg, Farm Vleiland, (–AC), 10 Sept. 1983, *Vlok 668* (MO, NBG, PRE); road to Seweweekspoort, Farm Modderfontein, (–AC), 21 Sept. 2003, *Goldblatt & Porter 12329* (K, MO); Seven Weeks Poort, (–AD), Sept. 1912, *Phillips 1545* (BOL); southern foot of Gamkaberg, SW of Oudtshoorn, rocky ground in loamy clay among sandstone rocks, (–DB), 4 Sept. 2007, *Goldblatt & Porter* (NBG, K, MO, PRE, S).

22. *Ixia monticola* Goldblatt & J.C. Manning, sp. nov.

Plantae 80–250 mm altae, cormo $\pm$ 6 mm diametro, tunicis submembranaceis, foliis 2 vel 3(4) inferioribus 1, 2(3) anguste ensiformibus vel linearibus usitate 2.5–4.5 mm latis, caule saepe simplici vel 1(2)-ramoso, ramis filiformibus erectis saepe leviter contortis 10–15 mm longis, spica 2- vel 3-flora, bracteis 5–6 mm longis membranaceis vel scariosis, floribus carneis in fauce flavis, tubo perianthii infundibuliformi $\pm$ 10 mm longo, tepalis subequalibus 12–17 $\times$ 6–7 mm, filamentis $\pm$ 6 mm longis ex tubo 2–3 mm exsertis, antheris 3.5–4 mm longis flavis, stylo inter basem et medium antherarum dividenti ramis styli $\pm$ 1 mm longis.

TYPE.—[Western Cape], 3319 (Worcester): Du Toit's Peak, rocky upper slopes and ledges, west aspect, $\pm$ 6000' [1 820 m], (–CC), 21 Dec. 1975, *Esterhuyusen 34162* (BOL, holo.!: MO, iso.!).

Plants mostly 80–250 mm high, sheathed at base by pale brown cataphylls, usually simple or 1-, rarely

2-branched, branches thread-like, suberect, often slightly twisted, 10–15 mm long, subtended by obscure, membranous bracts and prophylls $\pm$ 1 mm long. *Corm* $\pm$ 6 mm diam., with rust-brown, submembranous tunics, not accumulating. *Leaves* 2, 3(4), lower 1, 2(3) with narrowly sword-shaped to linear blades, half as long to $\pm$ as long as stem, mostly 2.5–4.5 mm wide, uppermost leaf mostly sheathing but with a free unifacial distal portion. *Main spike* erect, slightly flexuose, 2- or 3-flowered, lateral spikes 1- or 2-flowered; bracts 5–6 mm long, membranous or becoming dry, flushed red-purple, outer bract shortly 3-cusped, inner forked apically. *Flowers* pink, yellow in throat, presence of scent unknown; perianth tube narrowly funnel-shaped, $\pm$ 10 mm long; tepals subequal, 12–17 $\times$ 6–7 mm. *Stamens* with filaments $\pm$ 6 mm long, exserted 2–3 mm from tube; anthers 3.5–4.0 mm long, yellow. *Style* dividing between base and middle of anthers, style branches $\pm$ 1 mm long. *Flowering time*: December to mid-January.

Distribution: *Ixia monticola* is a local endemic of the mountains of Western Cape between Victoria Peak and Wemmershoek Peak, on sandstone rocks and cliffs, above 1 200 m, this high mountain plant evidently flowers well only after fire, and with just a handful or collections known, it remains poorly understood (Figure 10).

Diagnosis and relationships: most specimens assigned by Lewis (1962) to *Ixia latifolia* var. *angustifolia*, including the type, *Pillans 9790* from the Witzenberg, are *I. divaricata* (syn. *I. rapunculoides* var. *subpendula*) (Goldblatt & Manning 2008a) but the few from the high elevations in the Paarl and Stellenbosch Divisions represent a second species, which we here describe as *I. monticola*. This new species can be recognized primarily by the small corm, $\pm$ 6 mm in diameter, with rust-brown, submembranous, non-accumulating, onion-skin-like tunics, often a fairly low stature and usually a simple, rarely 1(2)-branched stem. The moderate-sized pink flowers are unremarkable and have a perianth tube $\pm$ 10 mm long, tepals 12–17 mm long, and short filaments exserted 2–3 mm from the mouth of the tube. The leaves are $\pm$ straight, 2.5–4.5 mm wide, and the cataphylls are typically rust-brown. The species name indicates the high elevation distribution, all known collections being from above 1 400 m.

Ixia monticola is most easily confused with the relatively small-flowered *I. divaricata*, the higher elevation populations of which often have few-branched or unbranched stems, and similar narrow, erect leaves. *Ixia divaricata* more often has white or very pale pink flowers, and while the floral proportions are similar to those of *I. monticola*, *I. divaricata* always has well-developed fibrous corm tunics. It is not surprising that some collections of the latter have been confused with *I. monticola* given the similar appearance of *I. divaricata* from higher elevations. While they can best be distinguished by the corms, unfortunately often lacking in herbarium collections, the perianth tube length, 10–12 mm and usually unbranched stem of *I. monticola* contrasts with the perianth tube 8–11 mm in *I. divaricata*, and usually only 8–9 mm in the higher elevation populations. The distinctive divaricate branching pattern of *I. divaricata* with the branches straight, held at 45–90° to the main axis, and the flowers crowded in the distal half, contrast markedly

with the single short, suberect branches of *I. monticola*. Although we are fairly confident that *I. monticola* is correctly assigned to sect. *Morphixia* we note that the upper leaf is not completely sheathing, but has a short blade.

Selected specimens

WESTERN CAPE.—3418 (Simonstown): Victoria Peak, 4500' [$\pm 1\ 450\ m$], (–AA), 2 Jan. 1944, Esterhuysen 9763 (BOL). 3319 (Worcester): Wemmershoek Peak, south slopes, (–CC), 31 Dec. 1945, Esterhuysen 11268 (BOL); mountains south of Wemmershoek, damp places, (–CC), Jan. 1921 (mostly fr.), Andreae 736 (PRE); Adolph's Kop, Franschhoek Mtns, after fire, (–CC), 15 Dec. 1944, Esterhuysen 11199 (BOL).

23. *IXIA parva* Goldblatt & J.C.Manning, nom. nov. pro *I. latifolia* var. *parviflora* G.J.Lewis in Journal of South African Botany 28: 86 (1962). Type: South Africa, [Western Cape], 3320 (Montagu): Laingsburg Div., Karoo Garden, Whitehill, (–BA), 9 Sept. 1935, Compton 5592 (NBG, holo.).

Plants mostly 70–120 mm high, usually 1- or 2-branched, branches short, twisted, subtended by membranous, attenuate bracts and prophylls 2–3 mm long. Corm 12–16 mm diam., with tunics of medium-textured, netted fibres, bearing medium-sized cormlets at base. Leaves 3, lower 2 with blades sword-shaped to falcate, 3–9 mm wide; margins and midrib slightly thickened; uppermost leaf sheathing lower half to two thirds of stem. Main spike mostly 3–6-flowered, markedly flexuose, branches (1–)3–5-flowered; bracts 5–7 mm long, membranous or papery, opaque-purple or rust-coloured and veins hardly evident, with short acute teeth, inner $\pm$ as long or slightly longer than outer. Flowers extending horizontally with tepals vertical, bright pinkish purple, yellow in throat with base of tepals edged with red, strongly scented of sweet pea; perianth tube funnel-shaped, 6–8 mm long; tepals subequal, oblong, 10–12 $\times$ ± 4 mm, spreading at right angles to tube. Stamens with filaments 6–7 mm long, ± 5 mm; anthers ± 4 mm long. Style dividing below or opposite bases of anthers, branches ± 3 mm long, spreading below anthers. Flowering time: mid-August to late September. Figure 11.

Distribution: local in the Western Karoo, *Ixia parva* occurs between Laingsburg and Matjiesfontein, in decomposed shale on south-trending slopes (Figure 10).

Diagnosis and relationships: known from just two collections when first described by Lewis (1962), both from Whitehill near Laingsburg, *Ixia latifolia* var. *parviflora* was readily distinguished from other varieties of *I. latifolia* by its small, red-purple flowers and low stature. Additional collections now available confirm a fairly uniform morphology and complete separation in all quantitative features from the remaining varieties of *I. latifolia*. Neither Lewis (1962) nor De Vos (1999) in her *Flora of southern Africa* treatment of *Ixia* noted the distinctive dark purple bracts of the plant and confined themselves to comments on its smaller size. Not only do the bracts differ from those of other plants they included in *I. latifolia*, but the smaller flowers have unusually long style branches, ± 3 mm long, unexpected in such a small flower. The style divides at or slightly below the apices of the filaments and the style branches extend outward beneath the anthers where they are conspicuous. The flowers are also strongly scented of sweet

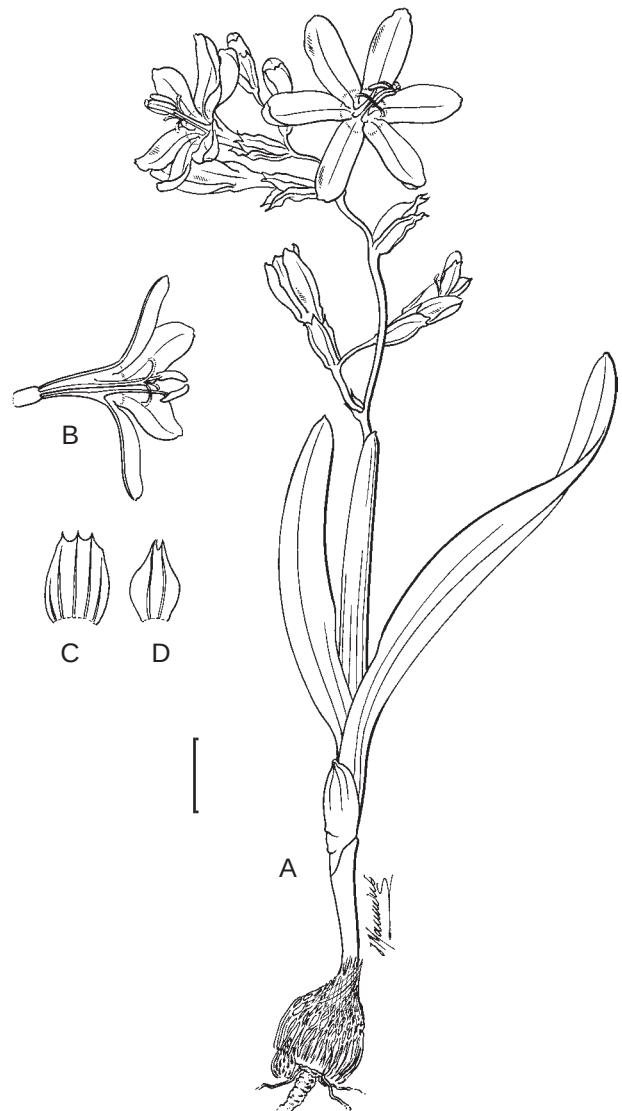


FIGURE 11.—*Ixia parva*, Goldblatt & Porter 12709 (NBG). A, plant; B, half-flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

pea, a feature unique among the species of the *I. latifolia* group where scent is lacking or weakly developed.

In view of its several differences from all variants of *Ixia latifolia*, we consider var. *parviflora* is best regarded as a separate species, here called *I. parva* because the name *I. parviflora* Salisb. (= *Romulea columnae* L.) prevents use of the varietal name at species rank. *Ixia parva* differs from *I. latifolia* in the very flexuose spike, twisted lateral branches, dark bracts and smaller flower with a perianth tube 6–8 mm long and tepals 10–12 mm long, versus straight lateral branches, a tube (7–)10–18(–23) mm long and tepals 13–20(–23) mm long in *I. latifolia*. The general appearance of *I. parva* most closely matches the eastern populations of *I. latifolia*, which also have twisted lateral branches, but these plants are usually taller and have larger, pale mauve to blue-mauve flowers. The shorter style branches, usually 1.8–2.3 (exceptionally 3) mm long, and style dividing opposite the middle third of anthers, of *I. latifolia* also stand in marked contrast to the style dividing below the anthers and relatively long style branches of *I. parva*. The delightful scent and bright red-purple colour of the

flowers make *I. parva* a particularly desirable plant for a container or rock garden.

Representative specimens

WESTERN CAPE.—3320 (Montagu): lower slopes of Ghaap Kop near Matjiesfontein, (–BA), 24 Sept. 1981, *Goldblatt* 6388A (MO, PRE); Karoo Garden, Whitehill, (–BA), 6 Aug. 1923, *Compton* 2873 (BOL, NBG); gravel road to Sutherland from N1 west of Laingsburg, 2760 ft [$\pm$ 910 m], (–BA), 27 Aug. 2006, *Goldblatt & Porter* 12709 (K, MO, NBG, PRE, S).

24. *Ixia ramulosa* (G.J.Lewis) Goldblatt & J.C.Manning, stat. nov. *Ixia latifolia* var. *ramulosa* G.J.Lewis in Journal of South African Botany 28: 86 (1962). Type: South Africa, [Northern Cape], 3017 (Hondeklipbaai): Grootvlei, Kamieskroon, (–BB), Sept. 1945, *Lewis* 1372 (SAM, holo.!, SAM, iso!, two sheets).

Plants mostly 150–400(–650) mm high, with 3–6(–8) short, slightly twisted branches subtended by minute, scale-like, $\pm$ truncate to obtuse bracts and prophylls 1(–2) mm long. *Corm* with tunics of coarse, netted fibres. *Leaves* 3, lower 2 sword-shaped to falcate, 4–10 mm wide; margins and midrib moderately or sometimes slightly thickened; uppermost leaf sheathing lower half to two thirds of stem. *Main spike* mostly 2- or 3-flowered, branchlets mostly 1- or 2(3)-flowered; bracts mostly 7–8 mm long, often rust-brown in distal half, with short acute teeth, inner bract $\pm$ as long or slightly longer than outer. *Flowers* deep purple, white in throat or mauve (also described as pink or blue) or white with a yellow throat, presence of scent unknown; perianth tube widely funnel-shaped, 7–9(–10) mm long; tepals subequal, ovate, 10–15 $\times$ 5–7 mm, spreading at right angles to tube. *Stamens* with filaments 4–6(–8) mm long, exerted 2–4(–6) mm from tube; anthers 4–5 mm long, slightly shorter to slightly longer than filaments. *Style* dividing between lower and middle third of anthers, style branches $\pm$ 1.0–1.8 mm long, apices emerging between anthers. *Flowering time*: mainly late August to early October, or early November at higher elevations.

Distribution: *Ixia ramulosa* is recorded from central Namaqualand in the Kamiesberg and along the Bokkeveld Escarpment in Northern Cape and adjacent Koebe Mtns in Western Cape, in granitic sand or light clay loam (Figure 10).

Diagnosis and variation: until now collections of *Ixia ramulosa* have been treated as var. *ramulosa* of *I. latifolia* (Lewis 1962; De Vos 1999). The taxon was associated with *I. latifolia* only because of the shared narrowly funnel-shaped perianth tube and moderately to well-exserted anthers, by no means an unusual feature and probably the ancestral condition for the genus. *Ixia ramulosa* can always be distinguished from other species with similarly exerted anthers, by the perianth tube 7–9(–10) mm long, several, short, wiry, lateral branchlets each bearing 1 or 2 or occasionally 3 flowers. Like other species of sect. *Morphixia*, *I. ramulosa* normally has just three leaves, the two lowermost with well-developed blades, and the upper one largely to entirely sheathing the stem.

Ixia ramulosa is best known from central Namaqualand where it has been repeatedly collected in the vicinity of Kamieskroon and the nearby farms, Grootvlei

and Skilpad. Populations from these sites have brilliant, dark purple (also described as magenta) flowers with a white throat. Collections from higher elevations in the Kamiesberg east of Kamieskroon have pink or blue-mauve flowers with a yellow throat (e.g. *Esterhuysen* 23700; *Rodin* 1474) and also differ in perianth tube length, 7–8 mm long, versus 8–9(–10) mm for purple-flowered plants from lower elevations. Their later flowering, in October to early November, is probably explained by the higher elevation. Among these Kamiesberg populations, *Goldblatt* 6697 consists of particularly tall, slender plants up to 650 mm high with long narrow leaves 5–6 mm wide. They appear very different to the short-leaved plants but this may be explained by marshy habitats in which the plants were found. Alternatively these plants represent a separate taxon.

Provisionally we also include plants from the Bokkeveld Mtns to the south in *Ixia ramulosa* (e.g. *Barker* 10743; *Helme* 3567; *Pretorius* 556). Like typical *I. ramulosa*, these plants have stems with several short, filiform, few-flowered lateral branches and bracts sometimes flushed rust-brown distally, but a perianth tube 8–9 mm long and filaments $\pm$ 8 mm long (longer than in typical *I. ramulosa*), exerted $\pm$ 5 mm from the tube. These southern populations have branchlets with one (*Pretorius* 556) or two (*Helme* 3567, 4240) or three flowers (*Barker* 10743), and white or pale blue-mauve flowers with a yellow cup. The Barker collection stands out in consisting of exceptionally robust plants, up to 750 mm high. Despite the longer filaments and different perianth colour, we see no reason based on current information to regard the southern populations as a new taxon. Disjunctions between the Bokkeveld Mtns and the Kamiesberg are not common but are known. Examples from the Iridaceae include *Hesperantha pauciflora* G.J.Lewis and *Ixia namaquana* L.Bolus.

The Bokkeveld Mtn populations that we include in *Ixia ramulosa* have also been referred in herbaria to *I. brunneobracteata* but this is a species of wet sandstone habitats and it has uniformly brown bracts, not merely light brown in the upper half. *Ixia brunneobracteata* also differs in having corms bearing stolons, longer, narrower leaves (up to 3.5 mm wide), a main spike of 3–6 flowers, 1 to 2 fairly long lateral branchlets (stems are sometimes unbranched), each with 2–4(5) flowers, and a perianth tube 5–7 mm long. Bokkeveld populations of *I. ramulosa* consist of plants with up to 5 branchlets each with 1 to 3 flowers, as well as a slightly longer perianth tube, $\pm$ 8 mm long, and the corms do not bear stolons.

Selected specimens

NORTHERN CAPE.—3017 (Hondeklipbaai): Grootvlei near Kamieskroon, (–BB), 7 Sept. 1945, *Leighton* 1216 (BOL, PRE); Grootvlei, rolling hills, 640 m, (–BB), 28 Aug. 1947, *Acoks* 19459 (K, PRE); Kamieskroon, (–BB), 24 Aug. 1941, *Esterhuysen* 5711 (BOL, PRE); Skilpad Nature Reserve, (–BB), 16 Aug. 1993, *Van Rooyen* 2622 (PRE); Skilpad Farm, Wolwepoort, (–BB), 15 Aug. 1967, *McMurtry* 287 (PRE); north of Darter's Grave, (–BD), 7 Sept. 1950, *Barker* 6750 (NBG). 3018 (Kamiesberg): Leliefontein, (–AC), 2 Oct. 1947, *Rodin* 1474 (BOL, K, MO, PRE); flats 1 km south of Leliefontein, local in marshy area, (–AC), 4 Nov. 1982, *Goldblatt* 6697 (MO, PRE); Kamiesberg, De Kom, Farm Karas, (–AC), Oct. 1940, *Leipoldt* 3606 (BOL); Kamiesberg, (–AC), 16 Oct. 1954, *Esterhuysen* 23700 (BOL); between Garies and Leliefontein, top of pass, (–AC), Nov. 1939, *Leipoldt* 3021 (BOL); lower north slopes of Rooiberg, jeep track to Damsland, 1 200 m, (–?), 14 Oct. 2004, *Helme* 3308 (NBG). 3119 (Calvinia): Oorlogskloof Nature Reserve, Farm De Vondeling,

west bank of Oorlogskloof River at jeep track crossing, renosterveld in loam, 680 m, (–AC), 18 Sept. 2005, *Helme* 3567 (NBG); Nieuwoudtville, Farm Groot Tuin, yellow clay, (–AC), 3 Oct. 2000, *Pretorius* 556 (K, NBG, MO); Farm Uitkomst, SW of Nieuwoudtville, sandy slopes and floor of valley, (–AC), 29 Sept. 1970, *Barker* 10734 (NBG, two sheets).

WESTERN CAPE.—3119 (Calvinia): Kobbie, near Farm Klein Kobbie, sandy loam along streams in shade of wild olives, (–CA), 4 Sept. 2006, *Helme* 4240 (NBG).

25. *Ixia ecklonii* Goldblatt & J.C.Manning, sp. nov.

Plantae 300–500 mm altae, caule ramis 1–3 brevibus filiformibus, foliis 3 folio superiori vaginanti inferioribus laminis lanceolatis 4–7 mm latis, spica axiali laterali 1-flora, floribus horizontaliter extensis, tubo perianthii ± 10 mm longo, tepalis $\pm 10 \times \pm 4$ mm, filamentis ± 1.5 mm exsertis, antheris 3–4 mm longis, ramis styli ± 2 mm longis.

TYPE.—[Western Cape], Olifants River Valley, without date, *Ecklon & Zeyher Irid. 271* (MO, holo.; B–Herb. Trevisanus, iso.).

Plants 300–500 mm high, with (1)2 or 3 short, wiry twisted branches 5–8 mm long, subtended by short, subacute bracts and prophylls ± 1 mm long. *Corms* 7–12 mm diam., with tunics of matted, $\pm$ fibrous layers. *Leaves* 3, lower 2 with lanceolate blades reaching to $\pm$ middle of stem, 4–8 mm wide, uppermost leaf sheathing stem almost to base of spike. *Spike* half nodding, 1-flowered, branches also 1-flowered; bracts membranous, dark translucent brown, 7–9 mm long, outer 3-veined and 3-toothed, inner 2-veined and 2-toothed, about as long as outer. *Flowers* facing to the side, colour and presence of scent unknown; perianth tube narrow, flared uniformly from base, curving outward, 10–11 mm long, ± 4 mm wide at mouth; tepals $\pm 10 \times \pm 4$ mm. *Stamens* with filaments exserted ± 1.5 mm from tube; anthers 3–4 mm long. *Style* dividing opposite lower third of anthers, style branches ± 2 mm long. *Flowering time*: not recorded.

Distribution: evidently extremely rare and local, *Ixia ecklonii* is known from just one early 19th century collection from the Olifants River Valley. This bears Ecklon & Zeyher's locality no. 76 which is their shorthand for Clanwilliam [District], along the Olifants River and at Villa Brakfontein [near present-day Citrusdal] (Figure 10). The area is well explored botanically and the fact that it has not been recollected is remarkable. The species must be a very local endemic.

Diagnosis and relationships: we have located nothing quite like the type collection of *Ixia ecklonii* and although we are reluctant to describe a species based on a single collection of several, poorly preserved specimens, scientific and conservation considerations are better served in this case by our describing the species formally than by waiting until plants are found in the wild. *Ixia ecklonii* is immediately recognized by the slender stem bearing up to three short, filiform branchlets, these as well as the main axis each bearing a single flower. The flowers have a slightly curved, narrow perianth tube 10–11 mm long, flaring uniformly from base to apex and they obviously face to the side but colour and other

aspects of the perianth are not known. The filaments are exserted ± 1.5 mm from the tube and the comparatively large anthers 3–4 mm long and well-developed style branches place *I. ecklonii* among a poorly defined cluster of species we treat as series *Morphixia*. The three leaves, of which the uppermost is entirely sheathing, indicate this placement. The general appearance of the plants recalls *I. mollis* and *I. namaquana* but both have a funnel-shaped perianth tube and the filaments and bases of the anthers included in the tube. The translucent, brown floral bracts recall the Bokkeveld Mtn species, *I. brunneobracteata*, but this plant has a funnel-shaped perianth tube 5–7 mm long, the main axis bears 3–5 flowers and the branches are not particularly short and usually bear 2–4 flowers.

26. *Ixia brunneobracteata* G.J.Lewis in *Journal of South African Botany* 28: 80 (1962). Type: South Africa, [Northern Cape], 5 miles [8 km] from Nieuwoudtville on Grasberg road, 16 Sept. 1961, *Barker* 9555 (NBG, holo.; BOL!, NBG!, PRE!, iso.).

Plants 200–500 mm high, simple or 1 or 2(3)-branched; branches subtended by $\pm$ dry, translucent brown, acute to attenuate bracts and prophylls 1.5–4.0 mm long. *Corm* 7–10 mm diam., with tunics of medium-textured fibres, bearing short to long stolons up to 12 mm long, each with an ovoid terminal cormlet. *Leaves* 3, the lower 2 with blades expanded, ascending to falcate, up to 4 mm wide, uppermost leaf largely or entirely sheathing stem. *Main spike* 3–5-flowered, lateral spikes 2- or 3(–5)-flowered; bracts membranous, dark translucent brown, 6–11 mm long, outer 3-veined and 3-toothed, inner 2-veined and 2-toothed, $\pm$ as long as outer. *Flowers* pale pink or white, pale yellow in tube, tepals sometimes flushed pink or light purple outside, scented faintly of fresh coriander; perianth tube funnel-shaped, 5–7 mm long; tepals ascending below, spreading above, ovate, 10–15 $\times$ 5–8 mm. *Stamens* with filaments inserted in middle of tube, 6–8 mm long, exserted ± 3.5 mm from mouth of tube; anthers 4–5 mm long. *Style* dividing opposite middle third of anthers, style branches 1.5–2.0 mm long. *Flowering time*: mid-September to mid-October.

Distribution: an extremely narrow endemic, *Ixia brunneobracteata* is known only from seasonally wet or marshy sites in the sandstone belt between the top of Vanrhyns Pass and farms to the north along the Bokkeveld Escarpment (Figure 10). The rapid agricultural development in this area has all but eliminated the species from much of its range but it is, fortunately, protected in the new reserve, established on the Farm Avontuur, northwest of Nieuwoudtville, where it is common (N. Helme pers. comm. 2008).

Diagnosis and relationships: as its name suggests, *Ixia brunneobracteata* is immediately distinguished by its unusually dark floral bracts, which although membranous and semi-translucent, are a glossy dark chestnut-brown. A feature of the species not before recorded is the production of stolons from the base of the main corm. The flowers appear to be unspecialized, having a funnel-shaped perianth tube 5–7 mm long, spreading, subequal tepals, and filaments exserted ± 3.5 mm from the tube. Lewis (1962) suggested that the species might be most closely allied to *I. capillaris* from which it dif-

ferred in the slightly wider leaves and usually more flowers per spike but we see no close relationship to *I. capillaris*, which has very specialized, linear leaves lacking the raised margins of the central vein, and wonder if *I. brunneobracteata* is not perhaps most closely related to *I. ramulosa* of the Kamiesberg and Bokkeveld Mtns. That species has a distinctively branched stem with up to five short, filiform branches bearing 1–3 flowers and a somewhat longer perianth tube, 7–9(–10) mm long. The floral bracts are translucent, or sometimes flushed light brown distally, and the flowers are magenta to blue-violet in Namaqualand, or in the Bokkeveld Mtns, pale yellow. In contrast, *I. brunneobracteata* has a spike of up to 5 flowers, only 1 or 2 branches or even an unbranched stem and white or sometimes pale pink flowers. The production of cormlets on long stolons is unusual in *Ixia*; the only other species of sect. *Morphixia* that has stolons, *I. oxalidiflora* and *I. sobolifera*, both series *Rapunculoides*, appear to have evolved this capacity independently and both favour heavier soils of clay or clay loam.

Although only described in 1962 by Lewis in her revision of the genus, *Ixia brunneobracteata* has been known at least since 1898 when plants were collected at sites in the vicinity of Nieuwoudtville by C.L. Leipoldt. His collections attracted no attention at the time, and were assigned in herbaria to the incertae or to *I. linearis* L.f., a name in the past often applied to *I. capillaris*, although the type is actually *Gladiolus quadrangulus* (D.Delaroche) Barnard (Goldblatt & Manning 2008a).

Selected specimens

NORTHERN CAPE.—3119 (Calvinia): Farm Avontuur, NW of Grasberg, sandy burned flats, (–AA), 21 Sept. 2008, *Helme* 5837 (NBG); Nieuwoudtville, marshy places ‘near the farm house’, (–AC), Sept. 1898, *Leipoldt* 790 (BOL); marshy slope south of top of Vanrhyns Pass, (–AC), 29 Sept. 1993, *Goldblatt & Manning* 9781 (MO, NBG); Bokkeveld Escarpment between Meulsteenvlei and Cloudskraal, wet ground, (–AC), 15 Oct. 1976, *Goldblatt* 4311 (MO); 2 miles [3 km] north of Nieuwoudtville, moist sandy places between restios, (–AC), 12 Oct. 1970, *Hall* 3875 (NBG); Farm Biekoes, NW of Nieuwoudtville, wet sandy ground, (–AC), 29 Sept. 2008, *Goldblatt & Porter* 13196 (K, MO, NBG, PRE).

2.2. Series *Brevitubae*

27. *Ixia marginifolia* Salisb. ex G.J.Lewis in Journal of South African Botany 28: 66 (1962) [as a combination based on *Hyalis marginifolia* Salisb.: 318 (1812), genus invalid]. *I. lancea* Jacq.: t. 218 (1795a), illegit. homonym not *I. lancea* Thunb. (1783). *I. capillaris* var. *lancea* Ker Gawl.: sub t. 570 (1802b) as a new name at varietal rank for *I. lancea* Jacq. *Morphixia capillaris* var. *lancea* (Ker Gawl.) Baker: 97 (1877). *Morphixia lancea* (Ker Gawl.) Klatt: 383 (1882). Type: South Africa, without precise locality or collector, illustration in Jacq., *Icones plantarum* 2: t. 281 (1795a).

I. capillaris var. *stricta* Ker Gawl.: t. 617 (1803a). Type: South Africa, without precise locality or collector, illustration in Curtis’s Botanical Magazine 17: t. 617 of *I. capillaris* var. *stricta* (1803a).

Plants 200–500 mm high, often with a collar of fibres around base, usually with 4 to several (up to 10), short, filiform, straight or twisted branches, subtended by scale-like truncate bracts and prophylls $\pm$ 1 mm long. *Corm* 15–20 mm diam., with tunics of medium-textured to coarse fibres. *Leaves* (3–)5, lower (2–)4 with

expanded blades, broadly lanceolate to falcate, one quarter to one third as long as stem, 8–15 mm wide; margins moderately to heavily thickened, pale, hyaline when dry; uppermost 1 or 2 leaves entirely sheathing. *Main spike* 1–3(–5)-flowered, lateral spikes (1)2–4-flowered; bracts membranous, translucent with dark veins, often dry; and brown distally, 6–7 mm long, outer 3-veined and obscurely 3-lobed, inner 2-veined and forked apically, $\pm$ as long as outer. *Flowers* facing to the side, blue-mauve, pink, or white, faintly freesia- or rose-scented, sometimes with an acrid odour or unscented; perianth tube funnel-shaped, (2.5–)3.0–4.0 mm long; tepals ascending below, spreading distally, ovate, (7–)10–13 $\times$ 5.5–8.0 mm. *Stamens* with filaments 5–7 mm long, exserted (1.5–)3.5–5.0 mm from mouth of tube; anthers 3.0–4.5 mm long, usually diverging at $\pm$ 30°, pale yellow. *Style* dividing opposite lower to middle third of anthers, style branches 1.5(–2.5) mm long. *Flowering time*: mostly mid-August to late September, but October at higher elevations.

Distribution: a widespread and often relatively common species of the western Karoo, *Ixia marginifolia* extends from the Kubiskou Range, west of Loeriesfontein, to Calvinia and then across the Bokkeveld Plateau south through the Roggeveld as far as Verlatekloof and east to Fraserburg and the Nuweveld Mtns near Beaufort West. The species has not been recorded in the Klein Roggeveld but further south, populations extend across the margins of the western Karoo and interior Cape flora region from Tweedside to Matjiesfontein (Figure 12). The record from near Beaufort West is a notable range extension of some 150 km from its next nearest recorded station near Fraserburg. Plants grow in renosterveld or karroid scrub on clay and loamy ground, usually the fine-grained, pale soils derived from Ecca or Beaufort shales and sandstones or occasionally loam in Witteberg Sandstone or even on the heavy red clays derived from dolerite.

Diagnosis and variation: distinctive in its short perianth tube, 2.5–4.0 mm long, and stem bearing several short, few-flowered wiry branches, *Ixia marginifolia* also has unusually broad, short, leathery leaves with strongly thickened, hyaline margins. It is sometimes confused in herbaria with *I. rapunculoides*, which is similar in general aspect, including flower colour and the falcate leaves with thickened margins, but the lat-

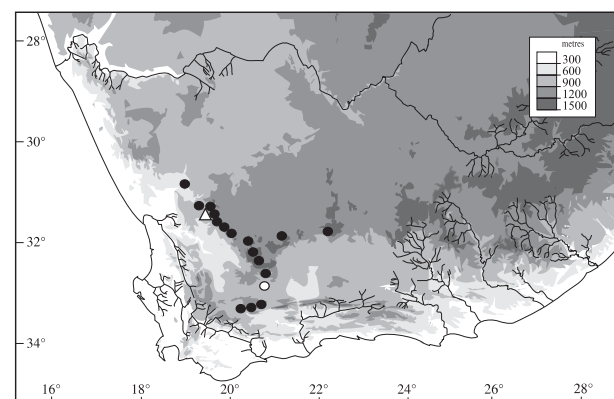


FIGURE 12.—Known distribution of *Ixia marginifolia*, ●; *I. linearifolia*, ○; and *I. pavonia*, △.

ter has short filaments included in the perianth tube, whereas *I. marginifolia* has the filaments exserted (1.5)3.5–4.0 mm so that the anthers are prominently displayed. The species displays a notable pattern of variation in flower colour. Plants in the northeast of its range have a pink perianth, but to the southeast in the Calvinia area, flower colour is pale blue-mauve, the same shade as equally common *I. rapunculoides* with which it is easily confused from a distance. On the northern and central Roggeveld Escarpment plants have either blue-mauve or white flowers, occasionally both colours occurring together (e.g. Goldblatt & Porter 12789), but at the southern end of the escarpment we have seen populations uniform for white flower colour, the same colour as reported for the Karoo National Park population (Bengis 375). Populations at the southern end of the range have violet flowers. White flowers remain open long after nightfall, whereas those of other colours close shortly after sunset. The variation in flower colour was not noted by Lewis (1962) or De Vos (1999), we suspect because they saw few plants in the wild and colour is soon lost in herbarium material.

Ixia marginifolia was poorly known to Lewis (1962), who cited just a handful of collections, mostly from the Sutherland area of the Roggeveld, but we now know the plant is quite common over a wide area across the western Karoo as far north as Loeriesfontein and east to the Nuweveld Mtns. Variation in number of flowers per branch is unusual: while 2 or 3 flowers are most common, plants with predominantly or only single-flowered branches occur throughout the range of the species (e.g. Bengis 375; Hafström & Acocks 309; Marloth 9782), most likely a reflection of poor growing conditions rather than an inherited feature. A few collections, e.g. from the base of the Voetpadsberg near Pietermeintjies Siding in Western Cape, consists of plants with smaller flowers than we consider typical for *I. marginifolia*, with tepals $\pm 7 \times 5.5$ mm (vs 10–12 $\times$ 6–8 mm), short filaments exserted ± 1.5 mm from the tube (vs 3.5–5.0 mm). These plants also have 1-flowered branches and we conclude that the smaller than normal floral features are the result of poor growing conditions that particular season. Plants from near Matjiesfontein a short distance to the east of the Pietermeintjies site and collected in another year have flowers typical in size for the species.

Despite being what we today consider a taxonomically isolated and distinctive species, *Ixia marginifolia* has been treated as a variety of *I. capillaris*, both as *I. capillaris* var. *lancea* and *Morphixia capillaris* var. *lancea* (Ker Gawler 1802b; Baker 1877). The immediate relationships of *I. marginifolia* are uncertain. The flowers, but not the leaves, closely resemble those of *I. linearifolia* and *I. pavonia* and we conclude that the three are closely related. The alliance may be allied to *I. latifolia*, although the latter has a much longer perianth tube. The overall similarity to *I. rapunculoides* is deceptive, for that species has short, included filaments and short, partly included anthers, very different from the longer and exserted filaments and long, prominent anthers of *I. marginifolia*.

History: the first record of *Ixia marginifolia* in the literature is the painting published in Jacquin's *Icones plantarum rariorum* (1795) under the name *I. lancea*.

The provenance of the plant was not recorded except that it was from the Cape of Good Hope. The epithet *I. lancea* is an illegitimate homonym for the species so named by Thunberg (1783), which is *Tritonia lancea* (Thunb.) N.E.Br. Salisbury (1812) placed the species in his genus *Hyalis* with a new name *H. marginifolia*, citing Jacquin's *I. lancea* as a synonym. As *Hyalis* was a *nomen nudum*, and thus invalid, the name *H. marginifolia* is itself invalid. We accordingly treat the apparent combination *Ixia marginifolia* made by Lewis as a replacement name dating only from 1962 and attribute it to her alone.

Selected specimens

NORTHERN CAPE.—3019 (Loeriesfontein): lower clay slopes of Kubiskou Mtn. (–CD), 6 Sept. 2006, Goldblatt & Porter 12777 (MO, NBG, PRE). 3119 (Calvinia): Holle River, 15 miles [24 km] from Calvinia, (–BC), 26 Sept. 1952, Lewis 2513 (BOL, SAM); Bokkeveld plateau, shale flats near Bloukrans Pass, (–DB), 25 Aug. 1976, Goldblatt 3935A (MO); Perdekloof between Middelpoos and Calvinia near Farm Rooiwal, (–DD), 7 Sept. 2006, Goldblatt & Porter 12789 (MO, NBG). 3120 (Williston): 28 km from Middelpoos on road to Calvinia, (–CC), Sept. 1976, Goldblatt 4270 (MO, NBG). 3121 (Fraserburg): hills near Fraserburg, (–DC), 20 Sept. 1938, Hafström & Acocks 309 (PRE, S). 3220 (Sutherland): Roggeveld Escarpment, top of Ganagga Pass, (–AA), 1 Sept. 1993, Goldblatt & Manning 9682 (MO, NBG); 14 miles [22.4 km] NNW of Sutherland, $\pm 5000'$ [1 535 m], (–BC), 27 Sept. 1957, Acocks 19600 (NBG, PRE); Komsberg Flats, (–DB), Oct. 1920, Marloth 9782 (NBG, PRE).

WESTERN CAPE.—3222 (Beaufort West): Karoo National Park, below FM tower, 2 000 m, (–BC), 30 Oct. 1984, Bengis 375 (PRE). 3320 (Montagu): 3.9 km west of turn-off to Matjiesfontein on N2, on recently burnt S-facing slope, (–BA), 29 Aug. 2007, Goldblatt & Porter 12902 (MO, NBG, PRE); Memorial, stony south-facing slope above cemetery, (–BA), 31 Aug. 2007, Goldblatt & Porter 12925 (K, MO, NBG, PRE).

28. *Ixia pavonia* Goldblatt & J.C.Manning, sp. nov.

Plantae 150–500 mm altae, usitate 2 vel 3-ramosae, ramis 2–3 mm longis, cormo globoso tunicis fibrosis, caule usitate 3-ramoso ramis 2–6 mm longis, spicis 1–3-floris, bracteis membranosis translucetibus 8–9 mm longis, floribus suberectis caeruleo-malvinis centro nigribus rubrisque, tubo perianthii infundibuliforme ± 3.5 mm longo, tepalis ascendentibus ovatis 12–14 $\times$ 5–6 mm, filamentis atropurpureis ± 4 mm longis ex tubo ± 1.5 mm exsertis, antheris ± 4.5 mm longis, ramis styli ± 2 mm longis.

TYPE.—Northern Cape, 3119 (Calvinia): Roggeveld Escarpment, opposite entrance to Farm Vondelingsfontein on Vaalfontein–Nooiensrivier road, renosterveld, (–DD), 15 Sept. 2009, Goldblatt, Manning & Porter 13355 (NBG, holo.; K, MO, PRE, S, iso.).

Plants 150–500 mm high, usually with 2–5(–12) short, filiform, branches 2–6 mm long, subtended by scale-like truncate bracts and prophylls ± 1 mm long. *Corm* 15–18 mm diam., with tunics of coarse fibres. *Leaves* usually 4 (or 3), lower 2 with expanded blades, broadly lanceolate to falcate, $\pm$ one quarter to half as long as stem, 8–15 mm wide; margins thickened, pale, hyaline when dry; upper two leaves partly to entirely sheathing, uppermost reaching to between upper third of stem and base of spike. *Main and lateral spikes* 1–3-flowered; bracts membranous, translucent, becoming brown and dry distally, 8–12 mm long, outer 3-veined and shortly 3-toothed apically, inner 2-veined and forked at tip. *Flowers* mostly half nodding,

blue-mauve, tepals dark red at base, black in wide part of tube, faintly acrid scented; perianth tube ± 3 mm long, funnel-shaped; tepals obovate, $12\text{--}15 \times 6\text{--}8$ mm, ascending to form a wide cup. *Stamens* with filaments purple, 4 mm long, exserted ± 1.5 mm; anthers 4.5 mm long, parallel, contiguous, yellow; pollen yellow. *Style* purple, dividing opposite middle of anthers, style branches ± 2 mm long, purple below, becoming pale blue distally. *Capsules* and *seeds* not known. *Flowering time*: September. Figure 13A–D.

Distribution: a narrow endemic, *Ixia pavonia* is known from a small area at the edge of the Roggeveld Escarpment south of Calvinia on the Farms Vondelingsfontein and Vaalfontein (Figure 12). Plants grow in clay ground in renosterveld.

Diagnosis and relationships: based on morphological similarity, *Ixia pavonia* must be regarded as most closely allied to the widespread Western Karoo species, *I. marginifolia*. Like that species, it has three leathery basal leaves with thickened margins and a main vein, a stem bearing three or more, short lateral branches, and a flower with a short perianth tube ± 3.5 mm long. Unlike the uniformly blue-mauve, white or pink flowers of *I. marginifolia*, *I. pavonia* has a blue-mauve perianth with a black centre surrounded by a broad red zone. Accompanying the colour difference in the perianth are purple-black filaments and style. Although the perianth tube and tepals are about the same dimensions as in *I. marginifolia*, the filaments in that species are 5–7 mm long and typically exserted 3.5–5.0 mm from the tube. The short filaments of *I. pavonia*, only 4 mm long and exserted ± 1.5 mm, stand in sharp contrast.

The small floral differences between *Ixia marginifolia* and *I. pavonia*, the dark central markings including short, dark filaments, a cupped, $\pm$ upright perianth, faint, not flowery scent and absence of nectar, are typical adaptations for hopliine beetle pollination and, indeed, beetles of the genus *Kubousa* have been seen and captured on flowers of the species (N. Helme pers. comm. 2009). *I. marginifolia* is pollinated by bees, often has a rose-like scent and produces trace amounts of nectar in the perianth tube.

Selected specimens

NORTHERN CAPE.—3119 (Calvinia): Roggeveld Escarpment, Vondelingsfontein, renosterveld, $31^{\circ}46'59.9''$ S $19^{\circ}50'27.9''$ E, 1 335 m, (–DD), 22 Sept. 2008, Helme 5906 (NBG).

29. *Ixia linearifolia* Goldblatt & J.C.Manning, sp. nov.

Plantae usitate 450–900 mm altae, cormo globoso, tunicis fibrosis, caule 2–5-ramoso ramis ad 5 mm longis, spica 2- vel 3-flora, bracteis argenteo-membranosis 9–11 mm longis, floribus cernuis ex pallide caeruleo albis, tubo perianthii late infundibuliformi ± 5 mm longo, tepalis patentibus ovatis $15\text{--}16 \times 6.5\text{--}7.5$ mm, filamentis ± 5 mm longis ex tubo ± 2 mm exsertis, antheris 4.5–5 mm longis, ramis styli ± 2 mm longis.

TYPE.—Northern Cape, 3220 (Sutherland): Klein Roggeveld, Farm De Hoop, Smoushoogte, heights northeast of farm, in clay in stony ground, (–DC), 30

Aug. 2007, Goldblatt & Porter 12921 (NBG, holo., K, MO, PRE, iso.).

Plants mostly 450–900 mm high, sheathed below by prominent, pale, dry-membranous, often irregularly torn cataphylls, usually with 2–5 short branches up to 5 mm long, branches subtended by pale, dry, attenuate scale-like bracts and prophylls 2–4 mm long. *Corm* 12–18 mm diam., with tunics of medium-textured fibres. *Leaves* 3, the lower 2 with long linear blades $\pm$ half as long as stem, mostly 1.5–2.0 mm wide (when alive), leathery succulent; midrib slightly raised; margins thickened and fleshy; uppermost leaf entirely sheathing. *Main spike* 2- or 3-flowered, lateral spikes 1- or 2(3)-flowered; bracts silvery membranous, translucent with darker veins, 9–11 mm long, outer 3-veined and 3-lobed to 3-toothed, inner 2-veined and shallowly forked at apex. *Flowers* facing to the side, white with a pale bluish cast, with pale green marks at tepal bases, faintly scented of rose; perianth tube broadly funnel-shaped, ± 5 mm long; tepals spreading at right angles to tube distally, ovate, $15\text{--}16 \times 6.5\text{--}7.5$ mm, outer tepals wider than inner. *Stamens* with filaments ± 5 mm long, exserted ± 2 mm from tube; anthers 4.5–5.0 mm long, parallel or slightly diverging when flower fully open. *Style* dividing opposite lower to middle third of anthers, style branches ± 2 mm long. *Flowering time*: mostly mid-August to mid-September. Figure 13G–H.

Distribution: rare and highly localized, *Ixia linearifolia* is known only from the upper, south-facing slopes of the Smoushoogte in the Klein Roggeveld, north of the Farm De Hoop (Figure 12). Plants grow in fairly dense Mountain Renosterveld vegetation often among tufts of *Merxmüllera* grasses, in light clay among rocks. Other geophytes in flower at the only known site include *I. lacerata* and *Geissorhiza cantharophila*, *Moraea* aff. *tripetala* and *Bulbine* sp.

Diagnosis and relationships: the short perianth tube, ± 5 mm long, flowers with outspread tepals and exserted filaments with prominently displayed anthers, and the several short lateral branchlets, at first suggest *Ixia marginifolia* but the leaves of *I. linearifolia* are quite unlike the short, broad, falcate leaves of that species. Instead the leaves are linear and about half as long as the stems, the latter mostly 45–90 mm high. The pale flowers have a faint blue cast and the tepals have pale green marks at the base of the tepals. Unlike *I. marginifolia* the leaf margins are not prominently thickened and hyaline but instead raised and fleshy without hyaline edges. The flowers of *I. linearifolia* are also slightly larger than those of *I. marginifolia* with tepals $15\text{--}16 \times 6.5\text{--}7.5$ mm compared with $(7\text{--})10\text{--}13 \times 5.5\text{--}8.0$ mm.

30. *Ixia alata* Goldblatt & J.C.Manning, sp. nov.

Plantae usitate 0.7–1.1 mm altae, cormo globoso 20–25 mm diam., tunicis fibrosis, caule 2–4-ramoso ramis ad 8 mm longis, spica 4–6-flora, bracteis membranoso-translucentibus 6–8 mm longis, floribus suberectis vel deminutibus pallide carneis fauce albis, tubo perianthii late infundibuliformi 5–6 mm longo, tepalis subpatentibus ovatis $13\text{--}16 \times 6\text{--}8$ mm, filamentis ± 5 mm longis ± 2 mm ex tubo exsertis, antheris 4.5–5.0 mm longis, ramis styli ± 2 mm longis, ovario minute verrucoso.



FIGURE 13.—A–D, *Ixia pavonia*, Goldblatt, Manning & Porter 13355 (NBG): A, plant; B, half-flower; C, outer bract; D, inner bract. E–H, *Ixia linearifolia*, Goldblatt & Porter 12921 (NBG): E, plant with c/s leaf; F, half-flower; G, outer bract; H, inner bract. Scale bars: 10 mm. Artist: J.C. Manning.

TYPE.—Northern Cape, 3119 (Calvinia): southeastern foothills of Driefontein se Berg, SE of Calvinia, rocky, northeast-facing dolerite slope, (–DA), 15 Sept. 2009, Goldblatt, Manning & Porter 13380 (NBG, holo., K, MO, PRE, iso.).

Plants mostly 0.7–1.1 m high, sheathed below by prominent, dry remains of cataphylls and leaf bases; cataphylls ± dry, pale chestnut-brown; usually with 2–4 short branches up to 8 mm long; branches subtended by pale, dry, attenuate scale-like bracts and prophylls 5–7 mm long; bracts sheathing in lower part. *Corm* 20–25 mm diam., with tunics of medium-textured fibres accumulating in a fairly dense mass. *Leaves* 3, lower 2 with linear blades ± one third to half as long as stem, mostly 3–4 mm wide (when alive), leathery; midrib strongly thickened; margins raised into wings held ± at right angles to blade, wings tilted to same side rendering one surface more exposed; uppermost leaf entirely sheathing. *Main spike* 4–6-flowered, lateral spikes mostly 3–5-flowered; bracts translucent with pale brown veins drying purple, 6–8 mm long, outer 3-veined and shallowly 3-lobed, often secondary veins not reaching bract apices, inner 2-veined, shallowly lobed at apex. *Flowers* suberect to half nodding, pale pink, white at base of tepals and in tube, with short vertical purple lines at tepal bases running into throat, unscented; perianth tube widely funnel-shaped, 5–6 mm long, narrow lower part ± 2.5 mm long; tepals laxly spreading distally but remaining slightly cupped, ovate, 13–16 × 5–8 mm, outer slightly wider than inner, indented abaxially along midline above filament insertion to a rounded median adaxial crest. *Stamens* with filaments ± 5 mm long, exerted ± 2 mm from wide part of tube, adaxial base with a flange decurrent on tepal midline; anthers 4–5 mm long, white, parallel or slightly diverging when flower fully open; pollen yellow. *Ovary* minutely warty; style dividing opposite middle to upper third of anthers, style branches ± 2 mm long, suberect and extending above anther tips. *Flowering time*: mostly mid-August to mid-September. Figure 14.

Distribution: highly localized but locally common, *Ixia alata* is known only from the northern edge of the Roggeveld Escarpment between the farms Vondelingsfontein and Driefontein in the western Karoo, south of Calvinia (Figure 15). Three large populations in the southern and northeastern foothills of Driefontein se Berg were restricted to heavy, red clay soils in dolerite outcrops but the plants at Vondelingsfontein grew in light sandy ground with ferricrete and dolerite fragments (C. Archer pers. comm.; N. Helme pers. comm.).

Diagnosis and relationships: the general appearance of *Ixia alata* is very much like *I. thomasiae* in the tall stature, stem with half nodding branches, suberect to half-nodding flowers, and the long narrow leaves with winged margins, are almost identical. The two differ, however, in flower size: the perianth tube of *I. alata* is just 5–6 mm long and the tepals 13–16 × 6–8 mm compared with a tube 8–10 mm long and tepals 14–20(–25) × 5.0–6.5(–8.0) mm. The perianth tube in particular is significantly shorter, and the tepals only slightly shorter but about as wide as those of *I. thomasiae*. Added to these differences are a main spike of 4–6 flowers and

floral bracts 6–8(–10) mm long in *I. alata* compared with a spike of 7–10 flowers and floral bracts 9–12 mm in *I. thomasiae*. These differences indicate to us that these are two distinct, albeit closely allied species. We also note that *I. alata* flowers from mid-September to early October, whereas *I. thomasiae* does not come into flower until the end of September and sometimes not until the second week of October. When we first encountered *I. alata* in mid-September 2009, plants of *I. thomasiae* were not in flower at its known stations only 30 km distant and at comparable elevation. Additional collections from the area between the known ranges of the two species may alter our decision but for the present, their populations show no overlap in critical floral characters, leading us to conclude that they represent separate species.

Selected specimens

WESTERN CAPE—3119 (Calvinia): Farm Vondelingsfontein, SE of Calvinia on Nooiensrivier road, E-facing shale slope, (–DD), 4 Oct. 1987, Reid 1347 (PRE); Farm Driefontein, SSW of Calvinia, dolerite outcrop in red clay, (–DA), 23 Sept. 2009, Goldblatt, Manning & Porter 13424 (K, MO, NBG, PRE, S, US).

31. *Ixia thomasiae* Goldblatt in Journal of South African Botany 45: 87 (1979). Type: South Africa, [Northern Cape], 3120 (Williston): Roggeveld Escarpment, Blomfontein Farm, between Middelpoos and Calvinia, (–CC), 30 Sept. 1976, Goldblatt 4268 (MO, holo.!, K!, NBG!, PRE!, S!, iso.).

Plants mostly 0.6–1.5 m high, with remains of old cataphylls and leaf bases persisting as a fibrous collar around stem base, usually with 1–3 short, twisted branches subtended by acute bracts and prophylls 4–10 mm long. *Corm* 15–20 mm diam., with tunics of coarse netted fibres. *Leaves* 3, lower 2 with expanded linear blades, reaching to upper third of stem, 3–5 mm wide; midrib and main vein thickened; margins forming wings held at right angles to blade, main vein with narrow wings parallel to blade; upper leaf sheathing stem. *Main spike* half nodding, 7–10-flowered, branches mostly 3–5-flowered; bracts membranous, translucent, becoming light brown distally, 9–12 mm long, outer 3-veined above with central vein more prominent, lateral veins paired in lower part and sometimes not reaching bract apex, obtuse to obscurely 3-lobed, inner 2-veined, forked apically, slightly shorter than outer. *Flowers* suberect or nodding, pale mauve, white in throat, presence of scent unknown; perianth tube funnel-shaped, widening in upper half, 8–10 mm long; tepals subequal, ovate-oblong, 14–20(–25) × 5.0–6.5(–8.0) mm, spreading ± at right angles to tube, indented abaxially along midline above filament insertion to form a rounded median adaxial crest. *Stamens* with filaments ± 6 mm long, included or exerted up to 2 mm from tube; anthers ± 6 mm long, yellow. *Ovary* slightly warty; style usually dividing opposite upper third of anthers, or just above anther tips, style branches ± 2.0 mm long. *Flowering time*: October, rarely late September.

Distribution: *Ixia thomasiae* occurs in the central Roggeveld Escarpment west of Middelpoos (Figure 15). The species is rare, and has to date only been found on two farms in the area. Plants favour heavy clay ground and bloom relatively late in the season, mainly in Octo-



FIGURE 14.—*Ixia alata*, Goldblatt, Manning & Porter 13380 (NBG). A, plant; B, half-flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

ber. Further collecting in the area will likely yield additional sites for the species.

Diagnosis and relationships: remarkable leaves with raised and winged margins, thus $\pm$ H-shaped in cross section, combined with a perianth tube $\pm$ 6 mm long and the remarkable, warty ovary and capsules make *Ixia tho-*

masiae unmistakable. The leaf shape and warty ovary and capsules are not known elsewhere in *Ixia* except in *I. alata*. Its relationships most likely lie with the *I. marginifolia* group with which it shares a funnel-shaped perianth tube and exserted filaments and fully sheathing uppermost leaf, hence we place it in series *Brevitubae*.

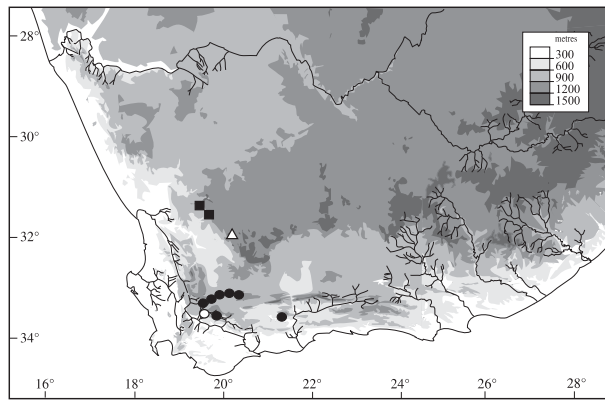


FIGURE 15.—Known distribution of *Ixia alata*, ■; *I. thomasiae*, △; *I. paucifolia*, ●; and *I. dolichosiphon*, ○.

The particularly large anthers, ± 6 mm long, and fairly long style branches, up to 2 mm long, are consistent with other species of the series.

Discovered in 1971, *Ixia thomasiae* was named for the Cape Town horticulturist, Margaret Thomas, who pioneered plant exploration in the Middelpos portion of the Roggeveld Escarpment. Her activities there resulted in the discovery of several novelties, including *Babiana virginea* and *Moraea virgata* subsp. *karooica*. Later collecting in the area has yielded more new species restricted to this area, notably in the Iridaceae: *Hesperantha teretifolia* (Goldblatt 1984) and *Romulea albiflora* (Manning & Goldblatt 2001). *Ixia brevituba* is also endemic there (Lewis 1962). It is now evident that the northern portion of the Roggeveld Escarpment is a minor but significant centre of endemism.

Selected specimens

NORTHERN CAPE.—3120 (Williston): Roggeveld Escarpment, west of Middelpos, Farm Blomfontein, (–CC), 19 Oct. 1995, *Goldblatt & Manning 10368* (MO, NBG); between farms Blomfontein and Matjiesfontein, west of Middelpos, (–CC), 28 Oct. 1983, *Snijman 769* (NBG); between Middelpos and Calvinia, (–CC), 29 Sept. 1971 (cult.), *Thomas s.n.* (NBG93822); 15 miles [24 km] along Blomfontein Road from Middelpos to Calvinia, (–CC), 12 Nov. 1975 (fr.), *Thomas s.n.* (NBG104707).

2.3. Series *Paucifoliae*

32. *Ixia paucifolia* G.J.Lewis in South African Gardening and Country Life 23: 213 (1933); Lewis: 153 (1962); De Vos: 65 (1999). Type: [Western Cape], Vanwyksdorp, 23 Oct. 1932, [Compton &] Archer 534 (BOL, lecto!, designated by De Vos 1999: 65).

I. bolusii G.J.Lewis: 10 (1938). Type: South Africa, [Western Cape], Hex River Valley near De Doorns, Oct. 1907, *Bolus s.n.* (BOL13197, holo!, PRE, iso!).

Plants 120–300 mm high, simple or 1(2)-branched, branches $\pm$ straight, subtended by pale, membranous, subacute to attenuate bracts and prophylls 2–5 mm long. *Corm* 12–15 mm diam., with hard tunics of coarse, netted fibres. *Leaves* 3, lower 2 basal with expanded blades, falcate, mostly 3–5 mm wide; margins moderately thickened; lowermost leaf usually wider and longer than next, uppermost leaf sheathing lower half of stem. *Main spike* mostly 4–10-flowered, lateral spikes 2–4-flowered; bracts pale and membranous, (6–)8–9 mm long, outer 3-veined

and 3-dentate, inner ± 1 mm longer than outer, with two veins and 2-dentate. *Flowers* beige to nearly white, unscented; perianth tube 24–34 mm long, slender and cylindric, divided inside into 3 compartments by decurrent filaments; tepals oblong, 11–15 $\times$ 3.0–4.5 mm, spreading at right angles to tube. *Stamens* with filaments ± 3 mm long, exerted ± 2 mm from tube; anthers ± 4 mm long. *Style* dividing shortly below or opposite anther tips, style branches ± 1 mm long, arching above anther tips, minutely bifurcate. *Flowering time*: late September and October.

Distribution: *Ixia paucifolia* extends from Hex River Pass and De Doorns eastward to the valleys of the Bonteberg, Vanwyksdorp near Ladismith and south to Koo (Figure 15). Plants are always associated with exposed, fairly dry shale slopes. They flower particularly well after fire when they are conspicuous among regenerating shrubby vegetation, which may later shade them out, but they continue to bloom for several years after fire. Near Pienaarspoort in the Bonteberg we have seen plants blooming in apparently mature renosterveld.

Diagnosis and relationships: as circumscribed here, *Ixia paucifolia* comprises plants with pale beige to almost white flowers (sometimes described as pale yellow), a cylindric perianth tube (22–)25–35 mm long, and narrow tepals 11–15 $\times$ 3.0–4.5 mm, spooned at the tips. The filaments are ± 3 mm long and exerted ± 2 mm from the tube, and the style divides close to or opposite the anther tips so that the style branches arch over the anthers. The species is readily distinguished from *I. dolichosiphon*, specimens of which have until now been included in *I. pauciflora* in herbaria by the very coarse-textured corm tunics, longer floral bracts, (6–)8–9 mm long, longer perianth tube (15–18 mm in *I. dolichosiphon*), beige (sometimes white) flower, and style dividing near the anther tips. In *I. dolichosiphon* the bracts are 5–6 mm long, the flowers white, flushed pale lilac, and veined purple outside, the style divides opposite the middle of the anthers and the style branches extend between them. The two species also differ in flowering time and habitat: *I. dolichosiphon* blooms in August and early September and favours south-facing sandstone slopes, whereas *I. paucifolia* grows on clay and shale slopes and blooms in late September and October.

Ixia paucifolia has in the past also included white- or pale pink-flowered plants from sandstone slopes in the Cold Bokkeveld and Cedarberg, here referred to the new species, *I. cedarmontana*. These plants have corm tunics of fine fibres, very different from the coarsely fibrous corm tunics of *I. paucifolia*. Other differences between these two species are discussed below under *I. cedarmontana*.

Representative specimens

WESTERN CAPE.—3319 (Worcester): upper slopes of Hex River Pass, south-trending shale slopes, (–BC), 10 Oct. 2004, *Goldblatt & Porter 12641* (K, MO, NBG, PRE); Bonteberg, (–BD), 3 Nov. 1940, *Compton 10002* (NBG); between Concordia and Eendracht, upper south slopes, (–CB), 12 Oct. 1922, *Tredgold 407* (PRE); Koo, 4000' [1 220 m], (–DB), 27 Oct. 1931, *Compton 3839* (BOL); rocky shale slopes of Burgers Pass, (–DB), 1 Oct. 2004, *Goldblatt & Porter 12604* (MO, NBG, PRE), 29 Sept. 1994, *Goldblatt & Manning 10012* (MO, NBG, PRE). 3320 (Montagu): Laingsburg Dist., Cabidu, (–AA), 20 Oct. 1941, *Olivier s.n.* (NBG61209), 27 Oct. 1950, *Hall 170* (NBG); Touns River to Pienaarskloof, Farm Karookop, renosterveld, ± 890

m, (–AA), 26 Sept. 2009, *Goldblatt & Porter 13450* (MO, NBG, PRE, S); Tweedside, quartzite hill, (–AB), Oct. 1921, *Marloth 10827* (PRE); Barrydale, 1200' [365 m], (–DC), 15 Oct. 1897, *Galpin 4709* (PRE, very depauperate specimen).

33. *Ixia dolichosiphon* Goldblatt & J.C.Manning, sp. nov.

Plantae 120–200 mm altae, (1–)3- vel 4-ramosae, cormo 10–16 mm diam., tunicis fibrosis, foliis 3 inferioribus 2 lanceolatis ad falcatis (5–)7–12 mm latis marginibus leviter incrassatis, spica principali flexuosa 4–10-flora spicis lateralibus $\pm$ contortis 2–8-floris, bracteis membranaceis translucetibus bractea externa 5–6 mm longa 3-nervosa leviter 3-dentata, interna 2-nervosa 2-dentataque, floribus albis vel ex lilacino albis extra purpureovenosis inodoris, tubo perianthii $\pm$ cylindrico 15–18 mm longo, tepalis obovatis patentibus subaequalibus 9–13 $\times$ 6–7 mm, filamentis $\pm$ 2 mm longis usitate $\pm$ 1 mm exsertis, antheris $\pm$ 3 mm longis, ramis styli $\pm$ 2 mm longis.

TYPE.—Western Cape, 3319 (Worcester): Hex River Kloof, SW-facing sandy mountain slopes of Keeromsberg above De Wet, Farm Rheboksfontein, (–DA), 9 Sept. 1993, *Goldblatt & Manning 9690* (NBG, holo.; K, MO, PRE, S, WAG, iso.).

Plants 120–200 mm high, (1–)3- or 4-branched, lowermost branches rarely also branched; branches twisted, diverging at 90° from main axis, subtended by pale, membranous, attenuate bracts and prophylls (1–)3–8 mm long. *Corm* 10–16 mm diam., with tunics of medium-textured, netted fibres. *Leaves* 3, lower 2 lanceolate to falcate, (5–)7–12 mm wide, usually reaching to $\pm$ base of or sometimes shortly exceeding spike; margins and midrib slightly thickened; uppermost leaf entirely sheathing, reaching at least to middle of stem or to base of spike. *Spike* flexuose, 4–10-flowered, lateral spikes somewhat contorted, 2–8-flowered, horizontal below first flower, then erect; bracts membranous and transparent, outer 5–6 mm long, 3-veined, slightly 3-dentate, inner slightly shorter to about as long as outer, 2-veined and 2-dentate. *Flowers* white or flushed pale lilac, tepals sometimes each with a purple basal mark, tepals and tube veined purple outside, scentless; perianth tube $\pm$ cylindric, tapering uniformly from $\pm$ 1 mm diam. at base to 2 mm diam. at apex, 15–18 mm long, internally divided into 3 compartments by decurrent filaments extending downward nearly to base; tepals obovate, spreading at right angles to tube, subequal, 9–13 $\times$ 6–7 mm. *Stamens* with filaments $\pm$ 2 mm long, inserted $\pm$ 1 mm below tube apex, decurrent nearly to base, mostly exserted $\pm$ 1 mm; anthers $\pm$ 3 mm long before anthesis, yellow. *Style* dividing between middle and upper third of anthers, branches extending between anthers, $\pm$ 2 mm long. *Flowering time*: late August to mid-September. Figure 16A, B.

Distribution: available records show that *Ixia dolichosiphon* is a narrow endemic of the lower slopes of the western end of the Langberg above De Wet (east of Worcester), close to the entrance to Hex River Kloof (Figure 15). Plants grow on stony, sandstone, south and southwest-trending slopes and have only been collected after fire. The species was discovered and collected only in 1993 after a fire on the Langeberg in the summer of that year. Occasional visits to the site where we first col-

lected *I. dolichosiphon*, and which has not been burned since 1993, failed to reveal any sign of the species. Like its relative, *I. paucifolia*, *I. dolichosiphon* is adapted for pollination by long-proboscid flies. Goldblatt *et al.* (2000) captured the horsefly, *Philoliche gulosa* visiting the flowers of the species at the type locality (reported under the name *I. paucifolia*).

Diagnosis and relationships: *Ixia dolichosiphon* is distinguished in sect. *Morphixia* by its relatively long perianth tube, 15–18 mm long, white or pale lilac-flushed perianth and short filaments $\pm$ 2 mm long, included or exserted up to 1.5 mm from the tube. It is closely allied to, and most easily confused with beige-flowered *I. paucifolia*, a species of the dry interior valleys of the southwestern Cape. That species has flowers with a perianth tube (22–)25–34 mm long, slightly constricted at the apex, spreading tepals 12–15 $\times$ 5 mm, filaments $\pm$ 3 mm long, exserted 2–3 mm from the perianth tube and anthers $\pm$ 4 mm long. We have collected *I. paucifolia* at several sites in the past 15 years and found it growing on shale slopes in thin, gravelly clay, in bloom in late September and October. *Ixia dolichosiphon* by contrast is restricted to sandstone slopes where it grows on coarse sandy ground characteristic of the Cape mountains. Although confined to cooler, south-facing slopes, it flowers from late August to mid-September, earlier than any population of *I. paucifolia*. It differs from *I. paucifolia* not only in its white or pale lilac-flushed flowers, veined purple on the outside, and shorter perianth tube, but in the tepals, stamens and style. The tepals are 9–13 mm long, filaments $\pm$ 2 mm long that reach the mouth of the tube or are exserted up to 1.5 mm, and the anthers are $\pm$ 3 mm long. The style divides opposite the middle of the anthers and the style branches emerge between them in contrast to the longer style of *I. paucifolia*, which divides close to the anther tips so that the style branches arch above the anthers. As in *I. paucifolia*, the filaments of *I. dolichosiphon* are decurrent almost to the base of the tube, dividing the interior of the tube into three compartments.

Leaf number is consistently three in both species, typical of sect. *Morphixia*. While *I. dolichosiphon* and *I. paucifolia* appear to be immediately related, we have wondered whether they should be treated as separate species or merely divergent populations of a single species; nevertheless they differ consistently in several vegetative and floral features, have different bracts and branching patterns. These morphological differences are associated with different habitats and flowering times and they have separate geographic ranges. It seems appropriate to recognize the two sets of populations as separate species.

Representative specimens

WESTERN CAPE.—3319 (Worcester): Hex River Kloof, SW-facing mountain slopes above De Wet, Farm Rheboksfontein, (–DA), 21 Sept. 1993 (flower and fruit), *Goldblatt & Manning 9745* (K, MO, NBG, PRE, S, WAG).

34. *Ixia cedarmontana* Goldblatt & J.C.Manning, sp. nov.

Plantae 150–300(–500) mm altae, usitate simplices raro 1- vel 2-ramosae, cormo subgloboso 7–12 mm



FIGURE 16.—A, B, *Ixia dolichosiphon*, Goldblatt & Manning 9690 (NBG): A, plant; B, half-flower. C–F, *Ixia cedarmontana*, Goldblatt & Porter 13477 (NBG): C, plant; D, half-flower; E, outer bract; F, inner bract. Scale bars: 10 mm. Artist: J.C. Manning.

diam., tunicis fibris tenuibus reticulatis, foliis 2 vel 3(4) inferioribus 3 anguste ensiformibus (1.5–)3.0–5.0(–8.0) mm latis folia superiore caulem vaginanti, spica (1–)3–5(–7)-flora, bracteis 6–9 mm longis, bractea externa 3-nervosa 3-dentataque vel 3-lobata, interna plusminusve aequilonga vel paulo longiore, floribus erectis albis vel pallide carnis, tubo perianthii (12–)18–25 mm longo anguste cylindrico, tepalis ovatis subaequalibus 10–12 × 5–7 mm externis quam internis paulo latioribus, filamentis 6–8 mm longis, antheris $\pm$ 4(5) mm longis, ramis styli $\pm$ 2 mm longis.

TYPE.—Western Cape, 3219 (Wuppertal): Heuningvlei, Groot Koupoort, 3200' [975 m], seasonally moist, (–AA), 11 Oct. 1975, Kruger 1668 (PRE, holo.; NBG, iso.).

Plants 150–300(–500) mm high, slender, rarely with 1 or 2 branches, branches straight, diverging at 40–80° from axis, subtended by obscure, membranous acute bracts and prophylls 1–2 mm long. *Corm* globose, 7–12 mm diam., bearing cormlets at base, with tunics of fine netted fibres. *Leaves* 2 or 3(4), lower 1 or 2 (rarely 3 in

Kruger 1668) with expanded blades and $\pm$ basal, narrowly sword-shaped to $\pm$ linear, (1.5–)3.0–5.0 mm wide (up to 8 mm in *Marloth 2328*), with moderately thickened main vein and margins, uppermost leaf sheathing lower part of stem. *Spike* (1–)3–5(–7)-flowered, lateral spikes 1–5-flowered; bracts translucent, often flushed pink or purple distally, 6–9 mm long, outer 3-veined and 3-dentate or 3-lobed, inner $\pm$ as long or 1 mm longer than outer, 2-veined and 2-dentate. *Flowers* upright or half nodding, white to pink, flushed light purple to pink outside, yellow in throat, tube finely veined with purple, not closing at night, usually sweetly scented, especially in evening; perianth tube $\pm$ cylindric or slightly flaring, (12–)18–25 mm long; tepals subequal, ovate, outer slightly wider than inner, 10–16 $\times$ 5–8 mm. *Stamens* with filaments 6–10 mm long, reaching mouth of tube or exerted up to 4 mm; anthers $\pm$ 4(–5) mm long. *Style* dividing opposite middle to apex of anthers, style branches 1–2 mm long. *Flowering time*: October to early December, rarely in late September. Figure 16C–F.

Distribution: a poorly documented and probably fairly rare species of the north-south-trending mountains of northwestern Western Cape, *Ixia cedarimontana* is centred in the Cedarberg and Cold Bokkeveld Mtns, but there are also records from the Great Winterhoek Mtns, to the south (Figure 17). Plants grow in peaty sandstone-derived soils, usually in moist habitats such as wet, poorly drained flats, seeps and seasonal marshes.

Diagnosis and variation: *Ixia cedarimontana* is recognized by a combination of a relatively long perianth tube, 18–25 (rarely only 12) mm long, and small to moderate-sized corms with finely fibrous corm tunics. Most collections also have white flowers, pale yellow in the throat, but occasionally pink tepals. Several of the white-flowered collections that we assign here to *I. cedarimontana* were known to Lewis (1962), who included them in *I. paucifolia*, noting that these northwestern populations had fine corm tunics and straight rather than falcate leaves. De Vos (1999) likewise regarded them as belonging to *I. paucifolia*, which she treated as a single variable species, adding that the tepals were sometimes suborbicular in the northwestern plants. Both Lewis and De Vos thought that intermediates made it impossible to separate the two sets of populations taxo-

nomically. We disagree. Not only do the corms of the two differ consistently in size and texture of the tunics, but flower colour and tepal shape do not overlap when carefully preserved flowers are measured. *Ixia cedarimontana* has white or pale pink, sweetly scented flowers with ovate tepals 10–16 $\times$ 5–8 mm, thus about twice as long as wide, and filaments reaching the apex or exerted up to 4 mm from the perianth tube. The almost white to light beige flowers of *I. paucifolia* are always unscented, have narrower tepals, 12–15 $\times$ 3.0–4.5 mm, thus about three to four times as long as wide, and the filaments are consistently exerted 2–3 mm.

The two species also have a different ecology. *Ixia cedarimontana* grows in sandstone-derived soils and is associated with moist habitats, such as seeps and seasonal marshes, its flowers are richly scented, more so in the evening, and the flowers remain open all night. We infer moth pollination for the species. In contrast, *I. paucifolia* grows in relatively dry habitats, usually on exposed, well-drained open clay and shale slopes that are dry at flowering time. It is known to be pollinated by long-proboscid flies and the unscented flowers close at night.

Ixia cedarimontana is fairly variable in size and leaf dimensions. One collection from the Great Winterhoek Mtns (*Marloth 2328*) consists of tall plants, one specimen reaching 500 mm, and with leaves up to 8 mm wide. In contrast, plants from Bokkeveld Tafelberg (*Esterhuysen 3909*) are 150–250 mm high and have leaves only 3–4 mm wide. Most collections fall between these two extremes and have unbranched stems. The type collection from Heuningvlei (*Kruger 1668*) consists largely of plants with one or two, long, straight, lateral branches each bearing 3–5 flowers, and some have four leaves, the lower three with well-developed blades. We include here a single plant from Hexberg, southeast of Citrusdal (*Goldblatt 7116*), with linear leaves 1.5–2.0 mm wide, and two flowers on a slender, unbranched stem.

Some pink-flowered plants that we include in *Ixia cedarimontana* from the Cedarberg were referred by both Lewis and De Vos to *I. latifolia* var. *angustifolia*. Other specimens cited under this name are now *I. divaricata* and *I. monticola* but both have flowers with a shorter perianth tube, 8–11 mm long. *Ixia monticola* has, in addition, leaves of a softer texture and papery rather than fibrous corm tunics. *Ixia divaricata*, often a taller plant, has distinctive long lateral branches with the flowers crowded in the distal half, and the perianth tube is funnel-shaped rather than $\pm$ cylindric.

Representative specimens

WESTERN CAPE.—3219 (Wuppertal): Cedarberg, Middelberg Plateau, 4 000' [$\pm$ 1 220 m], damp places, (–AA), Sept. 1927, *Levyms 2266* (BOL); northern Cedarberg, peak at Koupoort, 4000' [$\pm$ 1 220 m], (–AC), 22 Oct. 1945, *Esterhuysen 12153* (BOL, PRE); Cedarberg, Cedarhoutkloof, 3 500' [1 110 m], (–AA), Oct. 1923, *Pocock 324* (NBG); Cedarberg, Matjies River Valley along road to Driehoek, wet restio flats, (–AC), 1 Oct. 2009, *Goldblatt & Porter 13477* (MO, NBG, PRE); Elands-kloof, (–CA), 3 Oct. 1940, *Compton 9702* (NBG); Cedarberg, sandy flats near Sneeu-burg Hut, in grassland with Restionaceae, 1 300 m, (–AC), 25 Oct. 1989, *Le Maitre 620* (NBG, PRE); Cedarberg, Slangvlei, moist sandy soil, $\pm$ 1 650 m, (–AC), 11 Nov. 1956, *Taylor 1850* (NBG); Hexberg, SE of Citrusdal, rare in rocky kloof, 4000'

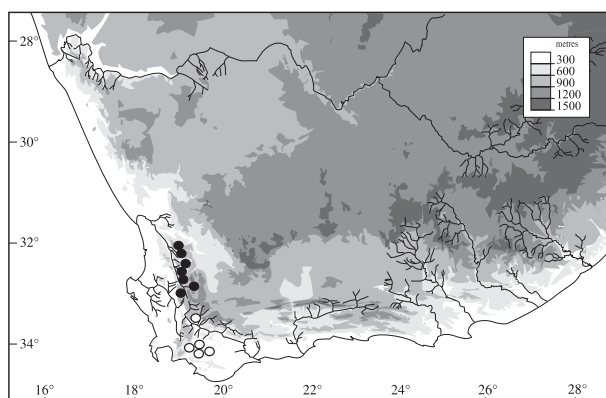


FIGURE 17.—Known distribution of *Ixia cedarimontana*, ●; and *I. stenophylla*, ○.

[$\pm$ 1 210 m], (–CA), 26 Oct. 1983, *Goldblatt 7116* (MO); Bokkeveld Tafelberg, Ceres, 5500' [$\pm$ 1 720 m], (–CD), 8 Dec. 1940, *Bond 700* (NBG), *Esterhuysen 3909* (BOL). 3319 (Worcester): Grootwinterhoek, 1 200 m, (–AA), Nov. 1896, *Marloth 2328* (PRE); 31 Dec. 1951, *Esterhuysen 19878* (BOL).

35. *Ixia stenophylla* Goldblatt & J.C.Manning, nom. et stat. nov. pro *I. fucata* var. *filifolia* G.J.Lewis in *Journal of South African Botany* 28: 99 (1962). Type: [Western Cape], Riviersonderend Mtns, northern slopes (as Boschjesveld Mtns, Worcester side), 1 Oct. 1955, *Stokoe s.n.* [SAM68608, 68609 (two sheets), syn.! (SAM69608 was said by De Vos 1999 to be the holotype, but this is without foundation)].

Plants 200–400 mm high, without collar of fibres around base, simple or rarely with single branch subtended by silvery, attenuate bracts and prophylls up to 4 mm long, slightly curved at base of spike. *Corm* globose, 7–15 mm diam., with tunics of fine to medium-textured netted fibres, sometimes thickened and claw-like below. *Leaves* 3, lower 2 with linear-filiform blades 0.8–1.2 mm wide, central vein heavily thickened and raised above blade surface, thickened secondary veins sometimes present; margins not thickened; uppermost leaf usually entirely sheathing. *Spike* slightly flexuose, 1- or 2(–3)-flowered; bracts 6–8 mm long, outer 3-veined and 3-toothed, inner about as long as outer, 2-veined, forked apically. *Flowers* nodding, white or flushed pale mauve, with a ring of dark streaks at tube mouth, pale mauve outside, with dark veins on tube; perianth tube straight and cylindric, (12–)15–20 mm long, $\pm$ 2 mm diam.; tepals subequal, 12–15 $\times$ 6–8 mm, spreading at right angles to tube. *Stamens* with filaments 5–6 mm long, unilateral, arcuate, exserted $\pm$ 3 mm from tube; anthers 3–4 mm long, parallel and facing the lower tepals. *Style* dividing opposite middle to upper third of anthers, style branches $\pm$ 1.5 mm long, weakly recurved. *Flowering time*: late September and October, rarely in late August. Figure 18.

Distribution: *Ixia stenophylla* is a narrow endemic of the western end of the Riviersonderend Mtns and the Hex River Mtns; it extends from Boesmanskloof Pass above Greyton to the western end of the Riviersonderend range near Villiersdorp (Figure 17). The one collection we have seen from the Hex River Mtns is from Brandwagberg. There is also a single record from the 'Frenchhoek Forest Reserve,' we assume from the eastern end of the Reserve, closest to the Riviersonderend Mtns. Plants grow in rocky sites, usually in low vegetation of the upper northern slopes, usually on sandy ground or in sandstone outcrops, but also on shale slopes.

Diagnosis and relationships: *Ixia stenophylla* was first recognized as a distinct taxon by Lewis (1962), who treated it as var. *filifolia* of the florally somewhat similar *I. fucata*. De Vos (1999), in her *Flora of southern Africa* account of *Ixia*, uncritically accepted that opinion. Lewis distinguished var. *filifolia* from var. *fucata* by its taller stem, three leaves, the basal two with filiform blades up to 1 mm wide, and the absence of a collar of fibres around the stem base, the latter characteristic of var. *fucata*. Lewis considered the spike, bracts and flowers virtually identical to those of var. *fucata*, particularly the wide, cylindrical perianth tube and well-exserted filaments. Our examination of the spike and flowers of the

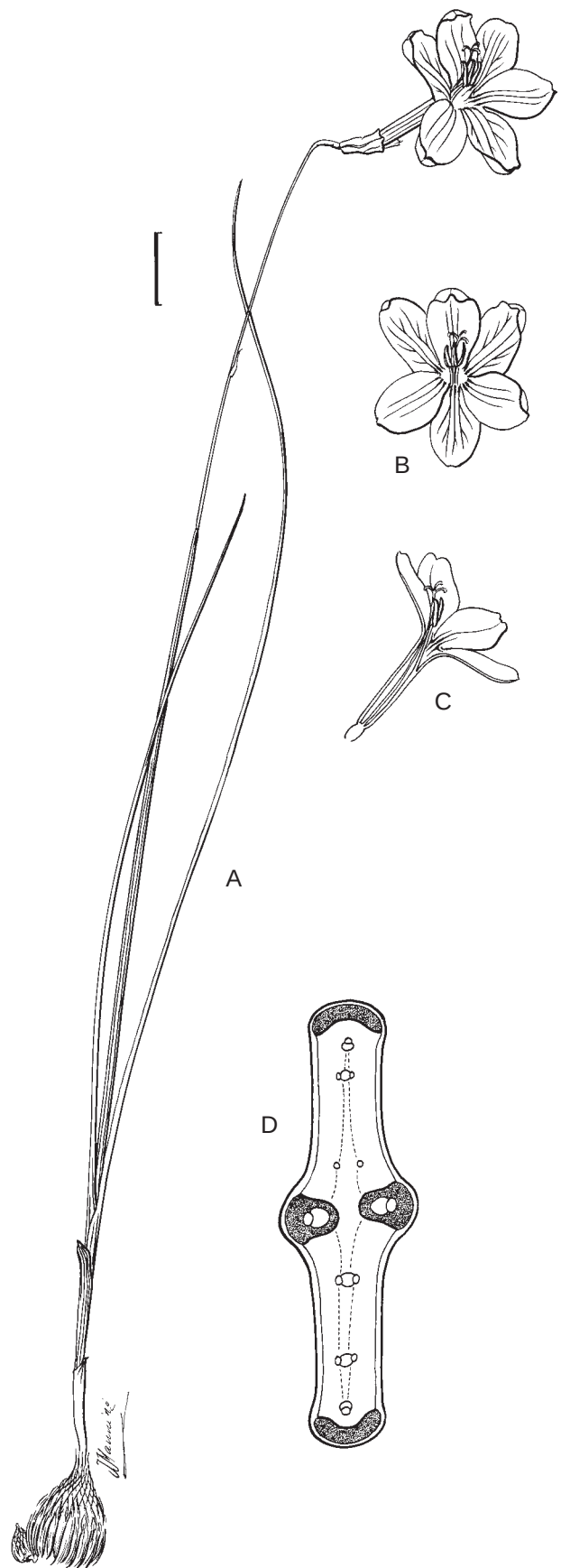


FIGURE 18.—*Ixia stenophylla*, Snijman 2181 (NBG): A, plant; B, flower, front view; C, half-flower; D, anatomical section of leaf blade. Scale bar: A–C, 10 mm. Artist: J.C. Manning.

two taxa refutes Lewis's contention. Var. *filifolia* differs not only in the vegetative features noted by Lewis, the narrow leaf blades, up to 1.2 mm wide, with the margins not thickened, and without a collar of fibres around the stem base, but in floral features as well. The spike bears 1 or 2, rarely 3 flowers, and the stem is almost invariably unbranched (just three of 52 specimens in herbaria examined have a single short branch). The white flowers are flushed mauve outside and have dark veining on the perianth tube, which is fairly wide and (12–)15–20 mm long. Fresh flowers we examined (Snijman 2181) also have unilateral stamens, presumably typical of the species. Although extended horizontally, the unilateral stamens have parallel anthers facing the lower tepals, an orientation unique in *Ixia*. We have no hesitation in treating the plants as a separate species, *I. stenophylla*, so named for its particularly narrow leaves. Lewis's varietal name *filifolia* has already been used at species rank in the genus.

The immediate relationships of *Ixia stenophylla* are uncertain. The two linear and very narrow foliage leaves suggest it belongs to the *I. capillaris* complex, all species of which also have narrow leaves. Close examination of the leaves, however, shows that they differ significantly in having a strongly thickened and raised central vein and a thickened secondary vein, whereas the leaves of all species of the *I. capillaris* complex lack thickened veins.

Typical *Ixia fucata*, as we now circumscribe the species, usually has four leaves, the lower three with narrowly sword-shaped blades, 2–3 mm wide, of a thinner texture than in *I. stenophylla* and with a fairly well-developed central vein. The white to pink flowers are deeper pink to reddish on the outside, lack obvious dark veining, the stamens in at least some populations are unilateral and declinate, and the filaments are exerted ± 5 mm. The perianth tube is narrower than in *I. stenophylla* and expands gradually from base to apex, thus different from the wide tube of uniform diameter in *I. stenophylla*. The range of *I. fucata* extends from the western Langeberg near Montagu to Keeromsberg and the western end of the Hex River Mtns. We assume that the similarities in the flowers of *I. fucata* and *I. stenophylla* are due to convergence and that they are not closely allied. The immediate affinities of *I. fucata* are most likely with the central Langeberg species, *I. stohrii*, which is similar in vegetative morphology but has longer-tubed pink, radially symmetric flowers with shorter filaments, either exerted up to 1 mm or included in the perianth tube and then the anthers also partly to fully included.

Selected specimens

WESTERN CAPE.—3319 (Worcester): Hex River Mtns, Brandwagberg 186, Tierkloof on path to Thomas Hut, 828 m, partly shaded south slopes on shale soils, (–CB), 4 Oct. 2009, Helme 6107 (NBG); NW end of Riviersonderend Mtns, road from Highlands to Paulsgat, in rocks along stream in fynbos, (–CD), 2 Oct. 2007, Snijman 2181 (NBG); Jonaskop, Langberg, rocky koppie on north slopes, ± 1 050 m, (–DC), 19 Oct. 1971, Esterhuysen 32696 (BOL, K, MO); Wolwen Kloof, Wildepaardeberg, $\pm 1050'$ [320 m], (–DC), 1931, Stokoe 2507 (BOL); Jonaskop, halfway up FM tower road, among rocks, (–DC), 20 Oct. 1989, Snijman 1239 (NBG, PRE). 3419 (Caledon): Silverstream, near Villiersdorp, moist rocky slope, (–AA), 5 Oct. 1985, Esterhuysen 36235 (MO, PRE); 5 miles [8 km] N of Theewaterskloof Dam wall, (–AB), 21 Sept. 1975, Burgers 115 (NBG); Riviersonderend Mtns, Boesmanskloof Pass, north slope on sandstone outcrop, (–BA), 19 Aug. 1993, Bean & Trinder-Smith 2873 (BOL). Without precise locality: Franschhoek Forest Reserve, 28 Sept. 1935, Lewis s.n. (BOL26938).

2.4. Series *Rapunculoides*

36. *Ixia rapunculoides* Delile in Redouté, Les Liliacées 8: t. 431 (1814b); Goldblatt & Manning: 7 (2008a). Type: South Africa, without precise locality, collector unknown, illustration in Delile in Redouté, Les Liliacées 8: t. 431 (1814b). Epitype: South Africa, [Northern Cape], Klipkoppies, red clay, 9 Aug. 1961, Lewis 5853 (NBG, epi., designated by Goldblatt & Manning 2008a: 7; K!, PRE!, iso.).

Illustration: Figure 1A–C in Goldblatt & Manning 2008a.

Since the publication of our account of the species (Goldblatt & Manning 2008a) one unusual variant has come to our attention. These are plants from the Keiskie Mtns south of Calvinia (Goldblatt & Porter 13140, MO, NBG). Very like *Ixia rapunculoides* in leaf and corm, and even general aspect, these plants differ from typical *I. rapunculoides*, which is common on flats and lower slopes both to the north and south, in the long narrow tepals $\pm 18 \times 4$ mm, perianth tube 8.5 mm long and filaments inserted ± 4 mm above the tube base and ± 4 mm long. Flowers of *I. rapunculoides* elsewhere have broader tepals 11–15 $\times$ 4.5–6.0 mm, a perianth tube rarely more than 8 mm long, and often less than 7 mm, filaments inserted 2–4 mm above the tube base and 2–3 mm long. The anthers of the Keiskie population are also longer, ± 4 mm, compared with 2.3–3.5 mm for *I. rapunculoides*. These plants need further investigation but we provisionally include them here without taxonomic recognition at any rank.

37. *Ixia robusta* (G.J.Lewis) Goldblatt & J.C.Manning in Bothalia 38: 9 (2008a). *Ixia rapunculoides* var. *robusta* G.J.Lewis: 74 (1962). Type: South Africa, [Northern Cape], Moordenaarspoort, 26 miles [41.6 km] NE of Calvinia, 26 Sept. 1952, Lewis 2503 (SAM, holo.; BOL!, PRE!, iso.).

Illustration: Figure 1D–F in Goldblatt & Manning 2008a.

38. *Ixia rivulicola* Goldblatt & J.C.Manning in Bothalia 38: 9 (2008a). Type: South Africa, Northern Cape, 3220 (Sutherland): Roggeveld Escarpment, drift across Bo-Vis River at Noudrif Farm, in muddy ground, (–AB), 11 Oct. 2004, Goldblatt & Porter 12666 (NBG, holo.; K!, MO!, PRE!, iso.).

Illustration: Figure 4A–C in Goldblatt & Manning 2008a.

39. *Ixia lacerata* Goldblatt & J.C.Manning in Bothalia 38: 10 (2008a). Type: South Africa, Western Cape, 3320 (Montagu): Klein Roggeveld, about 24 km north of N1 on road to Sutherland, dolerite slope, (–BA), 26 Aug. 2006, Goldblatt & Porter 12702 (NBG, holo.; K!, MO!, PRE!, iso.).

Illustration: Figure 4D–F in Goldblatt & Manning 2008a.

40. *Ixia mollis* Goldblatt & J.C.Manning, nom. nov. pro *I. flaccida* (G.J.Lewis) Goldblatt & J.C.Manning in Bothalia 38: 17 (2008a), illegit. homonym non *I. flaccida* Salisb.: 35 (1796), nom. illegit. superfl. pro *I. patens* Aiton: 59 (1789). Type: South Africa, [Western Cape], Boschkloof, 7 Aug. 1896, Schlechter 8432 (BOL, holo.; BM, G, K!, L, MO!, PRE (two sheets)!, S, Z, iso.).

41. ***Ixia namaquana*** L.Bolus in South African Gardening & Country Life 21: 368 (1931b); Goldblatt & Manning: 14 (2008a). *I. rapunculoides* var. *namaquana* (L.Bolus) G.J.Lewis: 76 (1962). Type: South Africa, [Northern Cape], Klipfontein, Sept. 1883, H. Bolus as Herbario Normale Austro-Africana 698 (BOL, lecto!., designated by De Vos 1999: 15; B, G, K!, PRE!, SAM!, Z, iso.).

Illustration: Figure 6A–D in Goldblatt & Manning 2008a.

42. ***Ixia oxalidiflora*** Goldblatt & J.C.Manning in Bothalia 38: 17 (2008a). Type: South Africa, [Western Cape], 3319 (Worcester): Hex River Pass, south-facing clay slopes, (–BC), 2 Sept. 1992, Goldblatt & Manning 9397 (NBG, holo!.; MO!, iso.).

Illustration: Figure 6E–G in Goldblatt & Manning 2008a.

43. ***Ixia sobolifera*** Goldblatt & J.C.Manning in Bothalia 38: 11 (2008a). Type: South Africa, Northern Cape, 3320 (Montagu): north of Matjiesfontein on road to Sutherland, (–BA), 9 Sept. 2006, Goldblatt & Porter 12809 (NBG, holo!.; MO!, PRE!, iso.).

Illustration: Figure 4G–I in Goldblatt & Manning 2008a.

44. ***Ixia contorta*** Goldblatt & J.C.Manning in Bothalia 38: 21 (2008a). Type: South Africa, Western Cape, 3219 (Wuppertal): Cold Bokkeveld, low hill east of Farm Waboomsrivier, well-drained sandy ground, (–CD), 17 Sept. 2006, Goldblatt & Porter 12854 (NBG, holo!.; MO!, PRE!, iso.).

Illustration: Figure 11 in Goldblatt & Manning 2008a.

2.5. Series **Capillares**

45. ***Ixia capillaris*** L.f., Supplementum plantarum: 92 (1782); Lewis: 68 (1962); Goldblatt & Manning: 117 (2008b). *Morphixia capillaris* (L.f.) Ker Gawl.: 106 (1827). Type: South Africa, [Western Cape], without precise locality, collected circa 1773, Thunberg s.n. (UPS-THUNB935 & 936, syn!).

Illustration: Figure 1A–C in Goldblatt & Manning 2008b.

46. ***Ixia exiliflora*** Goldblatt & J.C.Manning in Bothalia 38: 119 (2008b). Type: South Africa, Western Cape, 3319 (Worcester): ± 0.8 km S of turn-off to Montagu from N1, flat plateau, 3200' [± 1 050 m], (–BD), 25 Aug. 2006, Goldblatt & Porter 12688 (NBG, holo!.; K!, MO!, PRE!, iso.).

Illustration: Figure 1D, E in Goldblatt & Manning 2008b.

47. ***Ixia dieramoides*** Goldblatt & J.C.Manning in Bothalia 38: 120 (2008b). Type: South Africa, Western Cape. 3320 (Montagu): north of N1 between Matjiesfontein and Touws River, sandstone outcrop, (–BA), 27 Aug. 2006, Goldblatt & Porter 12713 (NBG, holo!.; K!, MO!, PRE!, BOL!, iso.).

Illustration: Figure 3 in Goldblatt & Manning 2008b.

48. ***Ixia pauciflora*** G.J.Lewis in Journal of South African Botany 27: 88 (1962); Goldblatt & Manning: 121 (2008b). Type: South Africa, [Western Cape], Cold Bokkeveld, north of Waboomsrivier, 2 Sept. 1956, Barker 8635 (NBG, holo!).

Illustration: Figure 5 in Goldblatt & Manning 2008b.

49. ***Ixia reclinata*** Goldblatt & J.C.Manning in Bothalia 38: 123 (2008b). Type: South Africa, Western Cape, 3419 (Caledon): hills south of Theewaterskloof Dam, Farm Cranesfield, north of Draaiberg road, stony shale outcrops, (–AA), 24 Aug. 2006, Goldblatt, Manning & Porter 12686 (NBG, holo!.; K!, MO!, PRE!, S!, iso.).

Illustration: Figure 6 in Goldblatt & Manning 2008b.

NOMENCLATURAL NOTE

In the course of our investigation of type material in European herbaria we located the type specimen of *Ixia striata* Vahl (1805) in the Copenhagen Herbarium. The species was excluded from *Ixia* in her account by Lewis (1962) who commented that it might be 'a form or variety' of *I. latifolia* based on the description. De Vos (1999) thought *I. striata* might be a species of *Tritonia* and although she saw and annotated the specimen at the Copenhagen Herbarium '*Tritonia strictifolia* (Klatt) Benth. & Hook.f.', she did not realize it was the type of *I. striata*. We have seen scanned images of the type and confirm that it is a species of *Tritonia* and are confident it is *T. gladiolaris* (Lam.) Goldblatt & J.C.Manning [= *T. lineata* (Salisb.) Ker Gawl.], of which it becomes a synonym. The basionym of *T. gladiolaris* is *Ixia gladiolaris* Lam. (1789) (see Goldblatt & Manning 2006), which predates *I. striata* by 16 years.

Tritonia gladiolaris (Lam.) Goldblatt & J.C.Manning in Bothalia 36: 57 (2006). *Ixia gladiolaris* Lam.: 341 (1789). Type: South Africa, Cape of Good Hope, cultivated in Paris, flowering March and April, original collector unknown (P–Herb. Lamarck, holo!).

Ixia striata Vahl: 65 (1805), syn. nov. Type: South Africa, without precise locality or collector (C, holo.–scanned image!).

Tritonia lineata (Salisb.) Ker Gawl.: 228 (1804); M.P.de Vos: 369 (1983). *Gladiolus lineatus* Salisb.: 40 (1796). *Montbretia lineata* (Salisb.) Baker: 169 (1877). *Tritonixia lineata* (Salisb.) Klatt: 357 (1882). Type: South Africa, without precise locality, grown at the Royal Botanic Gardens, Kew in 1781 (BM, lecto., designated by M.P.de Vos 1983: 371).

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collection, not always present there: B, BM, BOL, C, GRA, K, PRE, S, UPS and Z.

REFERENCES

- AITON, W. 1789. *Hortus kewensis*, vol. 1. Nicol, London.
- ANDREWS, H.C. 1802. *Ixia capitata* var. *stellata*. *The botanists's repository* 4: t. 232.
- BAKER, J.G. 1877 [as 1878]. *Systema iridearum*. *Journal of the Linnean Society, Botany* 16: 61–180.
- BAKER, J.G. 1892. *Handbook of the Iridaceae*. Bell, London.
- BAKER, J.G. 1896. Iridaceae. In W.T. Thiselton-Dyer, *Flora capensis* 6: 7–171. Reeve, Covent Garden, London.
- BAKER, J.G. 1904. Beiträge zur kenntnis der Afrikanischen-Flora. *Bulletin de l'Herbier Boissier* ser. 2, 4: 1005.
- BENTHAM, G. & HOOKER, J.D. 1883. *Genera plantarum* 3,1. Reeve, London.
- BERGIUS, P.J. 1767. *Descriptiones plantarum capensium*. Salvius, Stockholm.
- BOLUS, L. 1929a. Novitates africanæ. *Journal of Botany* 67: 132–139.
- BOLUS, L. 1929b. Plants—new and noteworthy. *South African Gardening* 19: 27.
- BOLUS, L. 1931a. Plants—new or noteworthy. *South African Gardening* 21: 281, 282.
- BOLUS, L. 1931b. Plants—new or noteworthy. *South African Gardening* 21: 367, 368.
- BORN, J., LINDER, H.P. & DESMET, P. 2006. The Greater Cape Floristic Region. *Journal of Biogeography* 34: 147–162.
- BROWN, N.E. 1928. The South African Iridaceae of Thunberg's herbarium. *Journal of the Linnean Society, Botany* 48: 15–55.
- BROWN, N.E. 1929. The Iridaceae of Burman's *Flora capensis prodromus*. *Kew Bulletin of Miscellaneous Information* 1929: 129–139.
- DELAROCHE, D. 1766. *Descriptiones plantarum aliquot novarum*. Verbeek, Leiden.
- DELILE, A.R. 1814a. *Ixia phlogiflora*. In J.P. Redouté, *Les Liliacées* 8(72): t. 432. Paris.
- DELILE, A.R. 1814b. *Ixia rapunculoides*. In J.P. Redouté, *Les Liliacées* 8(72): t. 431. Paris.
- DE VOS, M.P. 1974. *Duthiella*, 'n nuwe genus van die Iridaceae. *Journal of South African Botany* 40: 301–309.
- DE VOS, M.P. 1982. Die bou en ontwikkeling van die unifasiale blaar van *Tritonia* en verwante genera. *Journal of South African Botany* 48: 27–37.
- DE VOS, M.P. 1983. The African genus *Tritonia* Ker-Gawler 2. *Journal of South African Botany* 49: 347–422.
- DE VOS, M.P. 1988. Three new species of *Ixia* L. (Iridaceae) from the Cape Province. *South African Journal of Botany* 54: 596–602.
- DE VOS, M.P. 1999. *Ixia*. In M.P. de Vos & P. Goldblatt, *Flora of southern Africa* 7, part 2, fascicle 1: 3–87. National Botanical Institute, Pretoria.
- DIELS, L. 1930. Iridaceae. In A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien* edn 2, 15a: 463–505. Leipzig.
- DUMORTIER, B.C.J. 1822. *Commentationes botanicae*. Casterman-Diem, Tournai.
- DUMORTIER, B.C.J. 1829. *Analyse des familles des plantes*. Casterman, Tournai.
- ECKLON, C.F. 1827. *Topographisches Verzeichniss der Pflanzensammlung von C.F. Ecklon*. Reiseverein, Esslingen.
- FOSTER, R.C. 1936. Notes on nomenclature in Iridaceae. *Contributions from the Gray Herbarium of Harvard University* 114: 37–50.
- GOLDBLATT, P. 1969. The genus *Sparaxis*. *Journal of South African Botany* 35: 219–252.
- GOLDBLATT, P. 1971. Cytological and morphological studies in the southern African Iridaceae. *Journal of South African Botany* 37: 317–460.
- GOLDBLATT, P. 1979. New species of Cape Iridaceae. *Journal of South African Botany* 45: 81–89.
- GOLDBLATT, P. 1984. A revision of *Hesperantha* (Iridaceae) in the winter rainfall area of southern Africa. *Journal of South African Botany* 50: 15–141.
- GOLDBLATT, P. 1985. Revision of the southern African genus *Geissorhiza* (Iridaceae: Ixioidae). *Annals of the Missouri Botanical Garden* 72: 277–447.
- GOLDBLATT, P., BARI, A. & MANNING, J.C. 1991. Sulcus and operculum structure in the pollen grains of Iridaceae subfamily Ixioidae. *Annals of the Missouri Botanical Garden* 78: 950–961.
- GOLDBLATT, P., BERNHARDT, P. & MANNING, J.C. 1998. Pollination of petaloid geophytes by monkey beetles (Scarabaeidae: Rutelinae: Hopliini) in southern Africa. *Annals of the Missouri Botanical Garden* 85: 215–230.
- GOLDBLATT, P., BERNHARDT, P. & MANNING, J.C. 2000. Adaptive radiation of pollination mechanisms in *Ixia* (Iridaceae: Crocoideae). *Annals of the Missouri Botanical Garden* 87: 564–577.
- GOLDBLATT, P., DAVIES, T.J., SAVOLAINEN, V., MANNING, J.C. & VAN DER BANK, M. 2006. Phylogeny of Iridaceae subfamily Crocoideae based on combined multigene plastid DNA analysis. In J.T. Columbus, E.A. Friar, J.M. Porter, L.M. Prince & M.G. Simpson, *Monocots: comparative biology and evolution*, vol. 1: 399–411. Rancho Santa Ana Botanic Garden, Claremont, CA.
- GOLDBLATT, P., DAVIES, T.J., MANNING, J.C., POWELL, M.P., VAN DER BANK, M. & SAVOLAINEN, V. 2008. Iridaceae 'Out of Australasia'? Phylogeny, biogeography, and divergence time based on plastid DNA sequences. *Systematic Botany* 33: 495–508.
- GOLDBLATT, P. & MANNING, J.C. 1993. *Ixia acaulis*, a new acaulescent species of Iridaceae: Ixioidae from the Knersvlakte, Namaqualand, South Africa. *Novon* 3: 148–153.
- GOLDBLATT, P. & MANNING, J.C. 1995. Phylogeny of the African genera *Anomatheca* and *Freesia* (Iridaceae-Ixioidae), and a new genus *Xenoscapa*. *Systematic Botany* 20: 161–178.
- GOLDBLATT, P. & MANNING, J.C. 1997. The *Moegistorhynchus longirostris* (Diptera: Nemestrinidae) pollination guild: long-tubed flowers and a specialized long-proboscid fly pollination system in southern Africa. *Plant Systematics and Evolution* 206: 51–69.
- GOLDBLATT, P. & MANNING, J.C. 1998. *Gladiolus in southern Africa: systematics, biology, and evolution*. Fernwood Press, Cape Town.
- GOLDBLATT, P. & MANNING, J.C. 1999. New species of *Sparaxis* and *Ixia* (Iridaceae: Ixioidae) from Western Cape, South Africa, and taxonomic notes on *Ixia* and *Gladiolus*. *Bothalia* 29: 59–63.
- GOLDBLATT, P. & MANNING, J.C. 2000. Cape plants. A conspectus of the Cape flora of South Africa. *Strelitzia* 7. National Botanical Institute, Cape Town & Missouri Botanical Garden, St. Louis.
- GOLDBLATT, P. & MANNING, J.C. 2006. Notes on the systematics and nomenclature of *Tritonia* (Iridaceae: Crocoideae). *Bothalia* 36: 57–61.
- GOLDBLATT, P. & MANNING, J.C. 2007. Pollination of *Romulea syringodeoflora* (Iridaceae: Crocoideae) by a long-proboscid fly, *Prosoeca* sp. (Diptera: Nemestrinidae). *South African Journal of Botany* 73: 56–59.
- GOLDBLATT, P. & MANNING, J.C. 2008a. Systematics of the southern African genus *Ixia* (Iridaceae). 1. The *I. rapunculoides* complex. *Bothalia* 38: 1–23.
- GOLDBLATT, P. & MANNING, J.C. 2008b. Systematics of the southern African genus *Ixia* (Iridaceae). 2. The filiform-leaved *I. capillaris* complex. *Bothalia* 38: 115–124.
- GOLDBLATT, P. & MANNING, J.C. 2010. Reappraisal of *Ixia maculata* with *I. calendulacea* sp. nov., and an earlier name for *I. lutea* (Iridaceae). *Bothalia* 40: 59–64.
- GOLDBLATT, P. & SNIJMAN, D. 1985. New species and notes on the southern African genus *Ixia* (Iridaceae). *South African Journal of Botany* 51: 66–70.
- GOLDBLATT, P. & TAKEI, M. 1997. Chromosome cytology of Iridaceae, base numbers, patterns of variation and modes of karyotype change. *Annals of the Missouri Botanical Garden* 84: 285–304.
- HEYNHOLD, G. 1841. *Nomenclator botanicus hortensis* 2. Dresden & Leipzig.
- HEYNHOLD, G. 1847 [as 1846]. *Alphabetische und synonymische Aufzählung der Gewächse*. Dresden & Leipzig.
- HILLIARD, O.M., BURTT, B.L. & BATTEN, A. 1991. *Dierama. The hairbells of Africa*. Acorn Press, Johannesburg.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index herbariorum. Part. 1: the herbaria of the world*. New York Botanical Garden, New York.
- HORN, W. 1962. Breeding research on South African plants: III. Intra- and interspecific compatibility in *Ixia* L., *Sparaxis* Ker., *Watsonia* Mill. and *Zantedeschia* Spreng. *Journal of South African Botany* 28: 269–277.
- HOUTTUYN, M. 1780. *Natuurlijke historie* 12. Amsterdam.
- JACQUIN, N.J. VON. 1794. *Gladiolus longiflorus*. *Icones plantarum rariorum* 2,16: t. 262. Wappler, Vienna.
- JACQUIN, N.J. VON. 1795a. *Ixia lancea*. *Icones plantarum rariorum* 2,16: t. 281. Wappler, Vienna.
- JACQUIN, N.J. VON. 1795b. *Ixia incarnata*. *Icones plantarum rariorum* 2(16): t. 282. Wappler, Vienna.

- JACQUIN, N.J. VON. 1796. *Collectanea plantarum*, Supplement. Wappler, Vienna.
- KER GAWLER, J. 1802a. *Ixia aristata*. Salver-flowered ixia. *Curtis's Botanical Magazine* 16: t. 589.
- KER GAWLER, J. 1802b. *I. capillaris* (var. γ) *gracillima*. Slender ixia. *Curtis's Botanical Magazine* 17: sub t. 570.
- KER GAWLER, J. 1803a. *Ixia capillaris* (var. β) *stricta*. Wire-stemmed ixia. et *Ixia capillaris* var. γ *incarnata*. Flesh-coloured Ixia. *Curtis's Botanical Magazine* 17: t. 617.
- KER GAWLER, J. 1803b. *Tritonia capensis*. Long-tubed tritonia. *Curtis's Botanical Magazine* 17: t. 618.
- KER GAWLER, J. 1803c. *I. rochensis*. (α) Plaid ixia. *Curtis's Botanical Magazine* 17: t. 598.
- KER GAWLER, J. 1804. *Ensatorum ordo*. Koenig & Sims *Annals of Botany* 1: 219–247.
- KER GAWLER, J. 1807. *Ixia capillaris* (var. γ) *aulica*. Rose-coloured ixia. *Curtis's Botanical Magazine* 25: t. 1013.
- KER GAWLER, J. 1809. *Ixia erecta*. (v. *lutea*; *odorata*). Yellow sweet-scented ixia. *Curtis's Botanical Magazine* 29: t. 1173.
- KER GAWLER, J. 1810. *Tritonia viridis*. Greenish-flowered tritonia. *Curtis's Botanical Magazine* 31: t. 1275.
- KER GAWLER, J. 1811. *Ixia fucata*. Painted-flowered ixia. *Curtis's Botanical Magazine* 34: t. 1379.
- KER GAWLER, J. 1812a. *Tritonia rochensis* (α) Bending-flowered ixia. *Curtis's Botanical Magazine* 37: t. 1503.
- KER GAWLER, J. 1812b. *Tritonia longiflora* (β , γ). Long-flowered tritonia. *Curtis's Botanical Magazine* 37: t. 1502.
- KER GAWLER, J. 1821. Notes [3]. *The botanists register* 7.
- KER GAWLER, J. 1827. *Iridearum genera*. De Mat, Brussels.
- KLATT, F.W. 1882. Ergänzungen und Berichtigungen zu Baker's Systema Iridacearum. *Abhandlungen der Naturforschenden Gesellschaft zu Halle* 15: 44–404.
- LAMARCK, J.B.A.P.M. DE. 1789. *Encyclopédie méthodique Botanique* 3. Paris.
- LINNAEUS, C. fil. 1782 [as 1781]. *Supplementum plantarum*. Orphanotropheus, Brunswick.
- LEWIS, G. J. 1933. Plants—new or noteworthy. *South African Gardening and Country Life* 23: 213.
- LEWIS, G.J. 1938. Eight new Iridaceae from the Cape Province. *Journal of South African Botany* 4: 1–11.
- LEWIS, G.J. 1945. *Ixia cochlearis* G.J.Lewis. *The Flowering Plants of Africa* 25: t. 969.
- LEWIS, G.J. 1954. Some aspects of the morphology, phylogeny and taxonomy of the South African Iridaceae. *Annals of the South African Museum* 40: 15–113.
- LEWIS, G.J. 1962. South African Iridaceae: The genus *Ixia*. *Journal of South African Botany* 28: 45–195.
- MANNING, J.C. & GOLDBLATT, P. 1997. The *Moegistorhynchus longirostris* (Diptera: Nemestrinidae) pollination guild: long-tubed flowers and a specialized long-proboscid fly pollination system in southern Africa. *Plant Systematics and Evolution* 206: 51–69.
- MANNING, J.C. & GOLDBLATT, P. 2001. A synoptic review of *Romulea* (Iridaceae: Crocoideae) in sub-Saharan Africa, the Arabian Peninsula and Socotra, including new species, biological notes, and a new infrageneric classification. *Adansonia*, sér. 3, 23,1: 59–108.
- MANNING, J.C. & GOLDBLATT, P. 2005. Radiation of pollination systems in the Cape genus *Tritoniopsis* (Iridaceae: Crocoideae) and the development of bimodal pollination strategies. *International Journal of Plant Sciences* 166: 459–474.
- MANNING, J.C. & GOLDBLATT, P. 2006. New species of Iridaceae from the Hantam-Roggeveld centre of endemism and the Bokkeveld, Northern Cape, South Africa. *Bothalia* 36: 139–145.
- MANNING, J.C., GOLDBLATT, P. & SNIJMAN, D. 2002. *The color encyclopedia of Cape bulbs*. Timber Press, Portland, OR.
- NORDENSTAM, B. 1972. Types of Ecklon's 'Topographisches Verzeichniss' in the Swedish Museum of Natural History in Stockholm. *Journal of South African Botany* 38: 277–298.
- PAX, F. 1888. Iridaceae. In A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien* 2,5: 137–157. Engelmann, Leipzig.
- PETERS, W.C.H. 1864. *Naturwissenschaftliche Reise nach Mossambique*, Band 6, Botanik, II Abteilung. Georg Reimer, Berlin.
- PROCTOR, M., YEO, P. & LACK, A. 1996. *The natural history of pollination*. Timber Press, Portland, OR.
- REEVES, G., CHASE, M.W., GOLDBLATT, P., RUDALL, P.J., FAY, M.F., COX, A.V., LEJEUNE, B. & SOUZA-CHIES, T. 2001. A phylogenetic analysis of Iridaceae based on four plastid sequence regions: *trnL* intron, *trnL-F* spacer, *rps4* and *rbcL*. *American Journal of Botany* 88: 2074–2087.
- REICHENBACH, H.G.L. 1856. *Selectus e Seminario Horti. Academici Dresdensis* 1856. Dresden.
- ROEMER, J.J. & SCHULTES, J.A. 1817. *Systema vegetabilium secundum* 1. Cotta, Stuttgart.
- RUDALL, P.J. 1995. *Anatomy of the monocotyledons*, vol. 8, *Iridaceae*. Clarendon Press, Oxford, UK.
- RUDALL, P.J. & GOLDBLATT, P. 1991. Leaf anatomy and phylogeny of Ixiodeae (Iridaceae). *Botanical Journal of the Linnean Society* 106: 329–345.
- SALISBURY, R.A. 1796. *Prodromus stirpium in horto ad Chapel Allerton vigentium*. London.
- SALISBURY, R.A. 1812. On the cultivation of rare plants, etc. *Transactions of the Horticultural Society, London* 1: 261–366.
- STEUDEL, E.G. 1821. *Nomenclator botanicus*. Cotta, Stuttgart.
- SWEET, R. 1826. *Hortus britannicus*. Ridgeway, London.
- THUNBERG, C.P. 1783. *Dissertatio de Ixia*. Edman, Uppsala.
- THUNBERG, C.P. 1811. *Flora capensis*. Edman, Uppsala.
- VAHL, M. 1805. *Enumeratio plantarum*, vol. 2. Copenhagen.
- VOIGT, J.O. 1845. *Hortus suburbanus calcuttensis*. Bishop's College Press, Calcutta.

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A conspectus of *Combretum* (Combretaceae) in southern Africa, with taxonomic and nomenclatural notes on species and sections

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Keywords: Combretaceae, *Combretum* Loeft., lectotypification, phylogeny, sections, southern Africa, taxonomy

ABSTRACT

Two subgenera of *Combretum* Loeft. occur in the *Flora of southern Africa* (FSA) region. Previous sectional classifications were assessed in view of molecular evidence and accordingly modified. Ten sections in subgen. *Combretum*, 25 species and eight subspecies are recognized. Subgen. *Cacoucia* (Aubl.) Exell & Stace comprises four sections and seven species. *C. engleri* Schinz, *C. paniculatum* Vent. and *C. tenuipes* Engl. & Diels are reinstated as distinct species separate from *C. schumannii* Engl., *C. microphyllum* Klotzsch and *C. padoides* Engl. & Diels, respectively. *C. schumannii* occurs outside the FSA region. Records of *C. adenogonium* Steud. ex A.Rich., *C. platypetalum* Welw. ex M.A.Lawson subsp. *oatesii* (Rolfe) Exell and subsp. *baumii* (Engl. & Gilg) Exell in Botswana are doubtful. *C. celastroides* Welw. ex M.A.Lawson subsp. *orientale* Exell is elevated to species level as *C. patelliforme* Engl. & Diels. *C. grandifolium* F.Hoffm. is reduced to *C. psidioides* Welw. subsp. *grandifolium* (F.Hoffm.) Jordaan. Twenty-six names are lectotypified. The type, a full synonymy, other nomenclatural and taxonomic information, the full distribution range and a distribution map are provided for each taxon. Selected specimens examined are given for poorly known species. Keys to subgenera, sections and species are provided.

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INTRODUCTION

Combretum Loeft. belongs to Combretaceae, one of the 14 core families of the Myrtales (Dahlgren & Thorne 1984; Sytsma *et al.* 2004), one that is characterized by mainly opposite leaves and the absence of stipules or stipules being rudimentary (Stace 2007). Combretaceae is sister to all the other 13 families combined, and diverged early in the evolution of the Myrtales (Angiosperm Phylogeny website—APweb). *Combretum* (excluding *Quisqualis* L.) comprises about 250 species (Bredenkamp 2000) and occurs in tropical and subtropical regions (America, Africa, Madagascar, India, Asia, Malesia, Australia), but is absent from the Pacific Islands (Stace 2007). Although Bredenkamp (2000) gives the distribution as excluding Australia, *C. trifoliatum* Vent., a vigorous woody climber, was discovered in northern Australia in the 1980s (Clarkson & Hyland 1986; Pedley 1990). The greatest species diversity occurs in Africa, namely 163 in sub-Saharan Africa (Klopper *et al.* 2006), with 43 in Gabon (Jongkind 1999), 36 in Cameroon (Liben 1983), and about 30 in southern Africa (Jordaan 2003). It is widespread in the FSA region in all countries and provinces, except in the Free State (rare), Lesotho and Western Cape (Bredenkamp 2000).

Members of *Combretum* are mostly deciduous or semi-deciduous (rarely evergreen) trees, shrubs, scandent shrubs (scramblers), subshrubs with woody rootstocks (so-called geoxyllic suffrutes; rare in southern Africa) or woody climbers (lianas), sometimes with spine-tipped lateral shoots (*C. imberbe* Wawra). Bark on young stems is often flaking and peeling in stringy strips or threads in most species or in large ± cylindrical or hemicylindrical pieces revealing an exposed cinnamon-red surface (*C. psidioides* group). Leaves are opposite, subopposite (or locally alternate), sometimes 3- or 4-whorled, exstipulate, simple and the margins are

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always entire, rarely crenulate, or sometimes undulate (*C. elaeagnoides* Klotzsch, *C. petrophilum* Retief and *C. tenuipes* Engl. & Diels). Indumentum on leaves, flowers and fruit consists of unicellular, compartmented or combretaceous hairs (sharp-pointed, thick-walled with a bulbous base), multicellular stalked glands and multicellular scales. Mature scales can be classified into three major groups and have proved to be important in assessing taxon boundaries and phylogenetic relationships (Exell & Stace 1972). Leaves are pinnately veined where the lateral veins are arranged parallel to each other, somewhat spaced and looping before they reach the margin (brochidodromous). Hair-tuft domatia (marsupiform) in the axils of the veins below are present in a number of species (Stace 1965). Bases of leaf petioles may persist as straight spines or recurved hooks as in *C. bracteosum* (Hochst.) Brandis, *C. mossambicense* (Klotzsch) Engl. and *C. microphyllum* Klotzsch. Flowers are bisexual and are borne in axillary or terminal, branched or unbranched spikes, sometimes subcapitate, and are bracteate. Flowers are 4- or 5-merous and usually sweetly scented. Petals vary from white, cream-coloured, yellow, yellow-green in most species, but are sometimes pale to deep pink or bright red as in *C. bracteosum*, *C. microphyllum*, *C. paniculatum* Vent., *C. platypetalum* Welw. ex M.A. Lawson and *C. wattii* Exell. In deciduous species, the flowers appear before or with the new leaves, e.g. *C. elaeagnoides* Klotzsch, *C. microphyllum*, *C. platypetalum*, *C. psidioides* and *C. zeyheri* Sond. The calyx is produced into a short, campanulate or cup-shaped limb above the inferior ovary. Stamens are inserted on the hypanthium, usually twice as many as the sepals or petals, and usually exserted beyond the petals. The stamens vary in colour from yellow, orange, pinkish, crimson or reddish to red-brown. A glabrous or pilose, green or red, well-developed nectariferous disc is often present at the base of the upper hypanthium. Nectar production is indicative of flowers that are pollinated by a wide range of insects or birds (Stace 2007). The ovary is inferior and 1-locular with two pendulous anatropous ovules of which only one develops into a seed. The fruit is glabrous or covered with scales and/or hairs and is mainly a 4-winged, or occasionally 5-winged (*C. mossambicense*, *C. oxystachyum*, *C. wattii*) indehiscent samara, except in *C. bracteosum* which has wingless fruit (nuts). In most cases winged fruit are wind-dispersed and the wingless fruit seem to be an adaptation to water dispersal (Exell & Stace 1972).

Despite extensive taxonomical and anatomical studies on *Combretum* in tropical and southern Africa by Engler & Diels (1899), Dümmer (1913), Stace (1961; 1965; 1969; 1980; 1981), Exell (1968; 1978), Verhoeven & Van der Schijff (1973), Wickens (1973), Van Wyk (1984), Carr (1988), Rodman (1990) and Tilney (2002), there are still taxonomic and nomenclatural problems remaining, as well as new taxa to be described. Some names are misapplied and the identity of some taxa in southern African herbaria is uncertain. Recent molecular

work (Maurin *et al.* 2010) has indicated that taxa boundaries need revising to reflect more accurately the phylogeny of *Combretum* and its allies. Maurin *et al.* (2010) deal mostly with the subgeneric, sectional and generic delimitation of *Combretum*, whereas the present paper deals with species delimitation, the status elevation of infraspecific taxa and lectotypification of some names.

MATERIALS AND METHOD

All material of *Combretum* in the National Herbarium, Pretoria (PRE) and H.G.W.J. Schweickerdt Herbarium, University of Pretoria (PRU) was examined. Two websites were consulted for type material: 1, www.aluka.org and 2, the Zürich Herbarium: www.zuercherherbarien.unizh.ch. Types seen electronically are cited as e! Where the holotype was destroyed in the Berlin Herbarium (B) during World War II, lectotypification is covered by Article 9.15 of the Code (McNeill *et al.* 2006) which provides for narrowing the lectotype to a single specimen. Acronyms of herbaria where types are housed follow Holmgren *et al.* (1990).

Sectional classifications of Engler & Diels (1899), Exell (1978) and Stace (1981) were assessed in view of the phylogenetic studies done by Maurin *et al.* (2010) and adjusted where necessary. Sections are arranged from ancestral to derived according to the mentioned molecular studies. *C. mkuzense* is treated as belonging to sect. *Spathulipetala*. Species are arranged alphabetically within each section. An index is provided at the end for easy access to species. The following species are widespread, well defined and well known or recently described and no voucher specimens are cited for them: *C. apiculatum* Sond. subsp. *apiculatum*, *C. erythrophyl- lum* (Burch.) Sond., *C. hereroense* Schinz, *C. imberbe*, *C. kraussii* Hochst., *C. molle* R.Br. ex G.Don, *C. vendae* A.E. van Wyk and *C. zeyheri* Sond. Geographical distributions mentioned in the keys refer primarily to the FSA region, namely Botswana, Lesotho, South Africa (RSA: Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and North-West), Namibia and Swaziland. Species occurring north of the FSA region are indicated by an arrow on the distribution maps. Full range distribution, including all countries and the relevant provinces of South Africa, is given alphabetically under each species.

TAXONOMY

Subgeneric classification

Combretum is divided into three subgenera, namely subgen. *Combretum*, subgen. *Cacoucia* (Aubl.) Exell & Stace and subgen. *Apetalanthum* Exell & Stace (Stace 1981). The last-named is represented by only one species, *C. apetalum* Wall. ex Kurz which is restricted to

Key to the southern African subgenera of *Combretum* as modified from Exell (1978)

- 1a Scales present though sometimes inconspicuous or hidden by hairs; microscopic stalked glands absent; flowers and fruit usually 4-merous; petals cream-coloured, white, yellow or greenish, usually not red, < 3.5 mm long subgen. *Combretum* (p. 137)
 1b Scales absent; microscopic stalked glands present; flowers and fruit 5-merous or if 4-merous then petals red; petals > 4 mm long subgen. *Cacoucia* (p. 152)

Asia. It has leaves with scales and stalked glands, petals are absent and it has 10 stamens in two whorls. The first two subgenera have scales or stalked glands, petals are present, although sometimes reduced, and they have eight stamens in one or two whorls. Subgenera are mainly based on the presence or absence of petals, presence or absence of scales on the leaves, presence or absence of stalked glands, the flowers being 4- or 5-merous, colour of the flowers and length of petals.

A. *Combretum* Loefl. subgen. *Combretum*

Scales present, although sometimes inconspicuous or hidden by combretaceous hairs; microscopic stalked glands absent; flowers usually 4-merous; petals usually not red; stamens usually 8, in 1 or 2 whorls; fruit usually 4-winged. The structure and arrangement of scales are of great taxonomic significance (Stace 1965). The southern African material is divided into ten sections (Engl. & Diels 1899; Wickens 1973; Exell 1978; Stace

1980, 1981; Rodman 1990) which fall into two groups. The sectional grouping is based on the size of the scales on the leaves and the resultant two groups are congruent with the two major groups recovered in phylogenetic analyses (Maurin *et al.* 2010). Each group is represented by five sections. The first five sections treated here belong to the group with small, inconspicuous scales, usually smaller than 100 μm , $\pm$ circular in outline or slightly scalloped in sect. *Ciliatipetala* and divided by few radial and tangential walls. Sometimes the tangential walls are absent as in sect. *Angustimarginata*, sect. *Glabripetala* and sometimes in sect. *Ciliatipetala*. (Figure 1). The last five sections have conspicuous scales, usually larger than 100 μm , scalloped or irregularly undulate in outline and the scales are divided by many radial and tangential walls (Figure 2). *C. imberbe* is placed in its own section, sect. *Plumbea* (Maurin *et al.* 2010). Note that although 100 μm is taken as the cut-off measurement to separate the two groups, intermediates do occur.

Key to sections of subgen. *Combretum* in FSA region

- 1a Scales inconspicuous, usually < 100 μm in diam.; scales divided by few radial and tangential walls (tangential walls sometimes absent); stamens 1-seriate (Group 1, p. 137) (Figure 1):
 - 2a Petal apex ciliate or pilose; petals small, 0.5–1.5 mm long (if apex not ciliate then petals < 1 mm long as in *C. petrophilum*); leaf apices often apiculate; fruit 15–30 mm long V. sect. *Ciliatipetala* (p. 143)
 - 2b Petal apex glabrous; petals 1.5–2.5 mm long; leaf apices not apiculate; fruit 15–50(–100) mm long:
 - 3a Fruit up to 22 mm long; often with hair-tuft domatia in axil of veins below (except in *C. erythrophyllum* and *C. vendae*):
 - 4a Spring leaves at least partly cream-coloured or with some leaves turning bright red in autumn; petals narrowly spatulate; disc margin pilose; style without expanded stigma; fruit sparsely to moderately hairy, not lepidote, mature fruit tinged pink to dark red (rare in *C. erythrophyllum*); stipe 4–8 mm long I. sect. *Angustimarginata* (p. 137)
 - 4b Spring leaves not cream-coloured and autumn leaves not reddish; petals broadly spatulate; disc glabrous with only a very short free margin; style sometimes with expanded stigma; fruit green, glabrous and glutinous, yellowish green, with reddish brown scales, giving it a satiny sheen, wings papery; stipe up to 10 mm long III. sect. *Macrostigmatea* (p. 142)
 - 3b Fruit 35–50(–100) mm and longer; hair-tuft domatia in axil of veins below absent:
 - 5a Leaves large, 100–200 mm long; style without swollen apex; fruit up to 35 mm long; glutinous when young, glabrous, yellowish green tinged reddish brown; stipe up to 7 mm long IV. sect. *Glabripetala* (p. 143)
 - 5b Leaves medium-sized, 30–100 mm long; style with swollen apex; fruit up to 50(–100) mm long, pale green, glutinous only on body, sparsely hairy or glabrous, drying pale brown, straw-coloured or limegreen; stipe 10–30 mm long II. sect. *Spathulipetala* (p. 141)
- 1b Scales conspicuous and large, usually > 100 μm in diam. (84–160 μm in sect. *Breviramea*); scales divided by many radial and tangential walls; stamens 1- or 2-seriate (Group 2, p. 147) (Figure 2):
 - 6a Trees; petals subcircular; fruit dark brown or reddish grey to dark purple, glabrous to densely hairy, metallic in appearance, often acute at apex; disc with free pilose margin; cotyledons arising below soil level on a stalk formed by connate petioles VII. sect. *Metallicum* (p. 149)
 - 6b Trees, shrubs, scrambling shrubs or woody climbers; petals linear-elliptic, obovate to spatulate; fruit densely rufous, golden or silvery lepidote, otherwise glabrous; disc without free margin; cotyledons arising above or below soil level:
 - 7a Inflorescences usually terminal panicles of spikes or branched spikes; upper hypanthium little developed, flattened; stamens 1-seriate, inserted at margin of disc; fruit usually < 20 mm long; stipe 1–3 mm long; cotyledons arising above or below soil level; scales contiguous or not:
 - 8a Scrambling shrubs or woody climbers, usually multi-stemmed, not with spine-tipped short branches; disc glabrous or pilose at least on margin; style without stalked scales; fruit not densely silvery lepidote; stipes < 2 mm long; cotyledons arising above soil level; scales conspicuous but not contiguous or overlapping VI. sect. *Hypocrateropsis* (p. 147)
 - 8b Erect trees up to 15 m, occasionally up to 30 m tall, single-stemmed, with short lateral branches often spine-tipped; disc margin densely tomentose; style with stalked scales; fruit densely silvery lepidote; stipe 2–3 mm long; cotyledons arising below soil level; scales conspicuous, contiguous and/or overlapping X. sect. *Plumbea* (p. 152)
 - 7b Inflorescences usually axillary unbranched spikes; upper hypanthium well developed, campanulate or cup-shaped, not flattened; stamens 2-seriate; fruit 20–35 mm long; stipe up to 11(–15) mm long; cotyledons arising above soil level; scales contiguous or overlapping:
 - 9a Leaves with only 3 or 4(5) pairs of primary lateral veins; reticulate venation conspicuous below; hair-tuft domatia absent in axils of veins below; leaf margin flat, usually ciliate; flowers long hairy, not conspicuously lepidote; disc with free pilose margin; fruit densely reddish or golden lepidote VIII. sect. *Breviramea* (p. 151)
 - 9b Leaves with 9–13 pairs of primary lateral veins; only midrib and primary lateral veins conspicuous and prominently raised below; hair-tuft domatia in axil of veins below; leaf margin often undulate, glabrous; flowers not hairy but densely and conspicuously lepidote; disc without free margin; fruit silvery lepidote IX. sect. *Campestria* (p. 151)

GROUP 1

Species with small scales, usually smaller than 100 μm , divided by few radial and tangential walls or tangential walls sometimes absent (Figure 1).

I. *Combretum* sect. *Angustimarginata* Engl. & Diels (1899)

This section is a natural taxon of six closely related species restricted to Zimbabwe, Mozambique, Botswana,

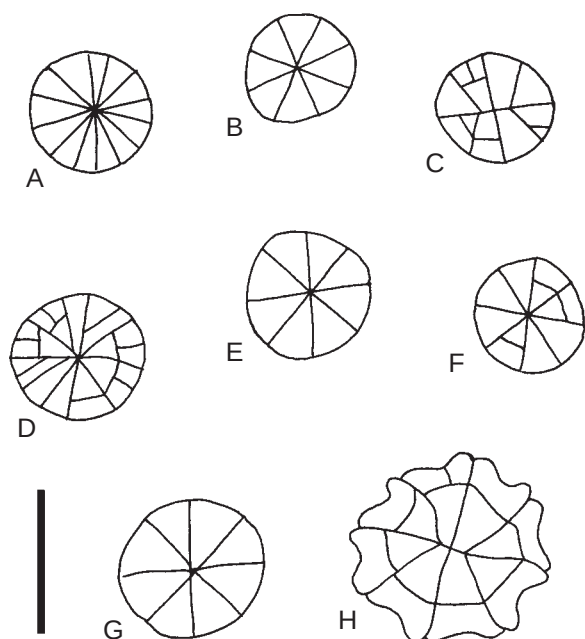


FIGURE 1.—Scales of *Combretum* subgen. *Combretum*. Group 1. Sections I–V, showing smaller size, $\pm$ circular in outline and divided by few radial and tangential walls, and sometimes tangential walls absent as in sect. *Angustimarginata*, sect. *Glabripetala* and sometimes in sect. *Ciliatipetala*. A, *C. erythrophyllum* (sect. *Angustimarginata*); B, *C. zeyheri* (sect. *Spathulipetala*); C, *C. engleri* (sect. *Macrostigmata*); D, *C. adenogonium* (sect. *Glabripetala*); E, *C. apiculatum* (sect. *Ciliatipetala*); F, *C. albopunctatum* (sect. *Ciliatipetala*); G, *C. molle* (sect. *Ciliatipetala*); H, *C. molle*. Taken from Stace (1969) and Exell (1978). Scale bar: 80 μ m. Artist: Daleen Roodt.

South Africa and Swaziland. It is characterized by their 4-merous flowers; upper hypanthium cupuliform to campanulate; petals subcircular, obovate, spathulate or narrowly elliptic, glabrous, margins not ciliate; stamens 8, 1-seriate, inserted shortly above margin of disc; disc glabrous with a pilose margin very shortly free for up to 0.5 mm; style not expanded; fruit 4-winged; scales inconspicuous, often obscured by hairs and/or glutinous secretions, $\pm$ 50–75 μ m in diam., weakly scalloped, delimited by 8–16 primary radial walls alone; cell walls very thin (Exell 1970, 1978).

Other diagnostic characters based on field observations are: the bark is $\pm$ smooth or flaking in small, rather papery pieces in older specimens; the first spring leaves are often partly or completely cream-coloured or at least some leaves turning red in autumn; the flowers have calyx lobes tinged reddish purple; the mature fruits are usually partly or completely tinged pink to dark red (Van Wyk 1984). The secondary xylem of older stems has islands of interxylary phloem (Verhoeven & Van der Schijff 1973).

Engler & Diels (1899) and Exell (1978) included *C. woodii* Dümmer under *C. kraussii* Hochst. Rodman (1990) considers *C. woodii* to be conspecific with *C. erythrophyllum*. Burt Davy (1926), Van Wyk (1984), Carr (1988) and Jordaan (2003, 2006) consider *C. woodii* to be a distinct species. There are ample DNA and morphological differences to separate *C. woodii* from *C. kraussii* and *C. erythrophyllum* (Maurin *et al.* 2010). See Carr (1988) for differences between these three species. Exell (1970, 1978) included *C. nelsonii* and *C. woodii* in the synonymy of *C. kraussii*. Chemosystematic studies conducted by Carr & Rogers (1987) support the recognition of *C. nelsonii* Dümmer, *C. kraussii* and *C. woodii* as three distinct species. *C. caffrum* (Eckl. & Zeyh.) Kuntze and *C. vendae* also belong to this section. A form of *Combretum vendae* with glabrous leaves occurs in the western Soutpansberg and represents a new subspecies to be described elsewhere.

Key to species of *Combretum* sect. *Angustimarginata* based on Van Wyk (1984)

- 1a Leaves glabrous below when mature, often with hair-tuft domatia:
- 2a Flowers in laxly elongated spikes (25–)35–60(–85) mm long:
- 3a Leaf lamina with secondary lateral veins raised but inter-secondary veins $\pm$ plane below; scales with 8–10 radial cells; trees; forest; widespread 3. *C. kraussii*
- 3b Leaf lamina with both secondary and intersecondary veins conspicuously raised below; scales with 10–16 radial cells; trees, shrubs or climbers; forest and savanna; Limpopo Province, Mpumalanga, KwaZulu-Natal and Swaziland 6. *C. woodii*

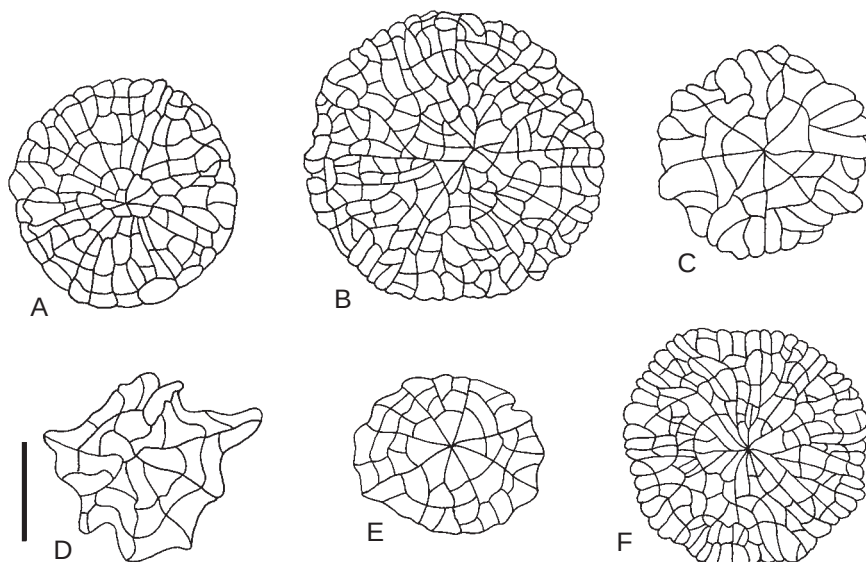


FIGURE 2.—Scales of *Combretum* subgen. *Combretum*. Group 2. Sections VI–X, showing larger size, $\pm$ scalloped in outline and divided by many radial and tangential walls. A, *C. patelliforme* (sect. *Hypocrateropsis*); B, *C. celastroides* (sect. *Hypocrateropsis*); C, *C. collinum* (sect. *Metallium*); D, *C. hereroense* (sect. *Breviramea*); E, *C. elaeagnoides* (sect. *Campestris*); F, *C. imberbe* (sect. *Plumbea*). Scale bar: 80 μ m. Artist: Daleen Roodt.

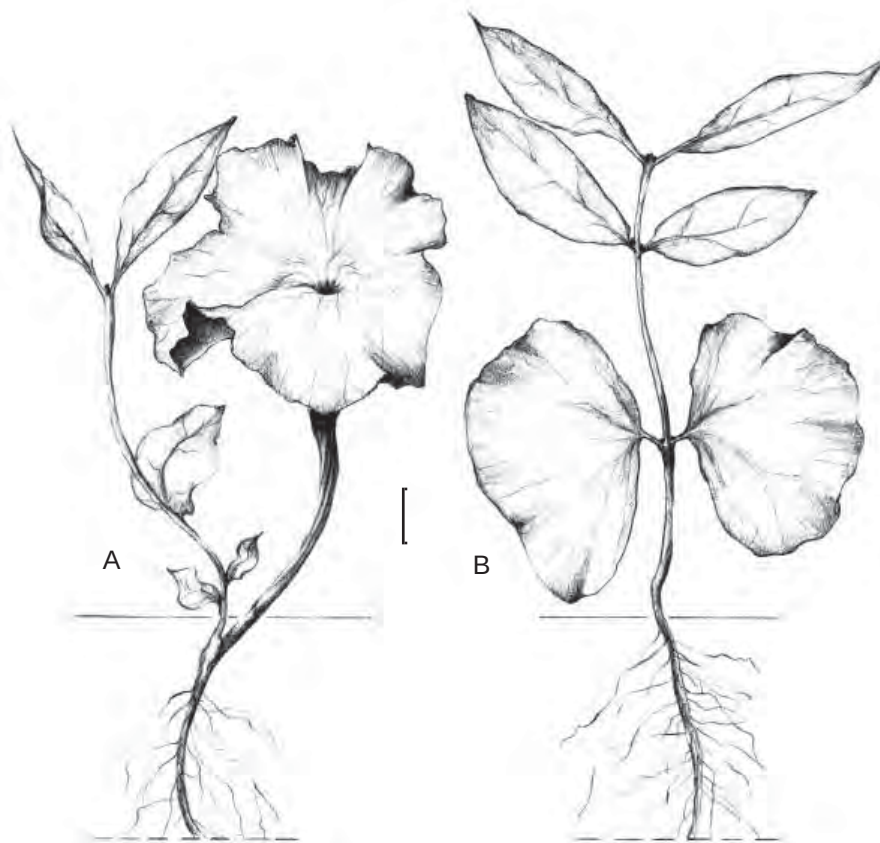


FIGURE 3.—Seedling morphology of *Combretum zeyheri* (A) and *C. mkuzense* (B). Solid transverse lines depict ground level. In *C. zeyheri* cotyledons fused to form a subcircular peltate structure which terminates primary stem. Growth in length is resumed by a lateral bud from a point below fused cotyledons (sympodial growth). In *C. mkuzense* growth in length of stem commences from what seems to be the primary growing tip located between two opposite cotyledons (monopodial growth). Scale bar: 10 mm Artist: Daleen Roodt.

- 2b Flowers in congested subcapitate spikes (10–)15–20(–35) mm long:
- 4a Usually shrubs; leaves elliptic, obovate-elliptic or obovate; flowers with upper hypanthium divided into a lower $\pm$ campanulate part containing the disc, and an expanded $\pm$ cupuliform upper part; Limpopo Province and Mpumalanga 4. *C. nelsonii*
- 4b Usually trees; leaves narrowly elliptic or lanceolate; flowers with upper hypanthium $\pm$ cupuliform, not divided into a lower and upper part; Eastern Cape 1. *C. caffrum*
- 1b Leaves distinctly hairy below when mature, at least on midrib and lateral veins:
- 5a Reticulate venation of leaf lamina conspicuously raised below; Venda (Limpopo Province) 5. *C. vendae*
- 5b Reticulate venation of leaf lamina plane or slightly raised below; widespread along watercourses 2. *C. erythrophyllum*

1. ***Combretum caffrum* (Eckl. & Zeyh.) Kuntze**, Revisio generum plantarum 3,2: 87 (1898); J.D.Carr: 40 (1988); M.Coates Palgrave: 797 (2002). Type: South Africa, Eastern Cape, ‘ad ripas fluminum Kat et Visch-rivier (Albany), Zondagsrivier (Uitenhage), Keys-kamma et Keyrivier (Caffraria)’, *Ecklon & Zeyher* 421 [SAM0036373-2, lecto. e!, designated here; FR e!, HBG e!, K e!, M e!, W e!, isolecto.].

Dodonaea caffra Eckl. & Zeyh.: 55 (1834–1835).

D. conglomerata Eckl. & Zeyh.: 55 (1834–1835). Type: South Africa, Eastern Cape, ‘Inter frutices fluvii Katrivier prope Fort Beaufort Caffraria terminis’, *Ecklon & Zeyher* 422 [SAM0036375-2 e!, lecto., designated here; K e!, M e!, isolecto.].

C. salicifolium E.Mey. ex Hook.: t. 592 (1843); Sond.: 511 (1862); Dümmer: 182 (1913). Type: South Africa, Eastern Cape, ‘Sundays River’, *Burke* 592 (K, holo. e!; BM, iso. e!).

C. dregeanum C.Presl: 73 (1844). Type: South Africa, Eastern Cape, Klein Winterhoek between Zoutpansnek and Enon, *Drège* 6849a (?PR, holo.; BM e!, HBG e!, K e!, MO e!, SAM e!, W e!, iso.).

Note: *Ecklon & Zeyher* 421, 422, both at SAM, are chosen as lectotypes for *Combretum caffrum* (= *Dodonaea caffra*), and *D. conglomerata* respectively, because they have the protologues and annotations attached to the specimens.

Distribution: RSA: Eastern Cape (Figure 4).

2. ***Combretum erythrophyllum* (Burch.) Sond.** in *Linnaea* 23: 43 (1850); Sond.: 509 (1862); Engl. & Diels: 26 (1899); Dümmer: 140 (1913); Bews: 146 (1921); Exell & Roessler: 8 (1966); Exell: 7 (1968); Exell: 112 (1978); J.D.Carr: 69 (1988); Pooley: 356 (1993); A.E.van Wyk & P.van Wyk: 330 (1997); McClelland: 460 (2002); M.Coates Palgrave: 802 (2002). Type: South Africa, Northern Cape, ‘on the banks of the Ky-gariep’ (Griqualand West, Kalahari region, Herbert Div., right bank of the Vaal River at Blaauwbosch Drift), *Burchell* 1749 (K, holo. e!; PRE, iso.!).

Terminalia erythrophylla Burch.: 400 (1822).

C. glomeruliflorum Sond.: 47 (1850); Sond.: 509 (1862); Engl. & Diels: 26 (1899); Burt Davy: 247 (1926); Codd: 130 (1951). Type: South Africa, Natal [KwaZulu-Natal], Port Natal [Durban], *Gueinzius* 62 (?S, holo.; HBG e!, K e!, P e!, W e!, iso.).

C. riparium Sond.: 47 (1850); Sond.: 511 (1862). *C. glomeruliflorum* Sond. var. *riparium* (Sond.) Burt Davy: 247 (1926); O.B.Mill.: 42 (1948). Type: South Africa, [?Gauteng], ‘On Magalisriver’, *Zeyher* 549 (S, holo. e!; BM, K e!, SAM, iso.).

C. sonderi Gerrard ex Sond.: 511 (1862). Type: South Africa, Natal [KwaZulu-Natal], ‘On the Nototi River, near Port Natal’, *Gerrard* 138 (?TCD, holo.).

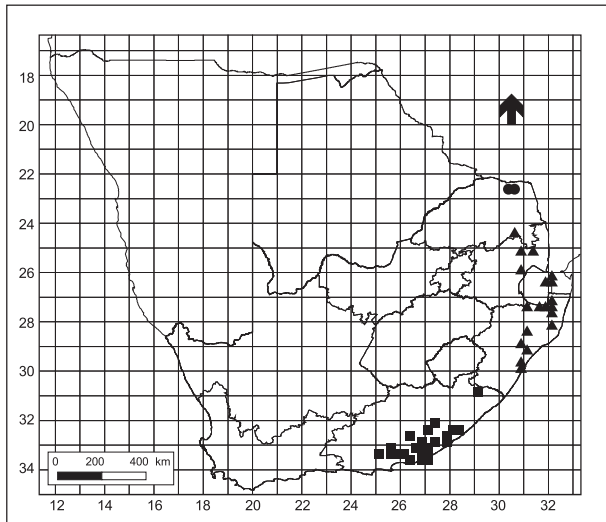


FIGURE 4.—Known distribution in FSA region of *Combretum vendae*, ●; *C. woodii*, ▲; and *C. caffrum*, ■.

C. erythrophyllum (Burch.) Sond. var. *obscurum* Van Heurck & Müll.Arg.: 237 (1871); Dümmer: 147 (1913). *C. glomeruliflorum* Sond. var. *obscurum* (Van Heurck & Müll.Arg.) Burt Davy: 37, 247 (1926). Type: South Africa, 'Africa australis, woods on Crocodile River', Zeyher 550 (K, holo. e!; P, iso. e!).

C. lydenburgianum Engl. & Diels: 26 (1899); Eyles: 428 (1916). Type: South Africa, [Mpumalanga], near waterfall in town of Lydenburg, Wilms 212 (B, holo.†; K, lecto. e!, designated here; BM, E e!, isolecto.).

Note: Wilms 212, the holotype of *Combretum lydenburgianum*, was destroyed in Berlin during World War II and the Kew specimen is chosen as lectotype, which is the best specimen of the isotypes that are available.

Distribution: Botswana, Mozambique; RSA: Eastern Cape, Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, Northern Cape, North-West; Swaziland, Zambia, Zimbabwe (Figure 5).

3. *Combretum kraussii* Hochst. in Flora 27: 424 (1844); Sond.: 510 (1862); Dümmer: 164 (1913); Bews:

147 (1921); Burt Davy: 246 (1926); Exell: 7 (1968); Exell: 114 (1978); J.D.Carr: 89 (1988); Pooley: 358 (1993); A.E.van Wyk & P.van Wyk: 332 (1997); McClelland: 462 (2002); M.Coates Palgrave: 804 (2002). Type: South Africa, Natal [KwaZulu-Natal], Port Natal [Durban], 'in sylvis primitivis circa Umlaas River', Oct. 1839, Krauss 253 [B, holo.†; K00022665, lecto. e!, designated here; BM e!, M e!, MO e!, OXF, TCD e!, W e!, Z e!, isolecto.].

C. lucidum E.Mey. ex Drège: 174 (1843); Dümmer: 164 (1913). Type: South Africa, [KwaZulu-Natal], between Umkomanzi and Umzimkulu Rivers, Drège s.n. (HBG, holo. e!; K, iso. e!).

Note: the holotype of *Combretum kraussii* at Berlin was destroyed in World War II and from all the extant isotypes, the fruiting specimen at Kew was chosen, because it shows the leaf characters the best, namely totally glabrous, obovate with a rounded to emarginate apex, with very conspicuous reticulate venation below, margin flat, not wavy and longitudinally folded upwards along the midrib as in *C. woodii*, and the apices not acute to acuminate as in *C. erythrophyllum*, its two closest allies; most of the other isotypes are just fragments, except the BM specimen which is flowering.

Distribution: Mozambique; RSA: Eastern Cape, KwaZulu-Natal, Limpopo Province, Mpumalanga; Swaziland (Figure 6).

4. *Combretum nelsonii* Dümmer in The Gardeners' Chronicle, ser. 3: 164 (1913); Burt Davy: 246 (1926); A.E.van Wyk: 132 (1984); A.E.van Wyk & P.van Wyk: 334 (1997); McClelland: 466 (2002); M.Coates Palgrave: 807 (2002). Type: South Africa, [Limpopo Province], mountain gorge, near Groot Vley, Pienaars River, Nelson 91 (K, holo. e!; PRE, iso.!).

Distribution: RSA: Limpopo Province, Mpumalanga (Figure 6).

5. *Combretum vendae* A.E.van Wyk in South African Journal of Botany 3: 125 (1984); J.D.Carr: 140 (1988); M.Coates Palgrave: 811 (2002). Type: South Africa, [Limpopo Province], Vuvha NE of Thengwe,

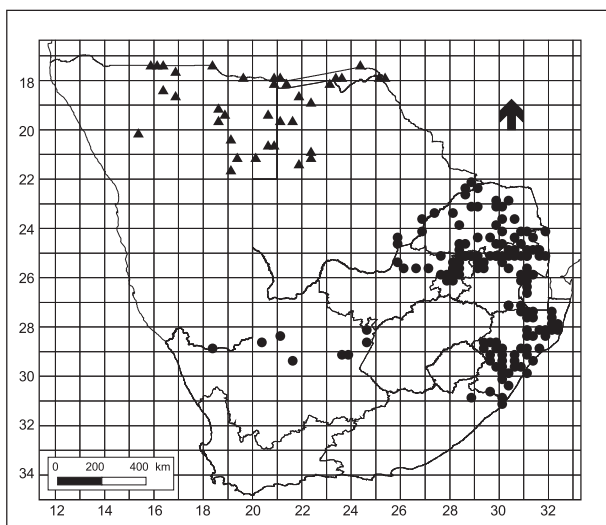


FIGURE 5.—Known distribution in FSA region of *Combretum erythrophyllum*, ●; and *C. engleri*, ▲.

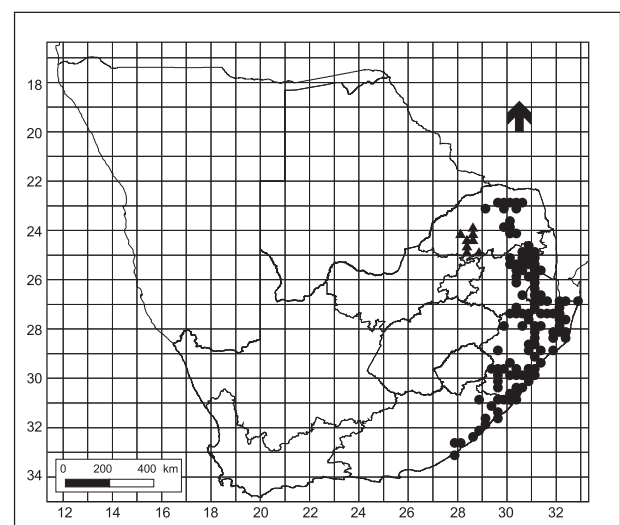


FIGURE 6.—Known distribution in FSA region of *Combretum kraussii*, ●; and *C. nelsonii*, ▲.

near Muledzhi Village, Van Wyk 3913 (PRU, holo.!, K e!, P e!, PRE!, iso.).

Distribution: RSA: Limpopo Province (Figure 4).

6. ***Combretum woodii* Dümmer** in The Gardeners' Chronicle, ser. 3: 181 (1913); Burt Davy: 245 (1926); Compton: 395 (1976); J.D.Carr: 147 (1988); Pooley: 358 (1993); McClelland: 468 (2002); M.Coates Palgrave: 812 (2002). Type: South Africa, [Mpumalanga], Barberton Dist., Kaap River Valley, Galpin 1176 (K, lecto. e!, designated here; NH e!, PRE!, SAM e!, isolecto.).

Note: Dümmer (1913) mentioned two specimens in his protologue, Wood 522 and Galpin 1176. The latter syntype in Kew where Dümmer worked for a few years is chosen, because it comprises flowers and fruit, and duplicates are housed in many other herbaria. This specimen (lectotype here chosen) shows the distinguishing characters which separate *Combretum woodii* from *C. kraussii*: leaves membranous, widest in the middle, folded along the midrib, and narrower elliptic fruit which are totally glabrous. The syntype Wood 522 in BM was not examined and is not available on the Aluka website, but a duplicate exists in the Zürich Herbarium, which does not show the leaves folding along the midrib as clearly as the Galpin specimens.

Distribution: probably Mozambique; RSA: KwaZulu-Natal, Limpopo Province, Mpumalanga; Swaziland (Figure 4).

II. *Combretum* sect. *Spathulipetala* Engl. & Diels (1899)

This section is characterized by leaves with hairy petioles, usually hair-tuft domatia in axils of veins below; 4-merous flowers; petals obovate-spathulate to spatulate, glabrous; stamens 8, 1-seriate, inserted at margin of disc; disc with pilose margin free for up to 2 mm; style with swollen apex; fruit 4-winged, large in genus, usually up to 50 × 50 mm and occasionally up to 100 × 80 mm, with rigid wings; stipe up to 20–25 mm long; scales ± 40–85 µm in diam., circular but slightly convexly scalloped; cells delimited by 7–9 radial walls and additional few tangential and extra radial walls; marginal cells 7–12 (Exell 1978).

Members of this section show two distinct types of germination (Figure 3) suggesting that the group is probably not a natural one. Four main types of germination are known in *Combretum*, the taxonomic significance of which is not clear (Exell & Stace 1972). *C. zeyheri* is unusual in also having the cotyledon blades fused into a subcircular peltate structure. According to Exell & Stace (1972) the fruit are adapted for blowing along by wind at ground level.

Although provisional molecular data have indicated that a re-evaluation of the taxonomic concepts of sections *Spathulipetala* and *Macrostigmatea* are needed (Maurin *et al.* 2010), formal taxonomic adjustment must await further phylogenetic analyses based on more taxa and more gene sequences. This should also take into account the data derived from all other fields, including micro- and macromorphology, vegetative and reproductive characters, phytogeography and chemis-

try. Only a combination of such evidence will provide a clear picture of the true phylogeny and evolution of the group. Traditionally *Combretum zeyheri* has been the only member of this section. Tentatively *Combretum mkuzense* is placed in this section. Hennessy & Rodman (1995) reduced *C. mkuzense* to synonymy under *C. zeyheri*. The latter is a single-stemmed tree, whereas *C. mkuzense* is a scrambling shrub. *C. mkuzense* and *C. zeyheri* also have markedly different seedlings (Figure 3). There is abundant morphological and molecular (Maurin *et al.* 2010) evidence that *C. mkuzense*, *C. zeyheri* and a third undescribed species from the northern Kruger National Park (as *C. mkuzense* in McClelland 2002: 464) with much smaller fruit, are separate entities.

Key to species

- 1a Usually single-stemmed tree with branches not trailing; leaf lamina (45–)70–120(–200) × 30–50(–110) mm; lateral veins in (5–)7–12 pairs 8. *C. zeyheri*
- 1b Usually multi-stemmed shrub or tree with branches with tendency to trail; leaf lamina (25–)45(–80) × (10–)20(–30) mm; lateral veins in up to 5 pairs:
 - 2a Fruit 50–70 mm long; KwaZulu-Natal 7. *C. mkuzense*
 - 2b Fruit smaller, 38–55 × 35–60 mm; Limpopo Province *Combretum* sp. nov.

7. ***Combretum mkuzense* J.D.Carr & Retief** in Bothalia 19: 38 (1989); Pooley: 360 (1993); McClelland: 458 (2002); M.Coates Palgrave: 805 (2002). Type: South Africa, [KwaZulu-Natal], Mkuze Game Reserve headquarters, Carr 187 (PRE, holo.!, K, iso. e!).

Distribution: RSA: KwaZulu-Natal (Figure 7).

8. ***Combretum zeyheri* Sond.** in Linnaea 23: 46 (1850); Sond.: 511 (1862); Engl. & Diels: 59 (1899); Dümmer: 116 (1913); Burt Davy: 248 (1926); O.B.Mill.: 44 (1948); Codd: t. 1230 (1956); Exell & Roessler: 11 (1966); Exell: 8 (1968); Liben: 72 (1968); Exell & J.G.Garcia: 66 (1970); Wickens: 31 (1973); Exell: 122 (1978); Vollesen: 54 (1980); J.D.Carr: 151 (1988); Pooley: 360 (1993); A.E.van Wyk & P.van Wyk: 338 (1997); McClelland: 470 (2002); M.Coates Palgrave: 812 (2002); Curtis & Mannheimer: 488 (2005). Type: South Africa, 'Africa australis, in

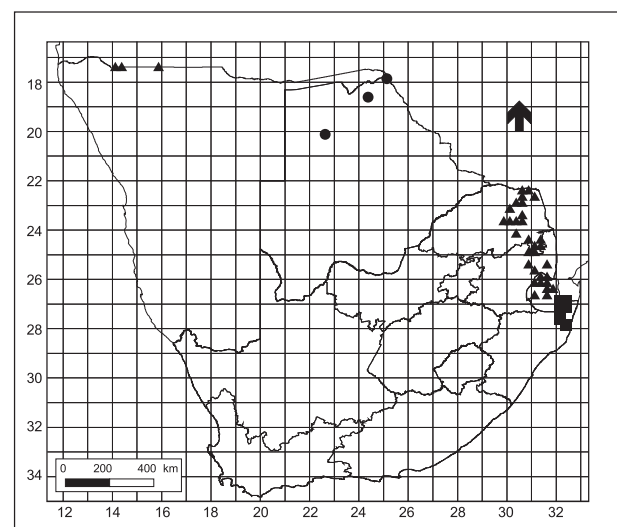


FIGURE 7.—Known distribution in FSA region of *Combretum adenogonium*, ●; *C. collinum* subsp. *suluense* (provisional; requires confirmation), ▲; and *C. mkuzense*, ■.

silvis montis Magalisberg', Zeyher 552 (S, holo. e!; BM, K e!, MEL, P e!, SAM e!, TCD, W e!, Z e!, iso.).

C. tinctorum Welw. ex M.A.Lawson: 430 (1871); Engl. & Diels: 30 (1899). Type: Angola, Cuanza Norte, Cacuso, Pedras de Guinga, Welwitsch 4373 (LISU, holo. e!; BM e!, COI, K e!, P e!, iso.).

C. oblongum F.Hoffm.: 34 (1889). Type: [Tanzania], Tabora Dist., Kakoma, Boehm 87a (B, holo.†; K, fragment e!).

C. antunesii Engl. & Diels: 58 (1899). Type: Angola, Lubango, Huila, Antunes 17 (COI, holo.).

C. odontopetalum Engl. & Diels: 60 (1899); De Wild.: 139 (1921). Type: [Namibia], 'Amboland, Omupanda, Unkuanyama', Wulffhorst 14 (Z, lecto. e!, designated here; K, isolecto. e!).

C. lopolense Engl. & Diels: 502 (1907); De Wild.: 138 (1921). Type: Angola, Benguella-Lopol., Dekindt 48 (B, holo.†; BM e!, K e!, iso.).

C. calocarpum Gilg ex Dinter: 169 (1919); Suess.: 336 (1953). Type: [Namibia], 'Hereroland', Neitsas, Dinter 795 (SAM, lecto. e!, designated here; BM, E e!, isolecto.).

Note: both syntypes of *Combretum odontopetalum*, Schinz 1050 and Wulffhorst 14, are housed in the Zürich Herbarium, but only the Wulffhorst specimen has a duplicate in another herbarium, namely in Kew, and is therefore chosen as the lectotype.

Dinter (1919) mentioned syntypes in his protologue of *Combretum calocarpum*: Dinter s.n., Dinter 795 and Dinter 2877. The large fruit, the most distinctive character of this species in Namibia, is best seen in the Dinter 795 specimen in SAM; it is here chosen as the lectotype.

Distribution: Angola, Botswana, Democratic Republic of the Congo (DRC), Kenya, Malawi, Mozambique, Namibia; RSA: Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West; Swaziland, Tanzania, Zambia, Zimbabwe (Figure 8).

III. *Combretum* sect. *Macrostigmatea* Engl. & Diels: 24 (1899); Stace: 158 (1969); Exell: 176 (1970); Wickens: 21 (1973); Exell: 115 (1978); Stace: 336 (1981).

Species in this section have yellow, 4-merous, glutinous flowers arranged in subcapitate spikes. The nectariferous disc is glabrous with only a very short free margin in *Combretum schumannii* Engl. and *C. engleri* Schinz. *C. kirkii* M.A.Lawson (Malawi, Mozambique, Zambia, Zimbabwe) and *C. gillettianum* Liben (DRC, Tanzania, Zambia) also belong to this section. Whether sections *Macrostigmatea* and *Spathulipetala* should be united, as suggested by provisional molecular analyses, must await further study (see under sect. *Spathulipetala* above).

Dinter (1919) published the name *Combretum parvifolium*, but the epithet was antedated by *C. parvifolium* Engl. (1895). Schinz's 'engleri' is, however, the earliest. Exell (1970) keeps *C. engleri* and *C. schumannii* as two separate species, but Wickens (1973) and Exell (1978) consider *C. engleri* to be conspecific with *C. schumannii* on the basis that the flowers of both entities have a glabrous nectariferous disc with a short free margin and the fruit are glabrous except for peltate scales. However, Carr (1988) maintains these two entities as separate species as they differ in habit and geographical distribution.

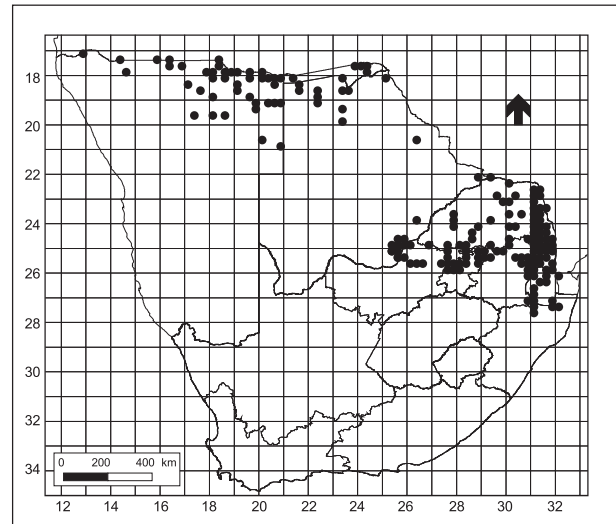


FIGURE 8.—Known distribution in FSA region of *Combretum zeyheri*.

He also points out that *C. schumannii* has been successfully propagated from seed in cultivation, whereas all attempts to germinate seed of *C. engleri* have failed. Based on flower and scale morphology, Hennessy & Rodman (1995) also concluded that *C. engleri* and *C. schumannii* are separate species. Engler (1895) based *C. schumannii* on a Holst specimen collected in Lushoto District, Tanzania. *C. engleri* is a multi-stemmed shrub up to 4 m tall, growing in mixed woodland and savanna, often semi-arid and on Kalahari sands in Angola, Zambia, Namibia, Botswana and western Zimbabwe (Wankie District). After viewing the type on the Aluka Digital Library, it is clear that *C. schumannii* does not occur in the FSA region and it is therefore a misapplied name in this region. Specimens from Namibia and Botswana previously named *C. schumannii* are all *C. engleri*. Carr (1988) mentions that *C. schumannii* is a tree up to 18 m tall with flaky bark, occurring in coastal and inland forest in Kenya, Tanzania, Malawi and northern Mozambique. There are enough morphological distinctions between these two species to keep them separate (Carr 1988; Hennessy & Rodman 1995).

9. *Combretum engleri* Schinz in Bulletin de l'Herbier Boissier sér. 2,1: 878 (1901); Stace: 14 (1961); Exell & Roessler: 8 (1966); Exell: 7 (1968); Exell: 176 (1970); Exell & J.G.Garcia: 55 (1970); J.D.Carr: 66 (1988); M.Coates Palgrave: 801 (2002); Curtis & Mannheimer: 476 (2005). Type: [Namibia], Ombalambuenge, Apr. 1896, Rautanen 236 (Z, holo. e!).

C. parvifolium Dinter: 170 (1919), nom. illegit.

C. myrtillifolium Engl.: 695 (1921). Type: [Namibia], Naruchas, Dünen, Dinter 7278 (PRE, lecto.!, designated here; BOL, K e!, isolecto.) & [Namibia], Neitsas, Dinter 668 (BM, fragment, e!, SAM, paralecto. e!).

C. chlorocarpum Exell: 167 (1928). Type: Angola, Oct. 1906, Gossweiler 3241 (BM, holo. e!; COI, LISJC, iso.).

Note: Dinter (1919) mentioned two specimens in his protologue of *Combretum parvifolium*, Dinter 668 and 7278, collected in Namibia. This name is a later homonym and therefore illegitimate and Engler (1921) chose the new name *C. myrtillifolium*. The PRE specimen of Dinter

7278, which must be an isosyntype, is chosen as lectotype for *C. myrtillifolium* because it has flowers and fruit.

Distribution: Angola, Botswana, DRC, Namibia, Zambia (Figure 5).

IV. *Combretum* sect. *Glabripetala* Engl. & Diels (1899)

While working on the *Flora of Ethiopia*, Vollesen (1986) realized that *Combretum adenogonium* is an earlier name for *C. fragrans* F.Hoffm. Wickens (1973) considers *C. adenogonium* (= *C. fragrans*) as occurring from Ethiopia in the north through Uganda, Kenya, Tanzania, Malawi, Zimbabwe, Mozambique, Zambia, Malawi, southwards to Zimbabwe and Botswana and westwards to Burkina Faso, Benin, Nigeria and the Congo. It is characterized by relatively large leaves, up to 180 × 90 mm, and glutinous leaves and fruit. The presence of this taxon in the FSA region is indicated by two old specimens in PRE, both dated pre-1950 and collected in Botswana. It needs to be re-collected to confirm the existence of this species in the FSA region.

10. *Combretum adenogonium* Steud. ex A.Rich., Tentamen florae abyssinicae 1: 266 (1848); F.W.Andrews: 204 (1950); Vollesen: 962 (1986); Wickens: 29 (1973); Vollesen: 117 (1995); A.E.van Wyk & P.van Wyk: 326 (1997); M.Coates Palgrave: 795 (2002). Type: Ethiopia, Sabra, May 1840, *Schimper 1289* (P, holo. e!; BR e!, K e!, MO e!, W e!, Z e!, iso.).

C. fragrans F.Hoffm.: 31 (1889); Engl.: 289 (1895); Wickens: 29 (1973); Exell: 183 (1970); Exell: 120 (1978); Liben: 18 (1983). Type: [Tanzania], Pa-Kabombue, Oct. 1881, *Böhm 16a* (B, syn.†; Z, lecto. e!, designated here; K, islecto. e!).

C. ghasalense Engl. & Diels: 47 (1899); F.W.Andrews: 206 (1950); Exell: 8 (1968); Liben: 75 (1968). Type: Sudan, Bahr el Ghazal, Sabbi [Ssabi], 1869, *Schweinfurth 2730* (B, syn.†; P, lecto. e!, designated here; K, islecto. e!).

C. multispicatum Engl. & Diels: 47 (1899). Type: Sudan, 'Im Lande der Bongo', Sabbi, Nov. 1864, *Schweinfurth 2662* (B, syn.†; P, lecto. e!, designated here; K e!, PRE!, WU e!, islecto.).

C. undulatum Engl. & Diels: 48 (1899). Type: Sudan, Ngama, im Lande der Mittu, 1869, *Schweinfurth 2815* (B, syn.†; P, lecto. e!, designated here; K e!, PRE!, WU e!, islecto.).

C. ternifolium Engl. & Diels: 49 (1899); O.B.Mill.: 43 (1948). Type: [Tanzania], Morogoro Dist., Mgeta, *Stuhlmann 9272* (B, holo.†; K, fragment, lecto. e!, designated here; ?BM, islecto.).

Notes: Hoffmann (1889) mentioned two syntypes in his protologue of *Combretum fragrans*: *Böhm 16a* and *Böhm 32a*. Both were destroyed in World War II, but fortunately duplicates survived in Zürich (Z) and Kew (K). *Böhm 16a* in Z, which shows the large ternate leaves the best, is chosen as the lectotype. Duplicates of the syntype, *Böhm 16a*, are not available on the Aluka Library, whereas only a fragment of the other syntype, *Böhm 32a*, survived in Kew.

Engler & Diels (1899) described *Combretum ghasalense*, *C. multispicatum* and *C. undulatum*: all these three names are based on types collected in the Sudan, and *C. ternifolium* is based on a specimen collected in Tanzania. The holo- and syntypes, all at Berlin, were destroyed and lectotypes are selected from material in Paris (P) and Kew (K).

Distribution: Benin, Botswana, Burkina Faso, Central African Republic, Cameroon, Cote d'Ivoire, DRC, Ethiopia, Ghana, Guinea-Bissau, Kenya, Malawi, Mozambique, Nigeria, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe (Figure 7).

V. *Combretum* sect. *Ciliatipetala* Engl. & Diels (1899)

This section comprises about 60 species and is the largest in the genus. Although the species are morphologically diverse they do seem to form a natural group. All members of this section have small petals which are ciliate or pilose at the apex, except in *Combretum petrophilum*, and the disc has a short, free, pilose margin. The scales are relatively small, 40–130 µm in diam., ± circular, scalloped at the margin with radial and tangential walls. Stace (1969) separates this section into two large aggregates centred on *C. apiculatum* and *C. molle*, but these two groups are not supported as natural entities by molecular evidence (Maurin *et al.* 2010). Leaves in the section vary from very glabrous, glutinous and always with apiculate apices in *C. apiculatum* subsp. *apiculatum* and *C. petrophilum*, with hairs only on the margin and main vein and with acute to rounded apices in *C. edwardsii* Exell, to very hairy leaves in *C. albopunctatum* Suess., *C. apiculatum* subsp. *leutweinii* (Schinz) Exell (apiculate apices), *C. moggii* Exell, *C. molle* and *C. psidioides*. Apices of leaves in *C. molle* are usually round, emarginate to abruptly acuminate with a long acumen or mucron, but are occasionally apiculate.

Combretum apiculatum subsp. *apiculatum* is widespread in Angola, Namibia, Botswana, the northern parts of South Africa, Zimbabwe, Zambia, Malawi and Mozambique and grows in savanna woodland, often on Kalahari sands, whereas subsp. *leutweinii* has a more restricted range in Namibia and Botswana, mainly in karstveld and mopaneveld. *C. apiculatum* subsp. *boreale* Exell is reinstated for the narrow-leaved form of *C. apiculatum* mainly from Tanzania and Kenya. Wood (1908) mentions *C. glutinosum* Guill. & Perr. ex DC. as occurring in KwaZulu-Natal, but it is a West African species that does not occur in southern Africa.

Combretum moggii and *C. molle* are both very hairy, especially their leaves and young stems. *C. moggii* is usually a multi-stemmed, small shrub up to 3(–5) m tall growing in sandy soil in the crevices between outcropping quartzitic rocks (Carr 1988). It has a smoother bark, smaller and narrower leaves with more silky hairs and longer inflorescences than *C. molle*. The latter is usually a single-stemmed tree up to 9 m tall, with main branching commencing 1.5–3.0 m above ground level (Carr 1988). Besides the former Transvaal records of *C. moggii* (Exell 1968; Carr 1988; Hennessy 1991a) additional localities were recorded in Swaziland (Loffler & Loffler 2005) and northern KwaZulu-Natal (Figure 12).

Combretum molle has a very wide distribution, from Saudi Arabia, Yemen and Ethiopia, from where the type is, in the north to KwaZulu-Natal (= *C. gueinzii* Sond.) in the south and westwards to West Africa, DRC and Angola, but it is absent from Namibia and most parts of Botswana. Exell (1978) points out that there is a great deal of variation in leaf shape, size and indumentum,

and that the species grows in various ecological habitats. A polymorphic species, *C. molle* is one of the aggregate groups of *Combretum* in Africa that needs to be investigated further for the possibility of recognizing distinct subspecies. Wickens (1973) for instance, recognized three forms of *C. molle* in East Africa.

Combretum petrophilum, as currently defined, comprises populations from the Strydom Tunnel in the Abel Erasmus Pass, Mariepskop, Loskop Dam, Doornkop and Mogol Nature Reserve. Leaves have an undulate margin, the base is often asymmetric and subcordate; the often twisted apex tapers to a long, narrow acumen with a mucro and is therefore described as apiculate.

Engler & Diels (1899) placed *Combretum psidioides* in sect. *Glabripetalae*, but Exell & Garcia (1970) and Stace (1981) later transferred it to sect. *Ciliatipetala*. Maurin *et al.* (2010) support the latter placement. In the FSA region, *C. psidioides* is represented by two subspecies: the typical one which occurs in northern Botswana and Namibia (Caprivi), and subsp. *dinteri* (Schinz) Exell from Angola, Namibia and Zimbabwe. Wickens (1971b) described a third subspecies, subsp. *psilophyllum*. The isotype of subsp. *psilophyllum*, Haerdi 174/87 in PRE, shows that the leaves are large, obovate, up to 80–125 × (32–)65–115 mm, with narrowly cuneate bases and are totally glabrous on both sides, except for scales, and with reticulate venation prominently raised on both sides. Specimens from the Chimanimani Mountains, Mozambique side, (T. Muller 1239 in SRGH) (Meg Coates Palgrave pers. comm.) and Tunduru Dist., Tanzania (Greenway & Hoyle 8340 in PRE), belong to this taxon. They also match Busse 325 (HBG, K), the type of *C. anacardifolium* from Tanzania, but this is an unpublished manuscript name used by Adolf Engler.

Wickens (1971b) placed *Combretum grandifolium* F.Hoffm. in synonymy under *C. psidioides* subsp. *psidioides*. The holotype of the former, Böhm 30a, was destroyed in World War II in Berlin, but a fragment of the isotype survived in the Zürich Herbarium. The isotype shows large leaves which match specimens in the National Herbarium (PRE) and Harare Herbarium (SRGH). These specimens are of tall trees with very rough, grey, thick, corky and deeply fissured bark, and with large leaves, (110–)120–240(–300) × (80–)130–160(–200) mm, densely hairy on midrib and veins, but glabrous on the areoles. The leaf bases are usually cordate to truncate, but sometimes (as in the isotype) are broadly cuneate. The fruits are up to 36 × 28 mm, with scales and a few scattered hairs. Young leaves are sparsely glabrous and glutinous. This form, which ranges from Tanzania, through Malawi, Zambia and Zimbabwe to Mozambique, is here proposed as a distinctive subspecies of *C. psidioides*. See key to sect. *Ciliatipetala*.

Nearly all specimens of the *Combretum psidioides* complex examined in PRE are either sterile or crimson to blood-red in fruit. An exception are collections from northern Zambia and the DRC (Milne-Redhead 2728, Robertson 138, Robson 142, Van Meel 4158), all with flowers only. The leaves, 62–115 × 30–48 mm, are very thickly tomentose on both sides, whereas the midrib and lateral veins are very prominently raised on both sides, with reticulate venation inconspicuous above, the apices tapering to an acute to acuminate point or, when rounded, with a mucro, and the bases are broadly cuneate to rounded. These specimens represent a distinct entity and either represent a new subspecies of *C. psidioides* or belong to *C. brachypetalum* R.E.Fr.

Key to species of *Combretum* sect. *Ciliatipetala*, partly from Wickens (1971b) and Exell (1978)

- 1a Leaf apex usually apiculate and often twisted:
 - 2a Leaf sparsely to densely pubescent on both surfaces; Namibia and Botswana 12b. *C. apiculatum* subsp. *leutweinii*
 - 2b Leaves glabrous, or only margin and midrib with hairs, glossy, glutinous and sometimes sticky when young:
 - 3a Most leaves with apiculate apices, leaf margin flat, often with hair-tuft domatia in axils of veins below, leaf base symmetrical, reticulate venation not prominent below; upper hypanthium 2–3 mm long; petal margin ciliate; fruit 17–28 mm long; widespread 12a. *C. apiculatum* subsp. *apiculatum*
 - 3b Only few leaves with apiculate apices, but margins often undulate, without hair-tuft domatia in axils of veins below, leaf base asymmetrical, rounded to subcordate, reticulate venation very prominent below; upper hypanthium up to 1.5 mm long; petal margin glabrous, not ciliate; fruit 16–19 mm long; Limpopo and Mpumalanga 16. *C. petrophilum*
- 1b Leaf apex round, obtuse, acute to acuminate, rarely apiculate:
 - 4a Woody climbers 13. *C. edwardsii*
 - 4b Multi-stemmed shrubs or single-stemmed trees:
 - 5a Fruit glabrous except for scales, sometimes glutinous; bark of branchlets peeling off in large ± cylindrical or hemicylindrical pieces revealing an exposed cinnamon-red surface:
 - 6a Leaves obovate, bases cuneate, glabrous on both sides; Tanzania and Mozambique 17c. *C. psidioides* subsp. *psilophyllum*
 - 6b Leaves oblong to oblanceolate to elliptic, bases broadly cuneate, or cordate to truncate, variously hairy on both sides; FSA region and tropical Africa:
 - 7a Leaves usually > 110 mm long 17d. *C. psidioides* subsp. *grandifolium*
 - 7b Leaves usually < 105 mm long, base cuneate:
 - 8a Leaves pubescent on reticulation below, but glabrous on areoles when mature 17a. *C. psidioides* subsp. *psidioides*
 - 8b Leaves shortly tomentose on reticulation and on areoles below when mature 17b. *C. psidioides* subsp. *dinteri*
 - 5b Fruit densely to sparsely hairy, sometimes only on body or sometimes glabrous; bark of branchlets peeling off in untidy, irregular, fibrous strips or threads:
 - 9a Scales glistening; stipe up to 8 mm long; northern parts of Botswana and Namibia 11. *C. albopunctatum*
 - 9b Scales not glistening; stipe up to 3(–5) mm long; southeastern parts of Botswana, Swaziland and South Africa:
 - 10a Plants with silky appearance; usually multi-stemmed shrubs growing on rocks; leaves usually shorter than 60 mm, reticulate venation not prominently raised below; fruit densely covered with longish appressed hairs over whole surface 14. *C. moggii*
 - 10b Plants without silky appearance; usually single-stemmed trees; leaves usually longer than 60 mm, reticulate venation prominently raised below; fruit very sparsely hairy mainly on the body or glabrous, but densely covered with scales 15. *C. molle*

11. **Combretum albopunctatum** Suess. in Mitteilungen der Botanischen Staatssammlung München 1: 336 (1953); Exell & Roessler: 7 (1966); Exell: 126 (1978); J.D.Carr: 29 (1988); M.Coates Palgrave: 795 (2002); Curtis & Mannheimer: 490 (2005). Type: Namibia, Popa Falls, 1938, Volk 2105 [M sheet M0106663, lecto. e!, designated here].

Combretum sp. 2. in White: 287 (1962).

Note: Suessenguth, curator of the Botanische Staatssammlung, München from 1927–1955 (Staffleu & Cowan 1986), mentioned two collections in the protologue of *C. albopunctatum*, namely Volk 2119 and 2105, which he must have examined in the München Herbarium (M). Both syntypes were collected in Namibia, at the Popa Falls. Volk 2105 (two specimens in M) are available on the Aluka Library website and the better of the two (M0106663), which shows the characters described the best, is here selected as the lectotype. An isosyntype, Volk 2119 is housed in PRE, but unfortunately there is no specimen of the original syntype at M available on the Aluka Library.

Distribution: Botswana, Namibia, Zambia, Zimbabwe (Figure 9).

12a. **Combretum apiculatum** Sond. subsp. **apiculatum** in Linnaea 23: 45 (1850); Sond.: 510 (1862); Dümmer: 164 (1913); Bews: 146 (1921); Burt Davy: 245 (1926); O.B.Mill.: 42 (1948); Exell: 3 (1961); Stace: 13 (1961); Exell & Roessler: 7 (1966); Exell: 7 (1968); Liben: 65 (1968); Exell & J.G.Garcia: 61 (1970); Wickens: 35 (1973); Exell: 129 (1978); Vollesen: 53 (1980); J.D.Carr: 32 (1988); Pooley: 352 (1993); A.E.van Wyk & P.van Wyk: 328 (1997); McClelland: 456 (2002); M.Coates Palgrave: 796 (2002); Curtis & Mannheimer: 469 (2005). Type: South Africa, [?Gauteng], Magaliesberg, Zeyher 553 (S, holo. e!; BM e!, K e!, P e!, SAM e!, TCD e!, W e!, iso.).

C. buchananii Engl. & Diels: 40 (1899). Type: Nyassaland [Malawi], without precise locality, Buchanan 1263 (K, lecto. e!, designated here).

C. apiculatum Sond. var. *parvifolium* Baker f.: 46 (1905). Type: Southern Rhodesia [Zimbabwe], Bulawayo, Eyles 1094 (BM, holo.; SRGH, iso.).

C. glutinosum sensu Wood: 156 (1908), non Guill. & Perr.: 288 (1833) ex DC.: 21 (1828).

Note: Buchanan 1263 in Kew (K) is the only extant specimen of *Combretum buchananii* and is chosen here as the lectotype.

Distribution: Angola, Botswana, DRC, Kenya, Malawi, Mozambique, Namibia; RSA: Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West; Swaziland, Tanzania, Zambia, Zimbabwe (Figure 10).

12b. **Combretum apiculatum** Sond. subsp. **leutweinii** (Schinz) Exell in Mitteilungen der Botanischen Staatssammlung München 4: 3 (1961); Exell & Roessler: 8 (1966); Exell: 19 (1968); Exell: 195 (1970); Exell: 132 (1978); Curtis & Mannheimer: 471 (2005). Type: [Namibia], Otjiwarongo, Waterberg, Mar. 1899, Dinter 413 (Z, holo. e!).

C. leutweinii Schinz: 878 (1901).

C. kwebense N.E.Br.: 111 (1909); O.B.Mill.: 43 (1948). Type: [Botswana], Ngamiland, Kwebe Hill, Lugard 48 (K, holo. e!).

Distribution: Botswana, Malawi, Mozambique, Namibia, Zambia, Zimbabwe (Figure 11).

13. **Combretum edwardsii** Exell in Boletim da Sociedade Broteriana, sér. 2, 42: 19 (1968); Verhoeven & Van der Schijff: 39 (1975); J.D.Carr: 59 (1988); Pooley: 354 (1993); McClelland: 460 (2002); M.Coates Palgrave: 800 (2002). Type: South Africa, [KwaZulu-Natal], Impendle Dist., Lundy's Hill, upper edge of Umkomaas Valley, Edwards 3147 (PRE, holo.!: K e!, NH e!, NU e!, iso.).

Distribution: RSA: KwaZulu-Natal, Limpopo Province, Mpumalanga (Figure 9).

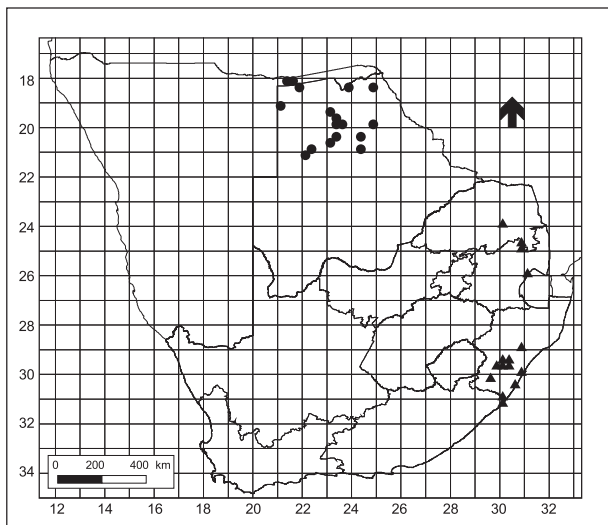


FIGURE 9.—Known distribution in FSA region of *Combretum albopunctatum*, ●; and *C. edwardsii*, ▲.

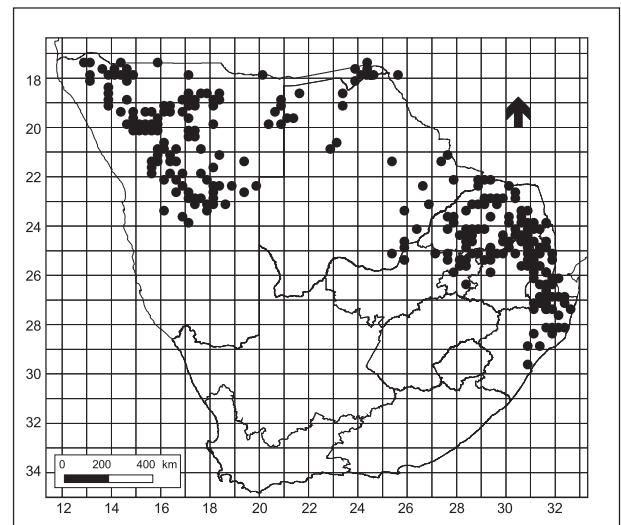


FIGURE 10.—Known distribution in FSA region of *Combretum apiculatum* subsp. *apiculatum*.

14. ***Combretum moggii* Exell** in Boletim da Sociedade Broteriana, sér. 2, 42: 21 (1968); J.D.Carr: 98 (1988); Hennessy: t. 2027 (1991a); McClelland: 464 (2002); M.Coates Palgrave: 805 (2002). Type: South Africa, [Mpumalanga], Middelburg Dist., Olifants River gorge, Hoornsnek, Farm Slaghoek 126, 20 miles [32 km] NW, Oct. 1953, *Mogg* 22400 (PRE, holo.!; BM e!, J, K e!, iso.).

Distribution: RSA: Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga; Swaziland (Figure 12).

15. ***Combretum molle* R.Br. ex G.Don** in Transactions of the Linnean Society of London 15: 431 (1827); F.W.Andrews: 201 (1950); Exell: 7 (1968); Liben: 67 (1968); Exell & J.G.Garcia: 62 (1970); Wickens: 33 (1973); Exell: 127 (1978); Vollesen: 53 (1980); Liben: 18 (1983); J.D.Carr: 102 (1988); Pooley: 356 (1993); Thulin: 249 (1993); Vollesen: 118 (1995); A.E.van Wyk & P.van Wyk: 334 (1997); McClelland: 466 (2002); M.Coates Palgrave: 806 (2002). Type: Ethiopia, without locality, *Salt* s.n. (BM, holo. e!).

C. velutinum DC.: 20 (1828). Type: Guinea, collector unknown (P, holo. e!).

C. ferrugineum A.Rich.: 267 (1848). Type: Ethiopia, Selassaquilla, Schimper 767 (P, holo. e!; BR e!, K, W e!, iso.).

C. gueinzii Sond.: 43 (1850); Sond.: 509 (1862); Engl. & Diels: 38 (1899); Dümmer: 116 (1913); Bews: 147 (1921); F.W.Andrews: 202 (1950). Type: South Africa, [KwaZulu-Natal], Port Natal [Durban], 'in silvis', *Gueinzii* 567 (S, holo. e!; K e!, SAM e!, TCD e!, iso.).

C. holosericeum Sond.: 44 (1850); Sond.: 510 (1862); M.A.Lawson: 430 (1871); Dümmer: 116 (1913); Burt Davy: 247 (1926); O.B.Mill.: 43 (1948). *C. gueinzii* Sond. var. *holosericeum* (Sond.) Exell ex Rendle: 93 (1932). Type: South Africa, [Gauteng], 'Magalisberg', *Zeyher* 575 (S, holo. e!; BM e!, K, fragment e!, P, fragment e!, PRE!, SAM e!, W e!, WU, fragment e!, Z e!, iso.).

C. splendens Engl.: 289 (1895); Engl. & Diels: 37, t. 11/D (1899). *C. gueinzii* Sond. subsp. *splendens* (Engl.) Exell ex Brenan: 137 (1949). Type: Nyassaland [Malawi], locality unknown, *Buchanan* 859 (K, lecto. e!, designated here).

C. welwitschii Engl. & Diels: 40 (1899). Type: Angola, Cuanza Norte, Golungo Alto, near banks of rivulet Quiposa, not far from Canguerasange, *Welwitsch* 4318 [LISU, lecto. e!, designated by Garcia (1961); BM e!, BR e!, G e!, P e!, isolecto.].

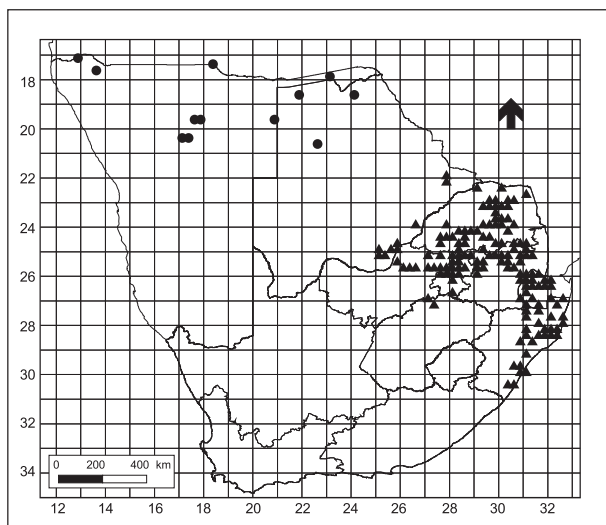


FIGURE 11.—Known distribution in FSA region of *Combretum apiculatum* subsp. *leutweinii*, ●; and *C. molle*, ▲.

C. galpinii Engl. & Diels: 41 (1899); Dümmer: 147 (1913); Burt Davy: 246 (1926). Type: South Africa, [Mpumalanga], Barberton Dist., Avoca, near Barberton, *Galpin* 112 (Z, lecto. e!, designated here; BOL, K e!, NH e!, PRE!, SAM e!).

C. obtusatum Engl. & Diels: 58 (1899). Type: Angola, Lubango, Huila, *Antunes* A50,61 [BM fragment, lecto. e!, designated by Exell & Garcia (1970); COI, isolecto.].

C. dekindianum Engl.: 136 (1902). Type: Angola, Lubango, Huila, *Dekindt* 51 [LUA, lecto., designated by Exell & Garcia (1970)].

C. arengense Sim: 62, t. 63, fig. B (1909). Type: Mozambique, Maganja da Costa, *Sim* 5916 (probably = *Sim* 20902) (NU, holo. e!; PRE, iso.).

C. ellipticum Sim: 63, t. 63, fig. D (1909). Type: Mozambique, without precise locality, *Sim* 6068 (NU, holo. e!; K e!, PRE!, iso.).

Note: in their protologue of *Combretum galpinii*, Engler & Diels (1899) mentioned *Galpin* 112 in the Zürich Herbarium (Z) and *Wood* 6547 in Berlin Herbarium (B). The Galpin specimen in Z is the only specimen that survived. It was examined by Engler & Diels and is therefore chosen as lectotype.

Engler (1895) cites syntypes from Tanzania and Malawi in his protologue of *C. splendens*, but only an isotype of Buchanan survived in Kew, which is here chosen as the lectotype.

Distribution: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Cote d'Ivoire, DRC, Ethiopia, Ghana, Guinea, Guinea-Bissau, Kenya, Malawi, Mozambique, Nigeria; RSA: Free State, Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West; Rwanda, Saudi Arabia, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Yemen, Zambia, Zimbabwe (Figure 11).

16. ***Combretum petrophilum* Retief** in Bothalia 16: 44 (1986); J.D.Carr: 124 (1988); McClelland: 468 (2002); M.Coates Palgrave: 809 (2002). Type: South Africa, [Limpopo Province], Strydom Tunnel, Oct. 1982, *Carr* 203 (PRE, holo.!; K, MO e!, iso.).

Distribution: RSA: Limpopo Province (Figure 13).

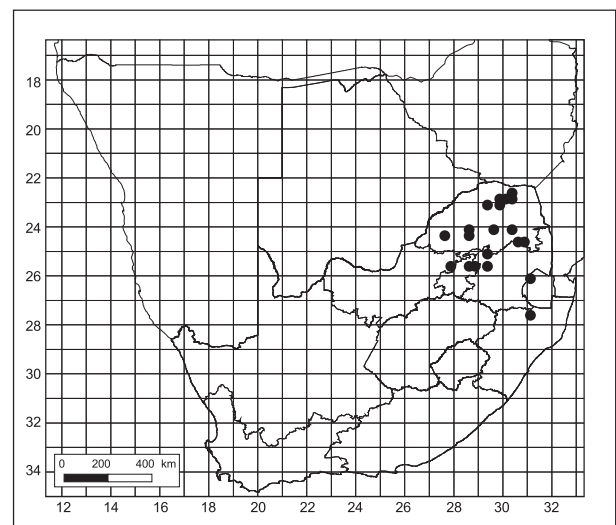


FIGURE 12.—Known distribution of *Combretum moggii*.

17. **Combretum psidioides** Welw. in Annaes Conselho Ultramarino, sér. 1, 24: 249 (1856); Exell: 5 (1961); Exell & Roessler: 10 (1966); Exell: 8 (1968); Exell & J.G.Garcia: 64 (1970); Wickens: 36 (1971b); Wickens: 37 (1973); Exell: 133 (1978); J.D.Carr: 135 (1988); A.E.van Wyk & P.van Wyk: 336 (1997); M.Coates Palgrave: 810 (2002); Curtis & Mannheimer: 484 (2005). Type: Angola, 'in dumetosis interioris Provinciae Angolensis, rarior avis. Arbuscula elegans filiis maximis, habitu exacte *Psidium*. Quicuze', Welwitsch 4378 (LISU, holo. e!; BM, BR e!, COI, K e!, P e!, iso.).

17a. subsp. **psidioides**

Distribution: Angola, Botswana, Namibia, Zimbabwe (Figure 13).

17b. subsp. **dinteri** (Schinz) Exell in Mitteilungen der Botanischen Staatssammlung München 4: 3 (1961); Exell & Roessler: 10 (1966); Exell & J.G.Garcia: 66 (1970); Wickens: 38 (1971b); Exell: 135 (1978); J.D.Carr: 135 (1988). Type: [Namibia], Hereroland, Apr. 1899, *Dinter* 580 (Z, holo. e!).

C. dinteri Schinz: 877 (1901).

C. quirirense Engl. & Gilg: 318 (1903). Type: Angola, Bié, Quiriri River, *Baum* 722 [B, holo.†; BM, lecto. e!, designated by Exell & Garcia (1970); BR e!, COI, E e!, HBG e!, K, S e!, W e!, Z e!, isolecto.].

C. omahecae Gilg & Dinter ex Engl.: 698 (1921). Type: [Namibia], Omaheke, 'bei Ojituio und Naitsas' (type not traced).

Distribution: Angola, Namibia, Zambia, Zimbabwe (Figure 13).

17c. subsp. **psilophyllum** Wickens in Kew Bulletin 26: 39 (1971b); Wickens: 38 (1973). Type: Tanzania, Ulanga Dist., Ifakara, *Haerdi* 174/87 (K, holo. e!; EA e!, PRE!, iso.).

Distribution: probably Mozambique, and Tanzania.

17d. subsp. **grandifolium** (F.Hoffm.) Jordaán, stat. nov.

C. grandifolium F.Hoffm. in Beiträge zu Kenntnis der Flora von Central-Ost-Afrika: 29 (1889); Engl.: 289 (1895); Engl. & Diels: 39

(1899); Engl.: 698 (1921). Type: Tanganyika [Tanzania], Mpanda Dist., Pa-Kabombue, *Böhm* 30a (B, holo.†; Z fragment, iso. e!).

Distribution: Malawi, Mozambique, Tanzania, Zambia, Zimbabwe.

GROUP 2

Species with large scales, usually larger than 100 µm, divided by many radial and tangential walls (Figure 2).

VI. **Combretum** sect. **Hypocrateropsis** Engl. & Diels (1899); Exell: (1968); Stace: 135 (1969); Exell: 105 (1978)

Species in this section are woody climbers, scramblers or sometimes trees, usually multi-stemmed and without spine-tipped lateral branches. The upper hypanthium of the flowers is almost flat and little developed and the petals are linear-elliptic and glabrous. The scales on the leaves are the largest in *Combretum*, mostly over 150 µm, and are circular, divided by many radial and tangential walls.

Engler & Diels (1899) described two species: 1, *Combretum tenuipes* from a plant collected at Low's Creek in the Barberton District and 2, *C. padoides* from a plant collected in Mozambique. *C. tenuipes* was subsequently placed in synonymy with *C. padoides* by Exell (1968, 1970, 1978), Wickens (1973), Carr (1988) and Rodman (1990). Rogers (1989) conducted chemotaxonomic studies on the leaves of *C. padoides* (his 'coastal form') and *C. tenuipes* (his 'inland form'). He found significant differences between the oxidation states of some of the compounds isolated from coastal and inland trees and suggested that the differences could be due to geographic or genetic factors and needed to be investigated further. Rogers's samples of his 'inland species' came from a plant growing in the Pretoria National Botanic Garden, which is without any doubt *C. tenuipes*. Samples of his 'coastal species' came from a tree in Durban, grown from seed originating from a tree growing in the National Botanic Garden, Harare, Zimbabwe. *C. tenuipes* is confined to the Barberton Centre of Endemism

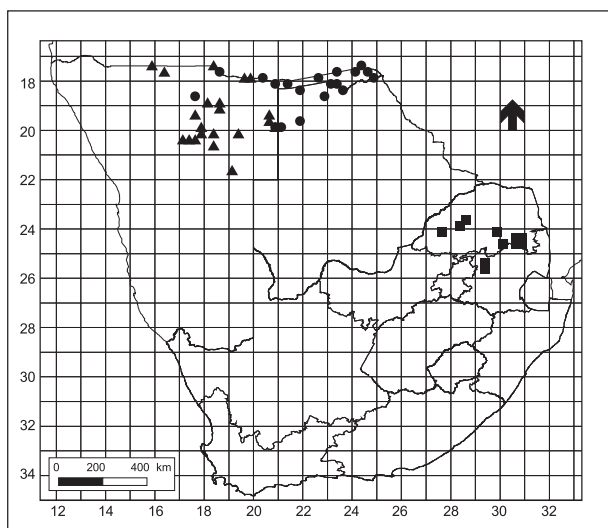


FIGURE 13.—Known distribution in FSA region of *Combretum petrophilum*, ■; *C. psidioides* subsp. *psidioides*, ●; and *C. psidioides* subsp. *dinteri*, ▲.

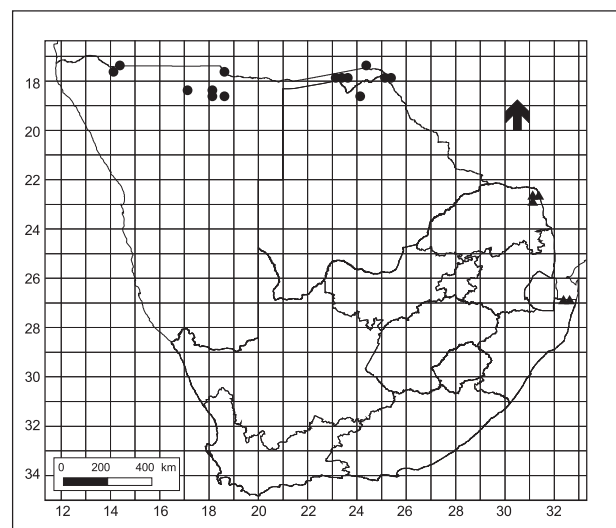


FIGURE 14.—Known distribution in FSA region of *Combretum celastroides* subsp. *celastroides*, ●; and *C. patelliforme*, ▲.

(Van Wyk & Smith 2001), whereas *C. padoides* grows in eastern tropical Africa, from Kenya southwards to Tanzania, Malawi, Zambia, eastern Zimbabwe and Mozambique, as well as the DRC, and just enters South Africa in the northernmost part of Limpopo Province. Pooley (1993) included *C. padoides* as occurring in KwaZulu-Natal and the accompanying photos to illustrate the species were taken in the Pretoria National Botanical Garden; this means that the photos depict *C. tenuipes*. *Combretum padoides* has not yet been recorded in KwaZulu-Natal, but there is a new, undescribed species of *Combretum* growing as a climber in the sand forest of Maputland with which it may be confused. However, this new species does not belong to sect. *Hypocrateropsis*. *Combretum tenuipes* and *C. padoides* are here reinstated as separate species since there are several differences, including geographical, molecular (Maurin *et al.* 2010) and morphological ones (see the key) to distinguish between them.

Exell (1968) described a third subspecies of *Combretum celastroides*, namely *C. celastroides* subsp. *orientale* based on a plant from Mozambique, collected by Schlechter at Maputo [Delagoa Bay]: Schlechter 11957. This is also one of the syntypes of *C. patelliforme* Engl. & Diels (1899). The other syntype of *C. patelliforme* is from Angola, namely Antunes A155, which was destroyed in World War II, but this belongs to subsp. *celastroides*. The two subspecies of *C. celastroides* in the FSA region, the typical subspecies and subsp. *orientale*, are quite different morphologically, and this is supported by molecular evidence (Maurin *et al.* 2010) and by the fact that the two taxa are geographically disjunct. Hence *C. celastroides* subsp. *orientale* is elevated to species level as *C. patelliforme* Engl. & Diels. See the key for differences between it and subsp. *celastroides*. *C. celastroides* subsp. *laxiflorum* (Welw. ex M.A.Lawson) Exell has larger flowers than the other subspecies, the leaves are nearly glabrous, and it is usually a tree. It occurs in Zambia, Angola, Tanzania and DRC.

Key to species of *Combretum* sect. *Hypocrateropsis*
based on Exell (1978)

1a Disc glabrous:

2a Leaves pubescent on entire leaf surface below; disc up to 4 mm diam.; fruit $\pm$ 18–20 $\times$ 17–22 mm; peg $\pm$ 1.0–2.5 mm long; Caprivi, Botswana 18. *C. celastroides*

2b Leaves almost glabrous below (except for hair-tuft domatia in axils of veins below); disc 2.0–2.5 mm diam.; fruit $\pm$ 15 $\times$ 15 mm; peg up to 1 mm long; Limpopo Province, KwaZulu-Natal 20. *C. patelliforme*

1b Disc pilose:

3a Ultimate twigs hairy; leaves narrowly elliptic, usually longer than 55 mm, margin flat, principal lateral veins in $\pm$ 5–8 pairs; fruit usually larger than 17 $\times$ 17 mm; Limpopo Province 19. *C. padoides*

3b Ultimate twigs glabrous; leaves ovate, usually shorter than 45 mm, margin markedly wavy, principal lateral veins in 3(4) pairs; fruit usually 15 $\times$ 15 mm or smaller; Mpumalanga and Swaziland (Barberton Centre of Endemism) 21. *C. tenuipes*

18. *Combretum celastroides* Welw. ex M.A.Lawson in Flora of tropical Africa 2: 422 (1871); Engl. & Diels: 12 (1899); O.B.Mill.: 42 (1948); F.White: 284 (1962); Exell & Roessler: 8 (1966); Exell: 16 (1968); Exell: 168 (1970); Exell & J.G.Garcia: 50 (1970); Wickens: 17 (1973); Exell:

107 (1978); J.D.Carr: 45 (1988); M.Coates Palgrave: 798 (2002); Curtis & Mannheimer: 472 (2005). Type: Angola, Huila, Welwitsch 4370 [LISU, lecto., designated by Exell & Garcia (1970); BM e!, BR e!, COI, K e!, P e!, PRE!, isolecto.].

C. patelliforme Engl. & Diels: 12, t. 1, fig. C (1899) pro parte quoad specim. Antunes A155 (B†).

Distribution: Angola, Botswana, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe (Figure 14).

19. *Combretum padoides* Engl. & Diels in Monographien afrikanischer Pflanzenfamilien und Gattungen 3: 13 (1899); Exell: 7 (1968); Liben: 40 (1968); Exell: 168 (1970); Wickens: 17 (1973); Exell: 107 (1978); Vollesen: 53 (1980); J.D.Carr: 17 (1988); Thulin: 248 (1993); Pooley: 354 (1993); McClelland: 468 (2002), pro parte; M.Coates Palgrave: 808 (2002). Type: Mozambique, Zambezi, Boroma, Menyharth 878 [Z, lecto. e!, designated by Exell (1970); K e!, WU e!, isolecto.].

C. homblei De Wild.: 196 (1914). Type: Democratic Republic of the Congo, Katanga, Kipiri Valley, 1913, Homblé 113 (BR, holo. e!; BM, fragment, iso. e!).

C. minutiflorum Exell: 245 (1930). Type: Tanganyika [Tanzania], Kilosa Dist., Kipera [Kipela], Oct. 1921, Swynnerton s.n. (BM, holo. e!).

Distribution: DRC, Kenya, Malawi, Mozambique, RSA: Limpopo Province; Somalia, Tanzania, Zambia, Zimbabwe (Figure 15).

20. *Combretum patelliforme* Engl. & Diels in Monographien afrikanischer Pflanzenfamilien und Gattungen 3: 12, t. 1, fig. C (1899); Dümmer: 183 (1913). Type: Mozambique, Delagoa Bay [Maputo], Schlechter 11957 [BM, lecto. e!, designated by Exell (1968); BOL, BR e!, COI, E e!, HBG e!, K e!, L e!, MO e!, P e!, PRE!, SAM, WAG e!, Z e!, iso.].

C. celastroides Welw. ex M.A.Lawson subsp. *orientale* Exell: 16 (1968); Wickens: 17 (1973); Exell: 107 (1978); J.D.Carr: 45 (1988); Pooley: 354 (1993); McClelland: 458 (2002).

Note: Engler & Diels (1899) described three species in this section, *Combretum patelliforme*, *C. padoides* and *C. tenuipes*. In the protologue of *C. patelliforme*, two syntypes are cited: Antunes A155 from Angola and Schlechter 11957 from Mozambique. The specimen from Angola belongs now to *C. celastroides* subsp. *celastroides* and Mozambique specimen to *C. patelliforme*, pro parte. Exell (1968) reduced this name to subspecific level and used a new epithet, namely *orientale* and lectotypified this name with the Schlechter specimen. Once this taxon is elevated now to species level the old epithet *patelliforme* must be used, because no name has priority outside its rank according to the International Code of Botanical Nomenclature (Vienna Code): 11.2 (McNeill *et al.* 2006).

Distribution: Mozambique, RSA: KwaZulu-Natal, Limpopo Province; Tanzania, Zambia, Zimbabwe (Figure 14).

21. *Combretum tenuipes* Engl. & Diels in Monographien afrikanischer Pflanzenfamilien und Gattungen 3: 13, t. 3, fig. b (1899); Dümmer: 182 (1913); Burt

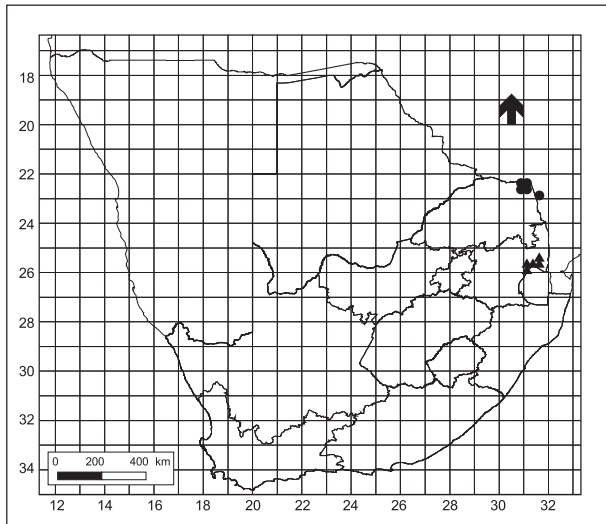


FIGURE 15.—Known distribution in FSA region of *Combretum padoides*, ●; and *C. tenuipes*, ▲.

Davy: 246 (1926). Type: South Africa, [Mpumalanga], Barberton Dist., Louws Creek, *Galpin 885* (Z, holo. e!; BOL, K e!, PRE!, SAM e!, iso.).

Distribution: Mpumalanga and probably Swaziland (Figure 15).

VII. *Combretum* sect. *Metallicum* Exell (1968); Stace: 145 (1969); Exell: 179 (1970); Exell: 117 (1978); Wickens: 23 (1973)

Species in this section are nearly always glutinous, especially when young. The scales on the leaves are usually extensively divided by many radial and tangential walls to give rise to $\pm 10\text{--}40$ marginal cells. The disc has a free, pilose margin. The fruit are glabrous to densely hairy in *Combretum collinum* subsp. *suluense*, and are usually somewhat 'metallic' in colour.

Okafor (1967) recognized four subspecies of *Combretum collinum* in the FSA region. Carr (1988) regarded the separation of *C. collinum* into subspecies as unjustified because of the largely overlapping geographical distribution patterns of these four subspecies. Here, however, we uphold the four subspecies as recognized by Okafor (1967). *C. coriaceum*, described by Schinz (1888), is conspecific with *C. gazense* and is the oldest validly published name for this subspecies but was not used by Okafor when he reduced this taxon to subspecific rank.

There are four synonyms of subsp. *suluense* described earlier than 1899, but Okafor chose to use the name *suluense* over the other four (*C. fischeri*, *C. brosigianum*, *C. fulvotomentosum* and *C. schinzii*). Type material for *C. fischeri*, *C. brosigianum* and *C. fulvotomentosum* was destroyed and they could be considered to be uncertain names. There is, however, an isotype of *C. schinzii* in the Zürich Herbarium (Z) described in 1899 that could serve as a lectotype. It seems, however, that this taxon rather belongs to *C. collinum* subsp. *ondongense* (1899) and not to *C. collinum* subsp. *suluense* as stated by Rodman (1990).

Pooley (1993) gives a group of records for *Combretum collinum* subsp. *suluense* from around False Bay and Mkuze Game Reserve, but specimens growing in these sand forest areas belong to an undescribed species. There is, however, one specimen in the KwaZulu-Natal Herbarium collected in the mountains north of Vryheid which gives the distribution for subsp. *suluense* as far north as Kenya and southwards as far south as Swaziland and far northern KwaZulu-Natal. *C. collinum* subsp. *ondongense* (Engl. & Diels) Okafor is confined to the Kalahari sands of Angola, Namibia, Botswana, Zambia and the eastern fringe of Zimbabwe, and has not been recorded in South Africa. The holotype of subsp. *taborense* is based on *Stuhlmann 506*, collected in Tabora, Tanzania, but was destroyed in World War II and no isotypes seem to exist. Okafor was confident enough to use this name despite the lack of type material. In the absence of good material from Tanzania in the National Herbarium in Pretoria, we have refrained from selecting a neotype for this taxon.

Key to subspecies of *Combretum collinum*

- 1a Leaves densely grey-hairy below; fruit glabrous; Namibia, Botswana, Limpopo Province and Mpumalanga 22a. *C. collinum* subsp. *gazense*
- 1b Leaves glabrous below, except for hairs in axils of veins; fruit glabrous or hairy:
 - 2a Fruit densely hairy, red scales conspicuous 22c. *C. collinum* subsp. *suluense*
 - 2b Fruit glabrous:
 - 3a Leaf apices acute to acuminate to apiculate, lamina silvery below, with conspicuous darker venation; Limpopo Province and Mpumalanga 22d. *C. collinum* subsp. *taborense*
 - 3b Leaf apices rounded to subacute, lamina yellowish below, without conspicuous darker venation; Namibia, Botswana 22b. *C. collinum* subsp. *ondongense*

22a. *Combretum collinum* Fresen. subsp. *gazense* (Swynn. & Baker f.) Okafor in Boletim da Sociedade Broteriana, sér. 2, 41: 145 (1967); Exell: 182 (1970); Wickens: 27 (1973); Coates Palgrave: 665 (1977); Exell: 120 (1978); J.D.Carr: 51 (1988); McClelland: 458 (2002); M.Coates Palgrave: 799 (2002); Curtis & Mannheimer: 474 (2005). Type: Mozambique, Gazaland, between upper Buzi and Mount Umtereni, *Swynnerton 587* (BM, holo. e!; K e!, Z e!, iso.).

C. gazense Swynn. & Baker f.: 68 (1911); Burt Davy: 248 (1926); O.B.Mill.: 42 (1948); Codd: 129 (1951). *C. mechowianum* O.Hoffm. subsp. *gazense* (Swynn. & Baker f.) DuVign.: 81 (1956); Liben: 77 (1968).

C. coriaceum Schinz: 247 (1888); Dinter: 169 (1919); O.B.Mill.: 42 (1948). Type: [Namibia], Ngamigebiet, 1888, *Fleck 422a* (Z, holo. e!; K, iso. e!).

C. bajonense Sim: 63, t. 63 (1909). Type: Mozambique, Magenja da Costa, 1908, *Sim 5715* (renumbered as 20901) (PRE, holo.!:; NU, iso.).

C. eylesii Exell: 170 (1939). Type: [Zimbabwe], Salisbury [Harare], *Eyles 849* (BM, holo. e!; K, iso. e!).

Distribution: Botswana, DRC, Malawi, Mozambique, Namibia; RSA: Limpopo Province, Mpumalanga; Tanzania, Zambia, Zimbabwe (Figure 16).

22b. subsp. *ondongense* (Engl. & Diels) Okafor in Boletim da Sociedade Broteriana, sér. 2, 41: 147 (1967); Exell: 120 (1978); J.D.Carr: 50 (1988); M.Coates Pal-

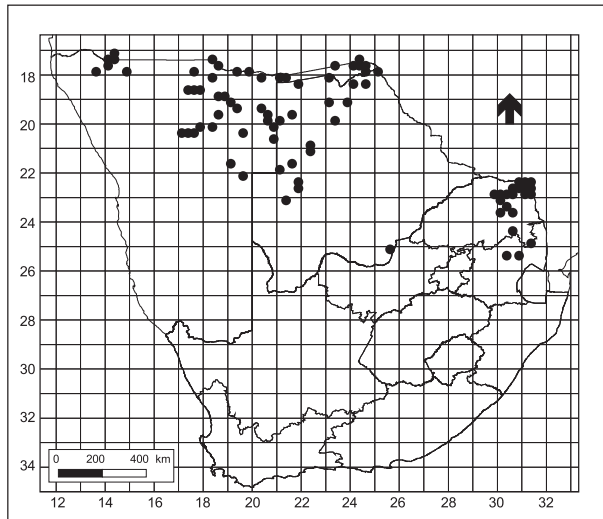


FIGURE 16.—Known distribution in FSA region of *Combretum collinum* subsp. *gazense*.

grave: 799 (2002); Curtis & Mannheimer: 474 (2005). Type: [Namibia], 'Amboland zwischen Ondonga und Unkussyama', July 1897, *Rautanen* 234 (HBG, holo.; BM, fragment e!, K e!, Se!, WU e!, Z e!, iso.).

C. ondongense Engl. & Diels: 56 (1899).

C. schinzii Engl. ex Engl. & Diels: 54 (1899). Type: Namibia, Onkumbi, Sep. 1885, *Schinz* 1037 (B, holo.†; Z, iso. e!).

Distribution: Botswana, Namibia, Zimbabwe (Figure 17).

22c. subsp. **suluense** (Engl. & Diels) Okafor in Boletim da Sociedade Broteriana, sér. 2, 41: 143 (1967); Wickens: 28 (1973); Exell: 120 (1978); Vollesen: 53 (1980); J.D.Carr: 51 (1988); McClelland: 458 (2002); M.Coates Palgrave: 799 (2002); Curtis & Mannheimer: 474 (2005). Type: Swaziland, hill slopes, Horo Mine, Dec. 1890–1894, *Galpin* 1264 (B, holo.†; BOL, K e!, NH, PRE!, SAM e!, Z e!, iso.).

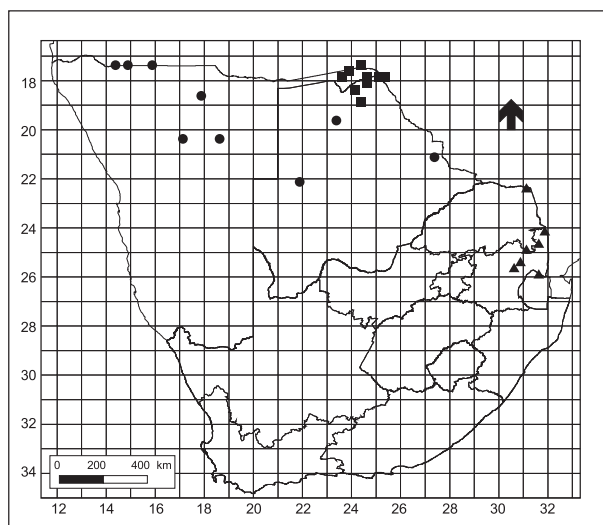


FIGURE 17.—Known distribution in FSA region of *Combretum collinum* subsp. *ondongense*, ●; and *C. collinum* subsp. *taborense*, ▲; and *C. elaeagnoides*, ■.

C. suluense Engl. & Diels: 54 (1899); Dümmer: 183 (1913); Burt Davy: 248 (1926); O.B.Mill.: 43 (1948).

C. junodii Dümmer: 183 (1913); Bews: 147 (1921). Type: South Africa, [Limpopo Province], hills, Shilouvane, *Junod* 613 (K, holo. e!; PRE!, Z e!, iso.).

C. griseiflorum S.Moore: 227 (1921); Burt Davy: 246 (1926); O.B.Mill.: 43 (1948). Type: South Africa, [Mpumalanga], Nelspruit, *Breyer s.n. sub Rogers* 24018 (BM, holo. e!).

C. angustilanceolatum Engl.: 702 (1921). Type: Mozambique, Lower Umswirizwi River, *Swynnerton* 45 (B, holo.†; BM, lecto. e!, designated here; K, isolecto. e!).

C. makindense Gilg ex Engl.: 703 (1921). Type: Kenya, Machakos Dist., Kibwezi, Makinde Steppe, *Scheffler* 210 (B, holo.†; K, lecto. e!, designated here; BM, E e!, HBG e!, P e!, PRE!, WAG e!, Z e!, isolecto.).

C. millerianum Burt Davy: 279 (1921). Type: Swaziland, Buckingham's to Forbes' Coal Mine, June 1911, *Burt Davy* 10681 (BOL, holo.; K, iso. e!).

Note: the holotype of *Combretum angustilanceolatum* was destroyed and from the two extant isotypes in BM and K, the first-mentioned specimen is chosen as lectotype, because it is the better one of the two.

The holotype, *Scheffler* 210, of *C. makindense* was destroyed and the Kew specimen, the best of all the duplicates, is the only one seen by Wickens (1968) and identified by him. It is here chosen as lectotype.

Distribution: Angola, Kenya, Malawi, Mozambique, ?Namibia; RSA: Limpopo Province, Mpumalanga; Swaziland, Tanzania, Zambia, Zimbabwe (Figure 17).

22d. **Combretum collinum** Fresen. subsp. **taborense** (Engl.) Okafor in Boletim da Sociedade Broteriana, sér. 2, 41: 144 (1967); Exell: 182 (1970); Wickens: 26 (1973); Exell: 120 (1978); Vollesen: 53 (1980); J.D.Carr: 51 (1988); McClelland: 460 (2002); M.Coates Palgrave: 800 (2002). Type: Tanzania, Tabora, *Stuhlmann* 506 (B, holo.†).

C. taborense Engl.: 290 (1895). *C. mechowianum* O.Hoffm. subsp. *taborense* (Engl.) Duval: 80 (1956); Liben: 76 (1968).

C. goetzenianum Diels: 500 (1907). Type: Tanzania, Dondoland, between Kilwa and Likemba, *Busse* 570 (B, holo.†; EA, lecto., designated here; BM, fragment, isolecto. e!).

C. psammophilum Diels: 502 (1907). Type: Tanzania, Lindi, Ruaha, *Busse* 1122 (B, holo.†; EA, lecto. e!, designated here; BM, isolecto.).

C. burtii Exell: 169 (1939). Type: Zambia, 25 miles [40 km] from Kassama on road to Issaka, near Malole Mission, *Burt* 5951 (BM, holo. e!; BR e!, EA e!, K, iso.).

Note: Diels (1907) described two species, *Combretum goetzenianum* and *C. psammophilum*, based on Busse's specimens he collected in Tanzania. Both species proved to be *C. collinum* subsp. *taborense*. The holotypes of both names was destroyed and the isotypes in the East African Herbarium (EA) in Kenya are chosen here as lectotypes. The material in BM are merely fragments.

Distribution: DRC, Malawi, Mozambique; RSA: Limpopo Province, Mpumalanga; Tanzania, Zambia, Zimbabwe (Figure 17).

VIII. **Combretum** sect. **Breviramea** Engl. & Diels (1899); Stace: 148 (1969); Exell: 199 (1970); Exell: 136 (1978)

Combretum hereroense Schinz belongs to this section. It often has divaricately branched stems; leaves mostly with only 3 or 4(5) pairs of principal lateral veins; 4-merous flowers; upper hypanthium campanulate to infundibuliform; petals spatulate to broadly obovate or obovate or subcircular and glabrous; disc with a pilose free margin; fruit up to 35 mm long and glabrous; scales very densely packed, contiguous, sometimes hidden by dense indumentum of combretaceous hairs on leaves below, (50–)75–120(–160) µm diam., irregular in outline, delimited usually by 8 primary radial walls with up to 8 tangential and up to 4 partial radial walls.

Combretum hereroense is extremely variable in leaf shape and indumentum and sometimes in the size of the fruit. The indumentum varies from densely tomentose to nearly glabrous. Wickens (1971a) subdivided *C. hereroense* into three subspecies, and subsp. *hereroense* into two varieties on account of their hairiness. Only the typical subspecies occurs in our area. We do not recognize these varieties.

Combretum hereroense, *C. imberbe* and *C. elaeagnoides* are clearly related according to the molecular analysis by Maurin *et al.* (2010), although currently placed in three different sections. They are characterized by 4-merous flowers in dense often subcapitate axillary spikes, a glabrous disc and lepidote fruit. Leaves in all these species are densely lepidote with scales contiguous or overlapping, silver or golden or rust-brown with cells divided by numerous radial and tangential walls. All three species are deciduous trees, although *C. elaeagnoides* has a tendency to scramble. Young stems of *C. imberbe* have short, opposite, spine-tipped lateral shoots.

23. **Combretum hereroense** Schinz subsp. **hereroense** in Verhandlungen des Botanischen Vereins der Provinz Brandenburg 30: 245 (1888); Engl. & Diels: 63 (1899); Dümmer: 201 (1913); Exell & Roessler: 8 (1966); Exell: 8 (1968); Exell & J.G.Garcia: 56 (1970); Wickens: 411 (1971a); Wickens: 40 (1973); Exell: 138 (1978); Vollesen: 53 (1980); J.D.Carr: 77 (1988); Pooley: 356 (1993); Vollesen: 118 (1995); A.E.van Wyk & P.van Wyk: 332 (1997); McClelland: 462 (2002); M.Coates Palgrave: 803 (2002); Curtis & Mannheimer: 478 (2005). Type: South West Africa [Namibia], Otjovazandu, Schinz 431 (Z, holo. e!; B, iso.†).

C. eilkeranum Schinz: 246 (1888); Engl. & Diels: 61 (1899); O.B.Mill.: 42 (1948). Type: South West Africa [Namibia], Kunene, Schinz 420 (Z, holo. e!).

C. transvaalense Schinz: 202 (1894); Dümmer: 201 (1913); Burt Davy: 246 (1926); O.B.Mill.: 43 (1948); Brenan: 139 (1949). Type: South Africa, [Limpopo Province], Makapansberge, Rehmann 5470 (Z, holo. e!).

C. sambesiaceum Engl. & Diels: 63 (1899). Type: Mozambique, Boroma, Menyhárh 892b (B, holo.†; Z, lecto. e!, designated here; K, fragment e!, WU, fragment e!, isolecto.).

C. hereroense Schinz subsp. *hereroense* var. *villosissimum* Engl. & Diels: 63 (1899); Dümmer: 201 (1913); Wickens: 41 (1973). *C. villosissimum* (Engl. & Diels) Engl.: 705 (1921). *C. transvaalense* Schinz var. *villosissimum* (Engl. & Diels) Burt Davy: 246 (1926). Type: South Africa, [Limpopo Province], Makapansberge, Streydpoort, Rehmann 5471 (Z, holo. e!).

C. porphyrolepis Engl. & Diels: 63 (1899), nom. illegit.

C. rautanenii Engl. & Diels: 64 (1899); O.B.Mill.: 43 (1948). Type: [Namibia], Katumare, Rautanen 199 (B, syn.†; Z, lecto. e!, designated here).

C. rhodesicum Baker f.: 435 (1899); Eyles: 428 (1916); O.B.Mill.: 43 (1948). Type: [Zimbabwe], Bulawayo, Rand 582 (BM, syn.) and Rand 583 (BM, syn.).

C. transvaalense Schinz var. *bolusii* Dümmer: 201 (1913). Type: South Africa, [Mpumalanga], 'Juxta ripas flum. Kaup prope Barberton', Bolus 7763 (K, holo. e!).

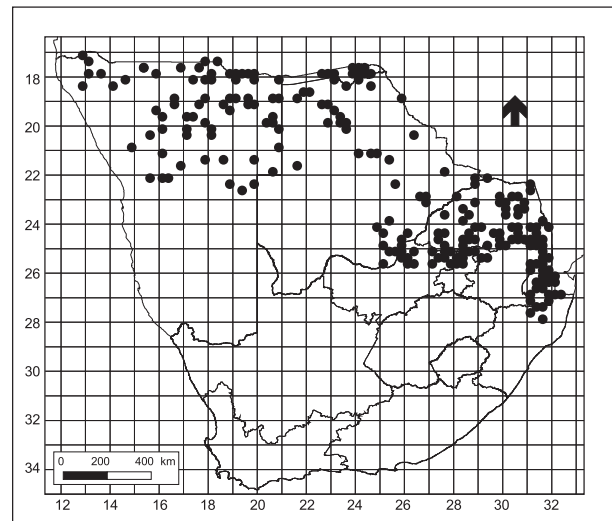


FIGURE 18.—Known distribution in FSA region of *Combretum hereroense*.

Note: Menyhárh 892b, collected in Mozambique, is the type of *Combretum sambesiaceum* (Engler & Diels 1899). The only acceptable extant specimen is housed in the Zürich Herbarium which is chosen as the lectotype. Specimens in K and WU are merely fragments. Engler & Diels (1899) mentioned Rautanen 199 and three specimens of Fleck in their protologue of *Combretum rautanenii*. None of the Fleck specimens are available on the Zürich Herbarium website, only Rautanen 199, after which the species was named.

Distribution: Angola, Botswana, Kenya, Malawi, Mozambique, Namibia; RSA: Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West; Swaziland, Tanzania, Uganda, Zambia, Zimbabwe (Figure 18).

IX. **Combretum** sect. **Campestris** Engl. & Diels (= sect. *Elaeagnoides* Engl. & Diels) (Stace 1981)

Exell (1978) placed *C. elaeagnoides* Klotzsch in sect. *Elaeagnoides* Engl. & Diels, but Stace (1981) sank it under sect. *Campestris*, stating that there are four species in Africa belonging to this section. Of these, *C. elaeagnoides* is the only species south of the Zambezi River where it is restricted to the *Flora zambesiaca* region (including the Caprivi Strip in Namibia). It has a peculiar type of scales and the leaves, flowers and fruit are densely silvery lepidote. The flowers are 4-merous, arranged in dense, often subcapitate axillary spikes; the disc is without a free margin. *C. elaeagnoides* grows in the Zambezi Valley often forming dense thickets and is known in Zimbabwe as jesse-bush.

24. *Combretum elaeagnoides* Klotzsch in Peters, Naturwissenschaftliche Reise nach Mossambique, Botanik 6, 1: 73 (1861); Engl.: 290 (1895); O.B.Mill.: 42 (1948); Exell: 7 (1968); Exell: 140 (1978); J.D.Carr: 63 (1988); A.E.van Wyk & P.van Wyk: 330 (1997); M.Coates Palgrave: 801 (2002); Curtis & Mannheimer: 491 (2005). Type: Mozambique, Sambesi Jitsch, Tete, *Peters s.n.* (B, holo.†; BM, K, fragment e!, iso.).

C. prunifolium Engl. & Diels: 28 (1899), pro parte. Type: Mozambique, Boroma, *Menyhárh 893* (Z, holo. e!; WU, iso. e!).

C. stvensonii Exell: 171 (1939); O.B.Mill.: 44 (1948). Type: Zambia, Mazabuka, Oct. 1929, *Stevenson 99* (BM, holo. e!; FHO, iso.).

Note: the type of *Combretum prunifolium* Engl. & Diels, *Menyhárh 893* (Z), consists of three specimens, the two upper ones being *C. elaeagnoides* and the lower one *C. hereroense* (Exell 1978).

Distribution: Botswana, Mozambique, Namibia, Zambia, Zimbabwe (Figure 17).

X. *Combretum* sect. *Plumbea* Jordaan, A.E.van Wyk & O.Maurin in Maurin *et al.* (2010)

This section is named *Plumbea*, derived from the Latin word *plumbum* which means lead, referring to the heartwood of *Combretum imberbe* which is extremely hard, heavy and durable; hence the common name leadwood.

Exell (1978) placed *Combretum imberbe* Wawra in sect. *Hypocrateropsis* but separated it from all the other species in this section by its very densely lepidote leaves with scales mostly contiguous. It has rather large scales, 120–300 µm in diameter, roughly circular, cells very numerous and small, divided by radial and tangential walls. A molecular phylogenetic study (Maurin *et al.* 2010) shows that *C. imberbe* is more closely related to *C. elaeagnoides* and *C. hereroense* than to the other members of sect. *Hypocrateropsis* and is treated here in a section of its own. In young growth, the branches are decussate and short lateral shoots end in a spinescent tip. The fruit is very small, less than 18 mm long and densely covered with silvery scales.

25. *Combretum imberbe* Wawra in Sitzungsberichte der Mathem.-Naturw. Classe der Kaiserlichen Akademie der Wissenschaften in Wien 38: 556 (1860); Engl. & Diels: 14 (1899); O.B.Mill.: 43 (1948); Exell & Roessler: 9 (1966); Exell: 7 (1968); Exell & J.G.Garcia: 52 (1970); Wickens: 18 (1973); Exell: 109 (1978); Vollesen: 53 (1980); J.D.Carr: 81 (1988); Pooley: 358 (1993); A.E.van Wyk & P.van Wyk: 332 (1997); McClelland: 462 (2002); M.Coates Palgrave: 803 (2002); Curtis

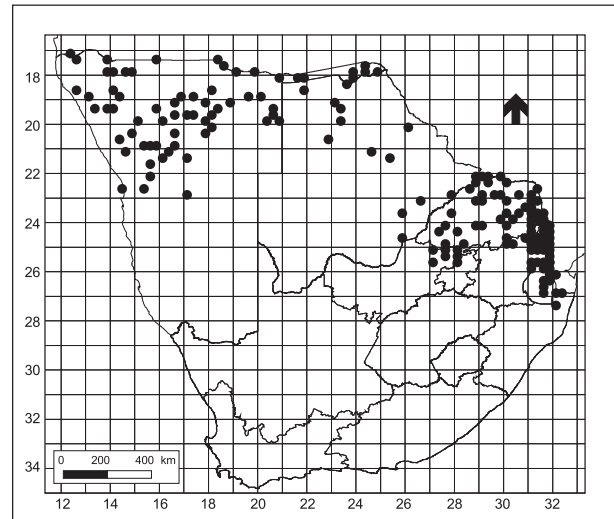


FIGURE 19.—Known distribution in FSA region of *Combretum imberbe*.

& Mannheimer: 480 (2005). Type: Angola, Benguela, Wawra 247 (W e!, holo.; BM e!, iso.).

Argyrodendron petersii Klotzsch: 101 (1861). *Combretum petersii* (Klotzsch) Engl.: 290 (1895). *C. imberbe* Wawra var. *petersii* (Klotzsch) Engl. & Diels: 14 (1899); Engl. & Gilg: 314 (1903); Diels: 491 (1907). Type: Mozambique, Sena, *Peters s.n.* (B, holo.†). Mozambique, Zambezia entre Mocuba e Mugeba, a 36 km de Mocuba (Marata), *Barbosa & de Carvalho 2667* (WAG, neo. e!, designated here).

C. truncatum Welw. ex M.A.Lawson: 427 (1871); Dümmer: 231 (1913); O.B.Mill.: 44 (1948). *C. imberbe* Wawra var. *truncatum* (Welw. ex M.A.Lawson) Burtt Davy: 246 (1926). Type: Angola, Benguela, Catumbela, *Welwitsch 4372* [LISU, lecto. e!, designated by Exell & Garcia (1970); BM e!, K e!, isolecto.].

C. primigenum Marloth ex Engl.: 49 (1888); Engl. & Diels: 14 (1899); O.B.Mill.: 43 (1948). South West Africa [Namibia], Hereroland, Usakos, Omumborombonga, *Marloth 1264* (B, holo.†; GRA e!, K e!, M e!, PRE!, W e!, iso.).

Distribution: Angola, Botswana, Malawi, Mozambique, Namibia; RSA: Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West; Swaziland, Tanzania, Zambia, Zimbabwe (Figure 19).

B. *Combretum* subgen. *Cacoucia* (Aubl.) Exell & Stace (Exell & Stace 1966; Wickens 1973)

Cacoucia Aubl.: 450, t. 179 (1775).

This subgenus is characterized by the absence of scales but the presence of microscopic (and sometimes macroscopic) stalked glandular hairs. The flowers are usually 5-merous (4-merous in sect. *Conniventia*).

Four sections are recognized.

Key to sections of subgen. *Cacoucia*

- 1a Scrambling shrubs or woody climbers, with persistent petiole bases developing into curved spines; leaf lamina densely covered with translucent crystalliferous idioblasts; flowers orange to scarlet-red or white tinged pink; petals minutely hairy or pilose; fruit hairy or glabrous, with wings or wingless sect. XI. *Poivreia* (p. 153)
- 1b Scrambling shrubs, erect shrubs, climbers or suffrutices, without persistent petiole bases developing into curved spines; leaf lamina without crystalliferous idioblasts; flowers red, grey-green or white; petals glabrous or velvety; fruit sparsely hairy to velvety, always with wings:
 - 2a Climbers, shrubs or suffrutices; flowers red; petals glabrous; fruit sparsely hairy on body only; Botswana, northern provinces of South Africa, Swaziland and KwaZulu-Natal sect. XII. *Conniventia* (p. 153)
 - 2b Scrambling shrubs; flowers not red; fruit with velvety covering all over; endemic to or centred on the Kaokoveld Centre of Endemism (Namibia and Angola):
 - 3a Leaves opposite or in whorls of three, not longitudinally folded; flowers grey-green with a pinkish or reddish tinge sect. XIII. *Megalantherum* (p. 155)
 - 3b Leaves opposite, longitudinally folded; flowers white with crimson to reddish brown stamens sect. XIV. *Oxystachya* (p. 155)

XI. **Combretum** sect. **Poivrea** (Comm. ex DC.) G.Don (1832); Wickens: 57 (1973); Exell: 154 (1978)

Combretum mossambicense and *C. bracteosum* belong to this section. They are characterized by the lack of epidermal scales and the presence of gland-tipped hairs on the midrib and lateral veins, hairy pockets in the axils of veins below and translucent gland dots in the leaf lamina. Species in this section have relatively large and showy flowers, usually 5-merous and up to 10 mm long with protruding stamens. The fruit are usually 5-winged or 5-angled. *C. mossambicense* has white or pinkish flowers and is one of the few species of *Combretum* in southern Africa with hairy fruit. The only other species of *Combretum* with pubescent or woolly fruit in our region belong to other sections, namely *C. albo-punctatum*, *C. collinum* subsp. *suluense*, *C. hereroense*, *C. moggii*, *C. oxystachyum* and *C. wattii*. *Combretum bracteosum* and *C. mossambicense* have petioles which persist as a recurved woody spine or hook. Similar recurved hooks are found in *Quisqualis parviflora* Sond. *Combretum bracteosum* is a free-standing, much-branched, many-stemmed shrub, but may climb on other vegetation. It has scarlet or red flowers, but differs from all other southern African species of *Combretum* in having wingless fruit.

26. **Combretum bracteosum** (Hochst.) Brandis in Engl. & Prantl, Die natürlichen Pflanzenfamilien 3,7: 125 (1893); Engl. & Diels: 95 (1899); Dümmer: 68 (1913); Bews: 146 (1921); J.D.Carr: 37 (1988); Hennessy: t. 2028 (1991b); Pooley: 354 (1993); M.Coates Palgrave: 796 (2002). Type: South Africa, [KwaZulu-Natal], 'in sylvis prope fl. Umlaas', Krauss 350 [B, holo.†; BM000902273, lecto. e!, designated here; G e!, MO, fragment e!, S, fragment e!, W, fragment e!, isolecto.].

Poivrea bracteosa Hochst.: 424 (1844); Sond.: 512 (1862); Sim: 223 (1907).

Codonocroton triphyllum E.Mey.: 149 (1843), nom. nud. Type: South Africa, [Eastern Cape], between Omtata [Umtata] and Omsamvubu [Umzimvubu] Rivers, Drège s.n. (S, holo. e!).

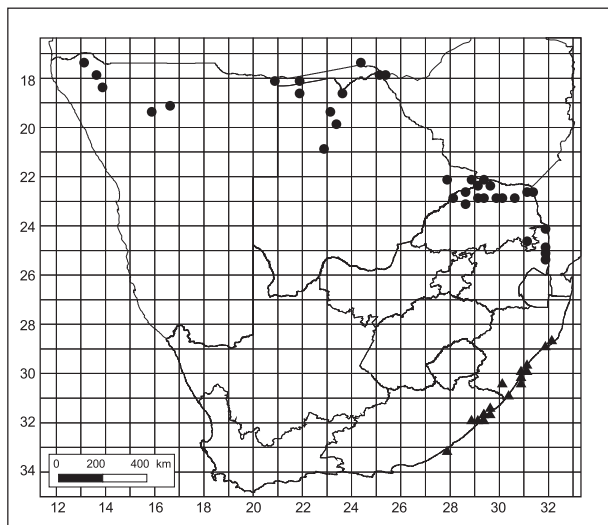


FIGURE 20.—Known distribution of *Combretum mossambicense*, ●, and *C. bracteosum*, ▲.

Note: Krauss 350 in the British Museum (BM), type of *Combretum bracteosum*, is an acceptable flowering specimen chosen here as the lectotype; the isotypes in the other herbaria are merely fragments.

The name *Codonocroton triphyllum* does not seem to be validly published and only appeared in Meyer's, *Zwei pflanzengeographische Documente von J.F. Drège* (1843), collected by Drège in the Eastern Cape, a year before Hochstetter published the name *Poivrea bracteosa*, based on a specimen from KwaZulu-Natal. The Drège specimen at Stockholm Herbarium has a handwritten label and was mounted on the same sheet as S08-899, the type of *Poivrea bracteosa*, the name under which it is filed.

Distribution: RSA: Eastern Cape, KwaZulu-Natal (Figure 20).

27. **Combretum mossambicense** (Klotzsch) Engl., Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete C: 292 (1895); Engl. & Diels: 98 (1899); O.B.Mill.: 43 (1948); Stace: 14 (1961); Exell & Roessler: 9 (1966); Exell: 6 (1968); Liben: 26 (1968); Exell: 219 (1970); Exell & J.G.Garcia: 78 (1970); Wickens: 63 (1973); Exell: 156 (1978); A.E.van Wyk & P.van Wyk: 334 (1997); M.Coates Palgrave: 807 (2002); Curtis & Mannheimer: 482 (2005). Type: Mozambique, Manica e Sofala, Sena, Peters s.n. (B, holo.†; BM, fragment, K, fragment e!, iso.).

Poivrea mossambicensis Klotzsch: 78, t. 13 (1861).

C. ukambense Engl.: 291 (1895). Type: Kenya, Kitui in Ukamba, Hildebrandt 2779 (B, holo.†; K, lecto. e!, designated here; M e!, P e!, W e!, isolecto.).

C. trichopetalum Engl.: 292 (1895); Engl. & Diels: 97, t. 28, fig. C (1899). Tanzania, Mwanza Dist., Makolo, Stuhlmann 722 & Bukumbi, Stuhlmann 822 & without locality, Fischer 250 (all syn. at B†).

C. guangense Engl. & Diels: 98 (1899). Type: Angola, Cuanza Norte, Golungo Alto, Welwitsch 4282 [BM, lecto. e!, designated by Exell & Garcia (1970); COI, G e!, K e!, LISU e!, P e!, isolecto.].

C. cataractarum Diels: 508 (1907); N.E.Br.: 111 (1909); Burt Davy: 248 (1926); Eyles: 427 (1916); O.B.Mill.: 42 (1948). Type: Zimbabwe, Victoria Falls, Oct. 1904, Allen s.n. (B, syn.†) and Ufer, country unknown, Sept. 1905, Engler 2925 (B, syn.†).

C. phillipsii Dümmer: 116 (1913). Type: South Africa, [Mpumalanga], Komatipoort, Kirk 57 (K, holo. e!).

C. detinens Dinter: 170 (1919). Type: [Namibia], between Franzfontein and Outjo, Dinter 2645 (SAM, iso. e!).

Note: the holotype of *Combretum ukambense* was destroyed and of the four extant isotypes, the one in Kew has the best preserved flowering material and is therefore chosen as the lectotype.

Distribution: Botswana, DRC, Kenya, Malawi, Mozambique, Namibia; RSA: Limpopo Province, Mpumalanga; Tanzania, Uganda, Zambia, Zimbabwe (Figure 20).

XII. **Combretum** sect. **Conniventia** Engl. & Diels (1899)

This section falls under subgen. *Cacoucia* because scales are absent but the leaves have stalked glandular

hairs. Flowers are red, 4-merous and the petals are glabrous. Ventenat (1808) described *Combretum paniculatum* from a plant collected in Senegal, West Africa and *C. microphyllum* was described by Klotzsch (1861) from a plant collected in Mozambique. Wickens (1971c, 1973) reduced *C. microphyllum* to a subspecies of *C. paniculatum*. Exell (1968, 1978) raised *C. microphyllum* to species level. Coates Palgrave (1977) placed *C. microphyllum* under *C. paniculatum* and therefore considers this as an aggregate species occurring in most parts of tropical and subtropical Africa. Exell (1978) and Carr (1988) consider *C. paniculatum* and *C. microphyllum* as two distinct species and there seems to be enough molecular evidence (Maurin *et al.* 2010) to maintain these two species. Chemotaxonomic studies conducted by Carr & Rogers (1987), however, found identical extracts for these two species suggesting that they are closely related, but they unfortunately did not include *C. platypetalum* Welw. ex M.A.Lawson in their studies, a species from the *Flora zambesiaca* region and further north, which forms part of this complex (see below). *C. paniculatum* flowers usually in autumn (March–May) and the leaves remain on the plant when in flower. The leaves and flowers are larger than in *C. microphyllum*, a deciduous species that flowers usually in spring (September and October) when no leaves are visible on the plants. Exell (1978) pointed out that, although it is difficult to separate *C. microphyllum* and *C. paniculatum* in the herbarium, the two species are different in the field and they are also ecologically distinct. *C. paniculatum* occurs in forest and forest edges in the Soutpansberg region of South Africa. *C. microphyllum* grows on river banks of, for example, the Limpopo, Letaba, Olifants, Crocodile, Sabi, Komati, Ngwavuma, Pongola and Mkuze Rivers in South Africa in open lowveld savanna in full sun. It has become a popular garden plant in subtropical gardens. Flowers of both species are rich in nectar and are eagerly visited by nectar-feeding sunbirds and passerine birds. The flowers are also visited by honeybees.

Combretum platypetalum is a multi-stemmed, sparsely branched to virgate dwarf shrub (geoxylic suffrutex) up to 1.5 m high (subsp. *oatesii* does not exceed 500 mm) with a thick woody rhizome, occurring in the *Flora zambesiaca* region as well as Namibia, Botswana, DRC, Angola and Tanzania. The differences between subsp. *platypetalum* and subsp. *baumii* (Engl. & Gilg) Exell are not clear because both have hairy leaves and flowers, and we accept the view of Exell (1978) and Carr (1988) that only the typical subspecies occurs in northeastern Namibia crossing the border into Botswana. Subsp. *oatesii* (Rolfe) Exell differs from the other two subspecies by its glabrous leaves. Exell (1978) cites one specimen from Botswana, Rogers 6109 (SRGH), collected at Lobatsi, under *C. platypetalum* subsp. *oatesii* (Rolfe) Exell. No specimen of this taxon has been located in the National Herbarium, Pretoria (PRE) and it is doubtful whether subsp. *oatesii* actually occurs in southeastern Botswana. Further investigation is needed to confirm its presence in southern Africa.

28. *Combretum microphyllum* Klotzsch in Peters, *Naturwissenschaftliche Reise nach Mossambique*, Botanik 6,1: 74 (1861); Dümmer: 183 (1913); Burt Davy: 246

(1926); I. Verd.: t. 978 (1945); O.B. Mill.: 43 (1948); Exell: 6 (1968); Exell: 150 (1978); Vollesen: 53 (1980); Pooley: 360 (1993); McClellan: 464 (2002); M. Coates Palgrave: 804 (2002). Type: Mozambique, Manica e Sofala, vicinity of Rios de Sena and Tete, Peters s.n. (B, holo.†; BM, fragment, lecto. e!, here designated).

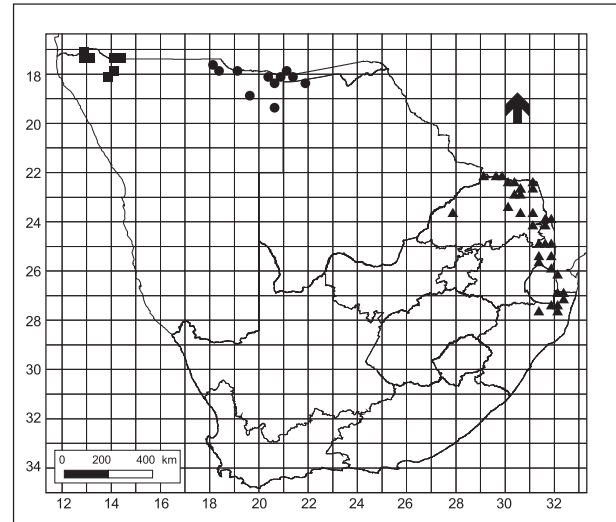


FIGURE 21.—Known distribution in FSA region of *Combretum platypetalum* subsp. *platypetalum*, ●; *C. microphyllum*, ▲; and *C. oxystachyum*, ■.

C. paniculatum Vent. subsp. *microphyllum* (Klotzsch) Wickens: 66 (1971c); Wickens: 53 (1973).

C. lomuense Sim: 62, t. 61/B (1909). Type: Mozambique, without precise locality, Sim 6393 (not traced).

Note: the holotype of *Combretum microphyllum* was destroyed in Berlin and the only extant isotype is in BM, although merely a fragment.

Distribution: Botswana, Malawi, Mozambique; RSA: KwaZulu-Natal, Limpopo Province, Mpumalanga; Swaziland, Tanzania, Zambia, Zimbabwe (Figure 21).

29. *Combretum paniculatum* Vent., *Choix de Plantes*, sub. T. 58 (1808); G. Don: 424 (1827); M.A. Lawson: 425 (1871); Exell: 171 (1928); Exell: 175 (1944); F.W. Andrews: 203 (1950); F. White: 283 (1962); Liben: 34 (1968); Exell: 212 (1970); Exell & J.G. Garcia: 69 (1970); Wickens: 52 (1973); Exell: 149 (1978); Vollesen: 53 (1980); Liben: 37 (1983); D.J. Carr: 120 (1988); Vollesen: 120 (1995); A.E. van Wyk & P. van Wyk: 336 (1997); Jongkind: 70 (1999); M. Coates Palgrave: 809 (2002). Type: Senegal, Roussillon 60 in *Herb. Jussieu* 13632 (P-JU, holo.).

C. ramosissimum Engl. & Diels: 72 (1899). Type: Sierra Leone, Afzelius s.n. (B, syn.†); Bioko, Mann 203 (B, syn.†; K, P, isosyn.); Gabon, Soyaux 86 (B, syn.†; K, iso.); Cameroun, Zenker 210 (B, syn.†); Cameroun, Zenker & Staudt 177 [B, syn.†; K, lecto., designated by Jongkind (1999), BM, isolecto. e!].

Distribution: Angola, Benin, Bioko, Burkina Faso, Cameroon, Cote d'Ivoire, DRC, Ethiopia, Gambia, Guinea, Guinea-Bissau, Kenya, Liberia, Malawi, Mali, Mozambique, Nigeria; RSA: Limpopo Province; São Tomé, Senegal, Sierra Leone, Sudan, Tanzania, Uganda, Zimbabwe (Figure 22).

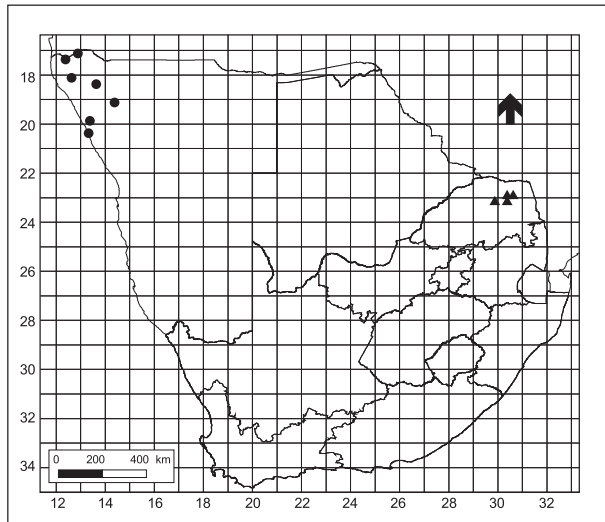


FIGURE 22.—Known distribution in FSA region of *Combretum wattii*, ●; and *C. paniculatum*, ▲.

30. *Combretum platypetalum* Welw. ex M.A.Lawson subsp. **platypetalum** in Flora of tropical Africa 2: 433 (1871); Engl. & Diels: 68 (1899); Exell: 7 (1968); Liben: 39 (1968); Exell: 214 (1970); Exell & J.G.Garcia: 71 (1970); Wickens: 54 (1973); Exell: 151 (1978); Curtis & Mannheimer: 493 (2005). Type: Angola, Huila, Mumpula-Humpata, Welwitsch 4356 (LISU, holo.; BM e!, COI, K e!, P e!, iso.).

C. zastrowii Dinter: 174 (1919); O.B.Mill.: 44 (1948). Type: [Namibia], Grootfontein to Okavango, Zastrow in Herb. Dinter 3135a (SAM, iso. e!).

Distribution: Angola, Botswana, DRC, Namibia, Zambia (Figure 21).

XIII. *Combretum* sect. *Megalantherum* Exell (1968)

Only one very distinct species, *Combretum wattii* Exell endemic to the Kaokoveld Centre of Endemism in northwestern Namibia and southwestern Angola (Van Wyk & Smith 2001), belongs to this section. It has leaves in pairs or in whorls of three and the foliage is confined mainly to short lateral shoots emerging from older wood. A single flower terminates the lateral shoots, accompanied by further individual flowers in one or two sets of distal axils, up to five flowers per lateral shoot. The colour of the flowers is also unusual in being grey-green with a pinkish or reddish tinge. They have a nectariferous disc and are densely pubescent with dark brown stalked glands. The stamens and style are exerted beyond the petals, green at first, becoming reddish. The fruits are 5-winged.

31. *Combretum wattii* Exell in Mitteilungen der Botanischen Staatssammlung München 4: 5 (1961); Exell & Roessler: 11 (1966); Exell & J.G.Garcia: 79 (1970); A.E.van Wyk & P.van Wyk: 336 (1997); M.Coates Palgrave: 812 (2002); Curtis & Mannheimer: 486 (2005). Type: [Namibia], Kaoko-Otavi, 1939, Watt 1766 (M e!, holo.).

Distribution: Angola, Namibia (Figure 22).

XIV. *Combretum* sect. *Oxystachya* Exell (1968)

Only one species from the FSA region, *C. oxystachyum* Welw. ex M.A.Lawson from the Kaokoveld and adjacent parts of Namibia, belongs to this section. It is a scrambling shrub or climber and the leaves are longitudinally folded, with dense white hairs and stalked glands. The flowers are white with crimson to reddish brown stamens. The fruit is 5-winged.

32. *Combretum oxystachyum* Welw. ex M.A.Lawson in Flora of tropical Africa 2: 422 (1871); Hiern: 341 (1898); Exell & Roessler: 10 (1966); Exell: 26 (1968); Exell & J.G.Garcia: 77 (1970); Curtis & Mannheimer: 492 (2005). Type: Angola, Bumbo, Quitibe de Cima, 1860, Welwitsch 4309 (LISU, holo.; BM, iso. e!).

Distribution: Angola, Namibia (Figure 21).

SPECIMENS EXAMINED

Specimens are held at PRE, unless otherwise indicated. The numbers in brackets are the species numbers as used in the text.

Abbott 82 (13). Acocks 9132 (1); 12985 (6). Archer 494 (27). Archibald 3959 (1).

Babich 9 (27). Balkwill & Cadman 1418 (13). Banks 25 (27); 58 (12b). Barrett 12 (28). Bayliss 677 (1). Baytopp 156 (28) UNIN (fide Miller 1948, Setshogo & Venter 2003); 275 (27). Biegel, Pope & Gibbs Russell 4043 (27); 4049 (12b). Biggs 273 (11). Bodenstein 619 (18). Bokelmann s.n. (26). Boshoff & Mason 257 (12b); 283 (9); 301 (22a). Boss TVM34971 (22b). D.J. Botha 3401 (20); 3522 (28). N.M. Botha FDH2889 (13). Botha & Bredenkamp 3608 (22a). Botha & Cilliers 3678 (27). Bowbrick BA625 (17d) SRGH. Bower 9148 (22a). Braun 153 (28). Breijer TRV16043 (28). Brown 7966 (9); 8713 (11). Brusse 6330 (22c). Brynard & Adendorff 4504 (22d). Buitendag 862, 948 (22c); 911 (22a); 1237 (13). Burger 596 (14); 1260 (27). Burgoyne 3262 (9); 3358, 3417 (22a).

Carr 72 (22b); 73, 98 (22a); 79, 107 (11); 96, 115 (17a); 99 (9); 146 (12b); 192 (7). Cawood & Ward 9 (22a). Codd 3025, 4334, 4364 (28); 4448, 5726 (27); 6031, 10291 (6); 7079 (22a); 10326 (14). Codd & Dyer 4585 (20). Coetzee 1195 (4); 1342 (22c). Cole 978 (27). Comins 1715 (1). Compton 26036, 28852, 32363 (22c); 30065 (6); 30145 (28). Cresswell 34 (22a). Culverwell 654, 955 (6); 709, 787 (22c). Curson 119 (10). Curtis 962a, 1022 (17b); 966 (22b); 996, 1081 (9); 1043 (22a).

Dehning RWD9413 (4). De Winter 3644, 3850, 9147 (22a); 3726, 3854 (17b); 3734, 4778 (9); 3861 (12b); 3923 (30); 5760 (31); 6008 (14); 9220, 9247 (24). De Winter & Giess 6953 (9); 6954, 7000 (22b); 6961 (17a); 6999 (17b); 7106 (32). De Winter & Leistner 5392, 5906 (32). De Winter & Marais 4593 (27). De Winter & Wiss 4204 (22a); 4267 (17a); 4286 (30). Du Plessis 279 (14). Du Preez & Steenkamp 104 (22a). G.J. du Toit 5133 (27). P.C.V. du Toit 875 (28). Dyer 26 (1); 4349 (6).

Edwards 1835, 4115 (6); 3139, 3147, 3330 (13); 4337, 4449 (18); 4339, 4395, 4405 (22a); 4398, 4416 (9); 4404, 4446 (17b). Erens 365 (24). Esterhuyse 441 (18).

Fourie 1332 (14). Foye 14 (28). Friederich FR12/77 (17b); FR12/79 (22a).

Galpin 2977, 8116, 11554 (1); 13697, 13853 (28). Geldenhuys 328, 334 (9). Germishuizen 949 (14); 6107 (22c). Gerstner 5887 (22a). Gibbs Russell 4007 (1). Giess 8967, 12385, 14795 (12b); 9303, 9311, 9469, 9478, 9515, 9790, 10003, 10142, 10149, 11473, 12363, 15108 (22a); 9793 (9); 9881 (17a); 9891, 10139, 10146a, 12365, 14803 (17b); 10114 (30); 10500, 10504, 15463 (27); 10505 (31); 14898 (11). Giess & Leippert 7004 (22c); 7581 (18). Giess & Loutit 14111 (27); 14166 (9). Giess & Van der Walt 12635 (32). Giess, Volk & Bleissner 6571 (12b). Gillett 3034 (28). Glen 1827 (22a); 3743 (14). Goosen

41 (22a). Greenway & Hoyle 8340 (17c). Greenway & Kanuri 14299 (17d). Grobbelaar 66a (32). Gush 24 (28).

Hansen 3473 (27). Hardy 7122 (17b). Hardy & Scott-Smith 1534 (6). Hardy & Wells 376 (27). Heath 560 (14). Hemm 36 (14); 97a (22c). Herman 856 (1). Hines 533 (18). Horler 209 (22c). Horn 167 (18). Hornby 2413, 2611 (17d). Hutchinson 2522 (22c).

Ihlenfeldt, De Winter & Hardy 3215 (31).

Jacobsen 3122 (18); 5043, 5142 (9); 5492 (14). Jacot Guillarmod 9471 (1). Jenkins TRV8145 (28). Joffe 1079 (22c). Jordaan 3068 (22c). Joubert PRF8721 (22c); PRF9513 (22d).

Karsten s.n. (22c). Kayombo 976, 977 (17d). Keet 1657 (30). Killick 3842 (22c). Killick & Leistner 3204 (18); 3205 (22a); 3207 (17a). Kirkman 3089 (1). Klaassen & Austaller EK169 (27). Koker 17 (29). Kolberg 746 (22a). Kolberg & Loots HK965 (22b). Kolberg, Loots & Moses HK1125 (32); HK1166 (27). Kolberg & Tholkes HK768 (31). Kreulen 493, 534, 538 (22a). I. Kruger s.n. (22a). P.R. Kruger 282 (13). Krynanuw 1351 (21).

Lang TVM30169 (27); TRV30579, TRV30935 (28). Leistner, Oliver, Steenkamp & Vorster 7 (32); 39 (22b); 70 (22a). Lemmer 13539 (17d). Le Roux 85, 151 (9); 166 (30); 1086 (22a). Letty 212 (26). Ley 154 (21). Liebenberg 4910 (9). Liengme 199 (28); 431 (22c). Lindstedt 86 (1). Loeb 144 (22c); 297 (9). Lötter 753 (19). Louw 2721 (6).

MacKenzie 30 (17b); 40 (9); 62 (22a). Maguire 1628, 2064 (30). Man-nheimer & Curtis CM709, CM726 (32). Mason & Boshoff 301 (22a). Mauve 1055 (26); 5256 (6). McFerren 8a (17a). McKay 1978 (24). Meeuse 9701 (27). Merxmüller & Giess 1392, 1555 (31); 1512 (32); 2002 (9); 2149 (17b); 30238 (12b); 30445 (22a). J.J. Meyer 4158 (28); BP00354 (22c). P.G. Meyer 1287 (32). Miller B/43, B/334 (27); B/106, B/1274 (18); B/178 (22a); B/181 (11); B/424 (30); B/641, B/1199 (9); B/1200 (24); B/1318 (17a); B/1341 (22a); PRF5377 (26). Mills 397 (26). Milne-Redhead 405 (22b). Mogg 17300, 37502 (14); 37096 (22c); 37485 (4). Moll 813 (13); 2091 (6); 4359 (7); 5655 (20). Moll & Muller 5688 (20). Moss PRE32234 (26). Müller 321 (17b); 322 (22a); 1833 (27). Müller & Biegel 2257 (17a); 2274 (11). Müller & Giess 444 (17a); 502 (30); 585, 602 (9). Mullin 1/52 (17d) SRGH.

Nel 119 (22d); 180 (22a); 237 (6). Netshiungani 996 (22c). Nicholson 2122, 2250 (13). Nienaber EN223 (28).

Oates 33 (22c). Obermeyer 542 (22c); 978 (29); TVM36098 (22d). Onderstall 777 (28). Orpen 200, 971 (17d) SRGH.

Pegler 2076 (1). Pienaar 49 (22c); 139 (26); 435 (27). Pienaar & Vahrmeijer 483 (9). Pole Evans 3236 (22b); 3702 (22a); 4598 (10). Porter 330, 342 (22c). Poynton 19428 (14).

P. Raal & G. Raal 1332 (14). Repton 3861 (14); 6415 (27). E. Retief 247 (1). I.M. Retief 205 (28). Richards 10035, 19084 (17d) SRGH. Roberts 1821A (1). Rodin 8978, 9310 (17b); 9119 (9); 9139 (22a). Rogers 2608 (27). Ross 1892 (13). Rossouw 248 (22a).

Scheepers 1133 (22a). Schoenfelder S531 (17b). Seely SEE/47 (22a). Silver SIL28 (22a). Smith 85 (17a); 173, 249, 1164, 1707, 1710, 2593, 2943 (11); 244, 314, 3434, 5686 (22a); 322, 2864 (9); 2063 (24); 2851, 3433, 4051 (17a); 3874 (1). Smook 1335 (6). Smuts 56 (22a); 2078, 2277 (17d). Stalmans 1046 (22c); 1215 (14). Steel 463 (22d). Stephen 335 (28). Steyl 21 (17a); 60 (24); 67 (12b). Steyn 10 (4); 11 (22d); 13 (19); 15 (6); 16 (22a); 17 (21); 18 (22c); 23 (32); PRE61956 (14). Story 2120 (1); 3962 (28); 4651 (27); 4723, 5052, 5270, 5330 (22a); 5093, 6493 (9); 5870 (31); 6356 (12b); 6461 (17b); 6465 (30). Straub 438 (28); 633 (27). Strey 6422, 6850, 7320, (26); 11148 (1). Strey & Moll 3750 (28). Swelankomo 29 (4).

Taylor 2129 (13). G.C. Theron 1067 (1); 1569 (26). G.K. Theron 2604 (22a). Thorncroft TVM22210 (21). Tinley 1004 (7); 1075 (22a); 1425 (24); 1427 (18); 1478 (17a); 1496 (11); 1501 (30).

Uiras MU622 (17b); MU652 (9). Uys 2/65 (17d) SRGH.

Vahrmeijer & Du Preez 2510 (18); 2626 (22c). Vahrmeijer & Tölken 970 (28). Van Daalen 504b (22a). Van der Merwe 58 (22a); 62 (19). Van der Schijff 61, 819 (28); 1010 (27); 1657 (6); 2151, 2898 (20); 3153, 3816, 3822 (22a); 5585 (13). Van der Walt 9510 (20). Van Graan & Hardy 543 (27). Van Greuning 247 (22a). Van Jaarsveld 735

(28); 1164 (21). A.S. van Rensburg PRF11303 (26). J.H. van Rensburg 3034 (17d) SRGH. Van Rooyen & Bredenkamp 609 (19). Van Son TVM28827 (22a); TVM28828 (24). Van Steenis 24011 (26). Van Warmelo 51 z 19/27 (29). A.E. van Wyk 2944 (14); 3069 (22c); 3215 (1); 5188a (27); 6673 (6). A.E. van Wyk & Theron 4913 (28). B.-E. van Wyk & C.M. van Wyk 1423(g) (1). E. van Wyk evw0095 (22d); avw112 (22a); evw117 (14). E. van Wyk & Gavhi evw300 (7); evw353 (19). E. van Wyk, Nkuna & Dlamini 557 (28). P. van Wyk BSA900 (22a); BSA905, BSA916 (17a); BSA918 (9); BSA940 (29); BSA1724 (18); BSA2029 (20); 4763 (19). F. Venter 7265, 7821 (22a); 10338 (4). H.J.T. Venter 6032 (26). Verhoeven 61 (19). Volk 238, 419 (17b). Von Breitenbach 19831 (22d); 20288 (4). Von Teichman 233 (22a).

Walsh 10842 (22a). C.J. Ward 526, 8614, 8727 (26); 2130 (6); 7276 (28); 8793 (7). M.C. Ward 1027 (28); 2286, 2301 (20). Ward & Hines 10334 (30). Wells 1855 (6); 3515 (26); 3587 (1). Wentzel 14 (22c). Westfall 998 (14); 1578 (4). Westphal 16 (27). Wild & Drummond 6840 (11); 6986 (9). Wirminghaus 1144 (13).

Yalala 416 (11).

Zambatis 323 (27); 1225 (28).

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REFERENCES

- ANDREWS, F.W. 1950. *The flowering plants of the Anglo-Egyptian Sudan* 1. Buncle, Scotland.
- AUBLET, J.B.C.F. 1775. *Histoire des plantes de la Guiane française* 1. Londres, Paris.
- BAKER, E.G. 1899. Rhodesian Polypetalae. *Journal of Botany* 37: 422–438.
- BAKER, E.G. 1905. Mr. Eyles's Rhodesian plants. *Journal of Botany* 43: 44–54.
- BEWS, J.W. 1921. Combretaceae. *An introduction to the flora of Natal and Zululand*. City Printing Works, Pietermaritzburg.
- BRANDIS, D. 1898. Combretaceae. In A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien* III, 7: 106–130. Engelmann, Leipzig.
- BREDENKAMP, C.L. 2000. Combretaceae. In O.A. Leistner, *Seed plants of southern Africa: families and genera*. *Strelitzia* 10: 228, 229. National Botanical Institute, Pretoria.
- BRENAN, J.P.M. 1949. Combretaceae. In J.P.M. Brenan & P.J. Greenway, *Check-lists of the forest trees and shrubs of the British Empire* 5, part 2: *Tanganyika Territory*: 132–146. Imperial Forestry Institute, Oxford.
- BROWN, N.E. 1909. List of plants collected in Ngamiland and the northern part of the Kalahari Desert, chiefly in the neighbourhood of Kwebe and along the Botletle and Lake Rivers. *Kew Bulletin* 1909: 89–146.
- BURCHELL, W.J. 1822. *Travels in the interior of southern Africa* 1. Longmans, London.
- BURTT DAVY, J. 1921. New or noteworthy South African plants. *Kew Bulletin* 1921: 278–288.
- BURTT DAVY, J. 1926. *A manual of the flowering plants and ferns of the Transvaal with Swaziland* 1. Longmans & Green, London.
- CARR, J.D. 1988. *Combretaceae in southern Africa*. Tree Society of southern Africa, Johannesburg.
- CARR, J.D. & RETIEF, E. 1989. A new species of *Combretum* from Natal. *Bothalia* 19: 38–40.
- CARR, J.D. & ROGERS, C.B. 1987. Chemosystematic studies of the genus *Combretum* (Combretaceae) I. A convenient method of identifying species of this genus by a comparison of the polar constituents extracted from leaf material. *South African Journal of Botany* 53: 173–176.
- CLARKSON, J.R. & HYLAND, B.P.M. 1986. *Combretum trifoliatum* Vent. (Combretaceae), a new record for Australia. *Austrobaileya* 2: 274–276.
- COATES PALGRAVE, K. 1977. *Trees of southern Africa*, edn 1. Struik, Cape Town.

- COATES PALGRAVE, M. 2002. *Keith Coates Palgrave Trees of southern Africa*, edn 3. Struik, Cape Town.
- CODD, L.E.W. 1951. Trees and shrubs of the Kruger National Park. *Memoirs of the Botanical Survey of South Africa* No. 26: 128–133. Government Printer, Pretoria.
- CODD, L.E.W. 1956. *Combretum zeyheri*. *The Flowering Plants of Africa* 31: t. 1230.
- COMPTON, R.H. 1976. The Flora of Swaziland. *Journal of South African Botany*, Suppl. vol. 11.
- CURTIS, B.A. & MANNHEIMER, C.A. 2005. *Tree atlas of Namibia*. National Botanical Research Institute, Windhoek.
- DAHLGREN, R. & THORNE, R.F. 1984. The order Myrtales: circumscription, variation and relationships. *Annals of the Missouri Botanical Garden* 71: 633–699.
- DE CANDOLLE, A.P. 1828. Combretaceae. *Prodromus systematis naturalis regni vegetabilis* 3: 9–24. Treuttel & Würtz, Paris.
- DE WILDEMAN, É.A.J. 1914. Decades novarum specierum florum katangensis. *Feddes Repertorium* 13: 193–212.
- DE WILDEMAN, É.A.J. 1921. *Contribution à l'étude de la flore du Katanga*. Reynaert, Bruxelles.
- DIELS, F.L.E. 1907. Combretaceae africanae. *Botanische Jahrbücher* 39: 485–515.
- DINTER, K. 1919. Index, der aus Deutsch-Südwestafrika bis zum Jahre 1917 bekannt gewordenen Pflanzenarten IV. *Feddes Repertorium* 16: 167–174.
- DON, G. 1827. A review of the genus *Combretum*. *Transactions of the Linnean Society of London* 15: 412–441.
- DON, G. 1832. Combretaceae. *A general system of gardening and botany* 2: 655–667. Rivington, London.
- DRÈGE, J.F. 1843. *Zwei pflanzengeographische Dokumente*. Leipzig.
- DÜMMER, R.A. 1913. The South African Combretaceae. *The Gardeners' Chronicle*, ser. 3, 53: 52, 53, 67, 68, 116, 117, 147, 148, 164, 165, 181–183, 201.
- DUVIGNEAUD, P. 1956. Géographie des caractères et évolution de la Flore Soudano-Zambézienne III: les Combretum arborescents des savanes et forêts claires du Congo Méridional. *Bulletin de la Société Royale de Botanique de Belgique* 88: 59–90.
- ECKLON, C.F. & ZEYHER, K.L.P. 1834, 1835. *Enumeratio plantarum africarum australis extratropicarum* 1. Perthes & Besser, Hamburg.
- ENGLER, A. 1888. Plantae Marlothianae. Ein Beitrag zur Kenntnis der Flora Südafrikas I. Monokotyledonae und Dikotyledonae archichlamydeae. *Botanische Jahrbücher* 10: 1–50.
- ENGLER, A. 1895. Combretaceae. *Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete* C: 288–295. Reimer, Berlin.
- ENGLER, A. 1921. Combretaceae. *Die Pflanzenwelt Afrikas* 3, 2: 681–729. Engelmann, Leipzig.
- ENGLER, A. & DIELS, F.L.E. 1899. In A. Engler, *Monographien afrikanischer Pflanzen-Familien und -Gattungen* 3: Combretaceae–Combretum. Engelmann, Leipzig.
- ENGLER, A. & DIELS, F.L.E. 1907. Combretaceae africanae. *Botanische Jahrbücher* 39: 487–515.
- ENGLER, A. & GILG, E. 1903. Combretaceae. In O. Warburg, *Kunene-Sambesi-Expedition by H. Baum*: 314–322. Kolonial-Wissenschaftliches Komitee, Berlin.
- ENGLER, A. & various authors. 1902. Plantae benguellense Antunesianae et Dekindtianae. A botanicis Musei Regii Berolinensis. *Botanische Jahrbücher* 32: 128–152.
- EXELL, A.W. 1928. Gossweiler's Portuguese West African plants. Combretaceae. *Journal of Botany* 66, Supplement Polypetalae: 164–174.
- EXELL, A.W. 1930. Notes from the British Museum Herbarium. *Journal of Botany* 68: 244–246.
- EXELL, A.W. 1939. Some new species of *Dombeya*, *Grewia*, and *Combretum* from tropical Africa. *Journal of Botany, London* 77: 165–173.
- EXELL, A.W. 1944. *Catalogue of the vascular plants of São Tomé*. British Museum, London.
- EXELL, A.W. 1961. New species and subspecies of *Combretum* from southern tropical Africa. *Mitteilungen der Botanischen Staatssammlung München* 4: 3–7.
- EXELL, A.W. 1968. Notes on the Combretaceae of southern Africa. *Boletim da Sociedade Broteriana*, sér. 2, 42: 5–33.
- EXELL, A.W. 1970. Summary of the Combretaceae of *Flora zambesiaca*. *Kirkia* 7: 159–252.
- EXELL, A.W. 1978. *Combretum*. In E. Launert, *Flora zambesiaca* 4: 101–160. Flora zambesiaca Managing Committee, Glasgow.
- EXELL, A.W. & GARCIA, J.G. 1970. Combretaceae. *Conspectus florum angolensis* 4: 44–93. Junta de Investigações Científicas do Ultramar, Lisbon.
- EXELL, A.W. & ROESSLER, H. 1966. Combretaceae. In H. Merxmüller, *Prodromus einer Flora von Südwestafrika* 99: 1–11. Cramer, Lehre.
- EXELL, A.W. & STACE, C.A. 1966. Revision of the Combretaceae. *Boletim da Sociedade Broteriana*, sér. 2, 40: 5–25.
- EXELL, A.W. & STACE, C.A. 1972. Patterns of distribution in the Combretaceae. In D.H. Valentine, *Taxonomy, phytogeography and evolution*: 307–323. Academic Press, London and New York.
- EYLES, F. 1916. A record of plants collected in southern Rhodesia. *Transactions of the Royal Society of South Africa* 5: 273–564.
- GUILLEMIN, J.B.A. & PERROTTET, G. 1833. *Combretum* L. *Florae Senegambiae Tentamen* 3, 8: 284–290. Paris.
- HENNESSY, E.F. 1991a. *Combretum maggii*. *The Flowering Plants of Africa* 51: t. 2027.
- HENNESSY, E.F. 1991b. *Combretum bracteosum*. *The Flowering Plants of Africa* 51: t. 2028.
- HENNESSY, E.F. & RODMAN, S. 1995. A note on *Combretum* subgenus *Combretum* section *Macrostigmataea* (Combretaceae). *Bothalia* 25: 149–153.
- HIERN, W.P. 1898. *Catalogue of the African plants collected by Dr. Friedrich Welwitsch*, vol. 1. Trustees of British Museum, London.
- HOCHSTETTER, C.F.F. 1844. Pflanzen des Cap- und Natal-Landes, gesammelt und zusammengestellt. *Flora* 27: 424.
- HOFFMANN, F. 1889. *Beiträge zu Kenntnis der Flora von Central-Ost-Afrika*. Loewenthal, Berlin.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index herbariorum, part 1: The herbaria of the world*, edn 8. New York Botanical Garden, New York.
- HOOKE, W.J. 1843. *Combretum salicifolium*. *Hooker's Icones Plantarum*, ser. 2, 6: t. 592.
- JONGKIND, C.C.H. 1999. Combretaceae. In P. Morat, *Flore du Gabon* 35: 5–115. Muséum National d'Histoire Naturelle, Paris.
- JORDAAN, M. 2003. Combretaceae. In G. Germishuizen & N.L. Meyer, *Plants of southern Africa: an annotated checklist*. *Strelitzia* 14: 369–371. National Botanical Institute, Pretoria.
- JORDAAN, M. 2006. Combretaceae. In G. Germishuizen, N.L. Meyer, Y. Steenkamp & M. Keith, *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41: 329, 330. SABONET, Pretoria.
- KLOPPER, R.R., CATELAIN, C., BÄNNINGER, V., HABASHI, C., STEYN, H.M., DE WET, B.C., ARNOLD, T.H., GAUTIER, L., SMITH, G.F. & SPICHIGER, R. 2006. *Checklist of the flowering plants of sub-Saharan Africa*. South African Botanical Diversity Network Report No. 42. SABONET, Pretoria.
- KLOTZSCH, J.F. 1861. *Combretum elaeagnoides*. In W.C.H. Peters, *Naturwissenschaftliche Reise nach Mossambique*, Botanik 6, 1. Reimer, Berlin.
- KUNTZE, C.E.O. 1898. Combretaceae. *Revisio generum plantarum* 3, 2: 87, 88. Felix, Leipzig.
- LAWSON, M.A. 1871. Combretaceae. In D. Oliver, *Flora of tropical Africa* 2: 413–436. Reeve, London.
- LIBEN, L. 1968. Spermatophytes. Combretaceae. *Flore du Congo du Rwanda et du Burundi*. Jardin Botanique National de Belgique, Bruxelles.
- LIBEN, L. 1983. *Combretum*. In B. Satabié, *Flore du Cameroun* 25: 13–61. Délégation Générale à la Recherche Scientifique et Technique, Yaoundé.
- LOFFLER, L. & LOFFLER, P. 2005. *Swaziland Tree Atlas, including selected shrubs and climbers*. Combretaceae. Southern African Botanical Diversity Network Report No. 35: 62–65. SABONET, Pretoria.
- MAURIN, O., CHASE, M.W., JORDAAN, M. & VAN DER BANK, M. 2010. Phylogenetic relationships of Combretaceae inferred from nuclear and plastid DNA sequence data: implications for generic classification. *Botanical Journal of the Linnean Society* 162: 453–476.
- McCLELAND, W. 2002. Combretaceae. In E. Schmidt, M. Lötter & W. McClelland, *Trees and shrubs of Mpumalanga and Kruger National Park*: 456–474. Jacana, Johannesburg.
- McNEILL, J., BARRIE, F.R., BURDET, H.M., DEMOULIN, V., HAWKSWORTH, D.L., MARHOLD, K., NICOLSON, D.H., PRADO, J., SILVA, P.C., SKOG, J.E., WIERSEMA, J.H. & TURLAND, N.J. (eds). 2006. International Code of Botanical Nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005. A.R.G. Gantner Verlag, Ruggell, Liechtenstein. *Regnum Vegetabile* 146.

- MEYER, E.H.F. 1843. Beigabe zur Flora. *Zwei pflanzengeographische Documente von J.F. Drège*. Leipzig.
- MILLER, O.B. 1948. Combretaceae. *Checklists of the forest trees and shrubs of the British Empire* No. 6: 42–44. Bechuanaland Protectorate. Scrivener Press, Oxford.
- MOORE, S. 1921. *Alabastra Diversa*—Part XXXIV. *Plantae Rogersianae*—VI. *The Journal of Botany* 1921: 227.
- OKAFOR, J.C. 1967. A taxonomic study of the *Combretum collinum* group of species. II. The subspecies of *Combretum collinum*. *Boletim da Sociedade Broteriana*, sér. 2, 41: 137–150.
- PEDLEY, L. 1990. Combretaceae. *Flora of Australia* 18: 255–293. Australian Government Publishing Service, Canberra.
- POOLEY, E.S. 1993. *The complete field guide to trees of Natal, Zululand and Transkei*. Natal Flora Publications Trust, Durban.
- PRESL, K.B. 1844. *Botanische Bemerkungen*. Haase, Prague.
- RENDLE, A.B. 1932. African notes II. *Journal of Botany* 70: 89–96.
- RETIEF, E. 1986. A new species of *Combretum* from the Transvaal. *Bothalia* 16: 44, 45.
- RICHARD, A. 1848. *Tentamen florae abyssinicae* 1. Bertrand, Paris.
- RODMAN, S. 1990. *The validity of currently recognized sectional limits within Combretum Loeffling, subgenus Combretum (Combretaceae) in southern Africa*. M.Sc. thesis, Department of Botany in the Faculty of Science at the University of Durban-Westville, Durban.
- ROGERS, C.B. 1989. New mono- and bi-desmosidic triterpenoids isolated from *Combretum padoides* leaves. *Journal of Natural Products* 52: 528–533.
- SCHINZ, H. 1888. Beiträge zur Kenntnis der Flora von Deutsch-Südwest-Afrika und der angrenzenden Gebiete. *Verhandlungen des Botanischen Vereins der Provinz Brandenburg* 30: 245–247.
- SCHINZ, H. 1894. Beiträge zur Kenntnis der afrikanischen Flora. Combretaceae. *Bulletin de l'Herbier Boissier* 2: 202, 203.
- SCHINZ, H. 1901. Beiträge zur Kenntnis der afrikanischen Flora. Combretaceae. *Bulletin de l'Herbier Boissier*, sér. 2, 1: 877–879.
- SETSHOGO, M.P. & VENTER, F. 2003. *Trees of Botswana: names and distribution*. South African Botanical Diversity Network Report No. 18. SABONET, Pretoria.
- SIM, T.R. 1907. *The forests and forest flora of the Colony of the Cape of Good Hope*. Taylor & Henderson, Aberdeen.
- SIM, T.R. 1909. *Forest flora and forest resources of Portuguese East Africa*. Taylor & Henderson, Aberdeen.
- SONDER, O.W. 1850. Beiträge zur Flora von Südafrika. Combretaceae. *Linnaea* 23: 42–47.
- SONDER, O.W. 1862. Combretaceae. In W.H. Harvey & O.W. Sonder, *Flora capensis* 2: 507–513. Hodges & Smith, Dublin.
- STACE, C.A. 1961. Cuticular characters as an aid to the taxonomy of the South West African species of *Combretum*. *Mitteilungen der Botanischen Staatssammlung München* 4: 9–19.
- STACE, C.A. 1965. The significance of the leaf epidermis in the taxonomy of the Combretaceae. I. A general review of tribal, generic and specific characters. *Botanical Journal of the Linnean Society* 59: 229–252.
- STACE, C.A. 1969. The significance of the leaf epidermis in the taxonomy of the Combretaceae. II. The genus *Combretum* subgenus *Combretum* in Africa. *Botanical Journal of the Linnean Society* 62: 131–168.
- STACE, C.A. 1980. The significance of the leaf epidermis in the taxonomy of the Combretaceae V. The genus *Combretum* subgenus *Cacousia* in Africa. *Botanical Journal of the Linnean Society* 81: 185–203.
- STACE, C.A. 1981. The significance of the leaf epidermis in the taxonomy of the Combretaceae: conclusions. *Botanical Journal of the Linnean Society* 81: 327–339.
- STACE, C.A. 2007. Combretaceae. In K. Kubitzki, *The families and genera of vascular plants* 9: 67–82. Springer Verlag, Berlin.
- STAFLEU, F.A. & COWAN, R.S. 1976–1988. *Taxonomic literature*, vol. 1–7. Bohn, Scheltema & Holkema, Utrecht.
- SUESSENGUTH, K. 1953. Neue Taxa, Kombinationen und Vorkommen in Süd-Afrika. *Mitteilungen der Botanischen Staatssammlung München* 1: 333–345.
- SWYNNERTON, C.F.M. & BAKER, J.G. 1911. Contribution to the flora of Gazaland. Dicotyledons, Polypetalae. *Journal of the Linnean Society* 40: 16–76.
- SYTSMA, K.J., LITT, A., ZJHRA, M.L., PIRES, C., NEPOKROEFF, M., CONTI, E., WALKER, J. & WILSON, P.G. 2004. Clades, clocks, and continents: historical and biogeographical analysis of Myrtaceae, Vochysiaceae, and relatives in the southern hemisphere. *International Journal of Plant Science* 165 (4 Suppl.): S85–S105.
- THULIN, M. 1993. Combretaceae. *Flora of Somalia* 1: 247–254. Royal Botanic Gardens, Kew.
- TILNEY, P.M. 2002. A contribution to the leaf and young stem anatomy of the Combretaceae. *Botanical Journal of the Linnean Society* 138: 163–196.
- VAN HEURCK, H.F. & MÜLLER, ARGOWIENSIS, J. 1871. *Observationes botanicae et descriptiones plantarum herbaria Van Heurckiani*. Antwerpen, Berlin.
- VAN WYK, A.E. 1984. A new species of *Combretum* from Venda and taxonomic notes on the section *Angustimarginata* (Combretaceae). *South African Journal of Botany* 3: 125–134.
- VAN WYK, A.E. & SMITH, G.F. 2001. *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umdaus Press, Pretoria.
- VAN WYK, A.E. (Braam) & VAN WYK, P. 1997. *Field guide to trees of southern Africa*. Struik Publishers, Cape Town.
- VENTENAT, E.P. 1808. *Choix de Plantes*. Crapelet, Paris.
- VERDOORN, I. 1945. *Combretum microphyllum*. *The Flowering Plants of Africa* 25: t. 978.
- VERHOEVEN, R.L. & VAN DER SCHIJFF, H.P. 1973. A key to the South African Combretaceae based on anatomical characteristics of the leaf. *Phytomorphology* 23: 65–75.
- VERHOEVEN, R.L. & VAN DER SCHIJFF, H.P. 1975. A short note on *Combretum edwardsii* Exell. *Journal of South African Botany* 41: 39, 40.
- VOLLESEN, K. 1980. Annotated check-list of the vascular plants of the Selous Game Reserve, Tanzania. *Opera Botanica* 59: 3–117.
- VOLLESEN, K. 1986. Name changes for two well-known African Combretaceae. *Kew Bulletin* 41: 962.
- VOLLESEN, K. 1995. Combretaceae. In S. Edwards, M. Tadesse & I. Hedberg, *Flora of Ethiopia and Eritrea* 2, 2: 115–131. The National Herbarium, Addis Ababa University, Ethiopia.
- WAWRA, H. 1860. Sertum Benguelense. Polypetalae. *Sitzungsberichte der Mathem.-Naturw. Classe der Kaiserlichen Akademie der Wissenschaften in Wien* 38: 556.
- WELWITSCH, F.M.J. 1856. Parte não official. *Annaes Conselho Ultramarino*, sér. 1, 24: 249, 250.
- WHITE, F. 1962. *Forest flora of Northern Rhodesia*. Oxford University Press, London.
- WICKENS, G.E. 1971a. The *Combretum hereroense* complex (Combretaceae). *Kew Bulletin* 25: 411–416.
- WICKENS, G.E. 1971b. The *Combretum psidioides* Welw. complex (Combretaceae). *Kew Bulletin* 26: 37–40.
- WICKENS, G.E. 1971c. Linear discriminant functions and the *Combretum paniculatum* Vent. and *C. microphyllum* Klotzsch complex in the Combretaceae. *Kew Bulletin* 26: 61–66.
- WICKENS, G.E. 1973. *Combretum*. In R.M. Polhill, *Flora of tropical East Africa, Combretaceae*: 2–66. Crown Agents for Oversea Governments and Administrations, London.
- WOOD, J.M. 1908. Revised list of the flora of Natal. *Transactions of the South African Philosophical Society* 18: 121–271.

Websites:

ALUKA LIBRARY. <http://www.aluka.org> [accessed March 2009].

ANGIOSPERM PHYLOGENY WEBSITE (APweb). 2008.

www.mobot.org/MOBOT/Research/APweb/ [accessed August 2009].

ZÜRICH HERBARIUM <http://www.zuerich-herbarien.unizh.ch/> [accessed August 2008].

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Generic status of *Quisqualis* (Combretaceae), with notes on the taxonomy and distribution of *Q. parviflora*

M. JORDAAN*, A.E. VAN WYK** and O. MAURIN***

Keywords: Africa, *Campylogyne* Hemsley, classification, Combretaceae, *Combretum* Loebl., new combination, phylogeny, pollination, *Quisqualis* L., southern Africa, taxonomy

ABSTRACT

The taxonomic status of *Quisqualis* L., a genus closely related to and sometimes considered congeneric with *Combretum* Loebl., is discussed. The genus *Quisqualis* is maintained to accommodate selected African, Indian, Asian and Malesian species (including *Q. indica* L. and *Q. parviflora* Sond.). Diagnostic characters for *Quisqualis* include: leaves with abundant sub-epidermal crystalliferous idioblasts, each containing a large druse of calcium oxalate; leaves, stems and flowers with stalked glands but no scales; persistent petiole bases that develop into curved spines; petals well developed; hypanthium tubular or cylindrical, usually longer than 20 mm; stamens and style not or scarcely exerted; style adnate to hypanthium for more than half its length. *Quisqualis* shares a number of morphological similarities with *Combretum* Loebl. subgen. *Cacoucia* (Aubl.) Exell & Stace sect. *Poivreia* (Comm. ex DC.) G.Don. Some species of Combretaceae from West, West Central and East Africa have the style adnate to the upper hypanthium and display features reminiscent of both *Quisqualis* and *Combretum*. These species also have characters of their own and in the past were placed in different sections under *Combretum*. It is suggested that at least some of these species may be best classified in genera distinct from *Combretum* and *Quisqualis*, one of which is *Campylogyne* Hemsley. *Combretum* s.str. is defined on the basis of a combination of characters and includes species of which the upper hypanthium is variable in shape, but when tubular or cylindrical, then always shorter than 20 mm. Other diagnostic characters include: stamens exerted well beyond petals; style exerted and free, but when shortly adnate to upper hypanthium (only at the base or for a short distance), then stamens long-exserted. It is suggested that different pollination strategies have developed independently in the *Combretum*–*Quisqualis* clade, resulting in convergent morphological trends in floral morphology. These homoplasious similarities in floral morphology are at the root of the difficulties experienced to demarcate genera. An alternative classification is provided for those preferring to include the southern African *Quisqualis parviflora* under *Combretum* s. l. For this purpose, a new combination and name, *Combretum sylvicola* O.Maurin is provided. *Quisqualis parviflora* is confined to the Eastern Cape and KwaZulu-Natal coastal regions and does not extend beyond this area as has been claimed by some. A comparative table to differentiate among four groups in *Quisqualis* and *Combretum* in Africa, as well as a photo of a herbarium specimen and a distribution map of *Quisqualis parviflora*, are provided.

INTRODUCTION

Quisqualis L., a genus comprising ± 17 species, occurs in Africa, India, Asia (China) and Malesia (Exell 1954; Chen & Turland 2007). It shares a number of morphological similarities with *Combretum* Loebl. subgen. *Cacoucia* (Aubl.) Exell & Stace sect. *Poivreia* (Comm. ex DC.) G.Don. In southern Africa, *Combretum mossambicense* (Klotzsch) Engl. and *C. bracteosum* (Hochst.) Brandis belong to this section. *Quisqualis parviflora* Sond. (Figure 1), the only southern African member of the genus, as well as the latter two species of *Combretum*, are characterized by the absence of epidermal glandular scales and leaves with stalked glands on the petiole, midrib, lateral veins and flowers. Scales are always present in subgen. *Combretum* where they are of considerable taxonomic significance, especially at sectional level (Jordaan *et al.* 2011). Stalked glands, on the other hand, are of little use for resolving sections in subgen. *Cacoucia* as well as in genera such as *Quisqualis* and *Calopyxis* Tul. (Stace 1980). Long unicellular combretaceous hairs (non-glandular, sharp-pointed, thick-walled

with a bulbous base) are present in both subgenera of *Combretum* and in *Quisqualis*.

Hennessy (1991) described the leaf lamina of *Combretum bracteosum* as ‘pellucid-punctate’. This distinctive character has now also been observed in *C. bracteosum*, *C. mossambicense*, *Quisqualis parviflora* and *Q. indica* L. These so-called pellucid dots are abundant, spherical, subepidermal, crystalliferous idioblasts, each containing a large druse of calcium oxalate (Figure 2) (see Tilney 2002). These idioblasts are also quite noticeable in dry material as numerous tiny bumps on one or both lamina surfaces when viewed under a stereo light microscope. *Quisqualis* may have extrafloral nectaries (Tilney & Van Wyk 2004), structures not yet recorded in *Combretum*. Furthermore, *C. mossambicense*, *C. bracteosum* and *Quisqualis parviflora* all have hooked or straight spines derived from persistent petioles by means of which they climb in or over vegetation. The flowers vary from white with long protruding stamens in *C. mossambicense*, bright red in *C. bracteosum*, to greenish with included stamens in *Quisqualis parviflora*. *C. mossambicense* has 5-winged, softly hairy fruits, but those of *C. bracteosum* are quite different in being wingless, hairless and indistinctly 5-angled nuts.

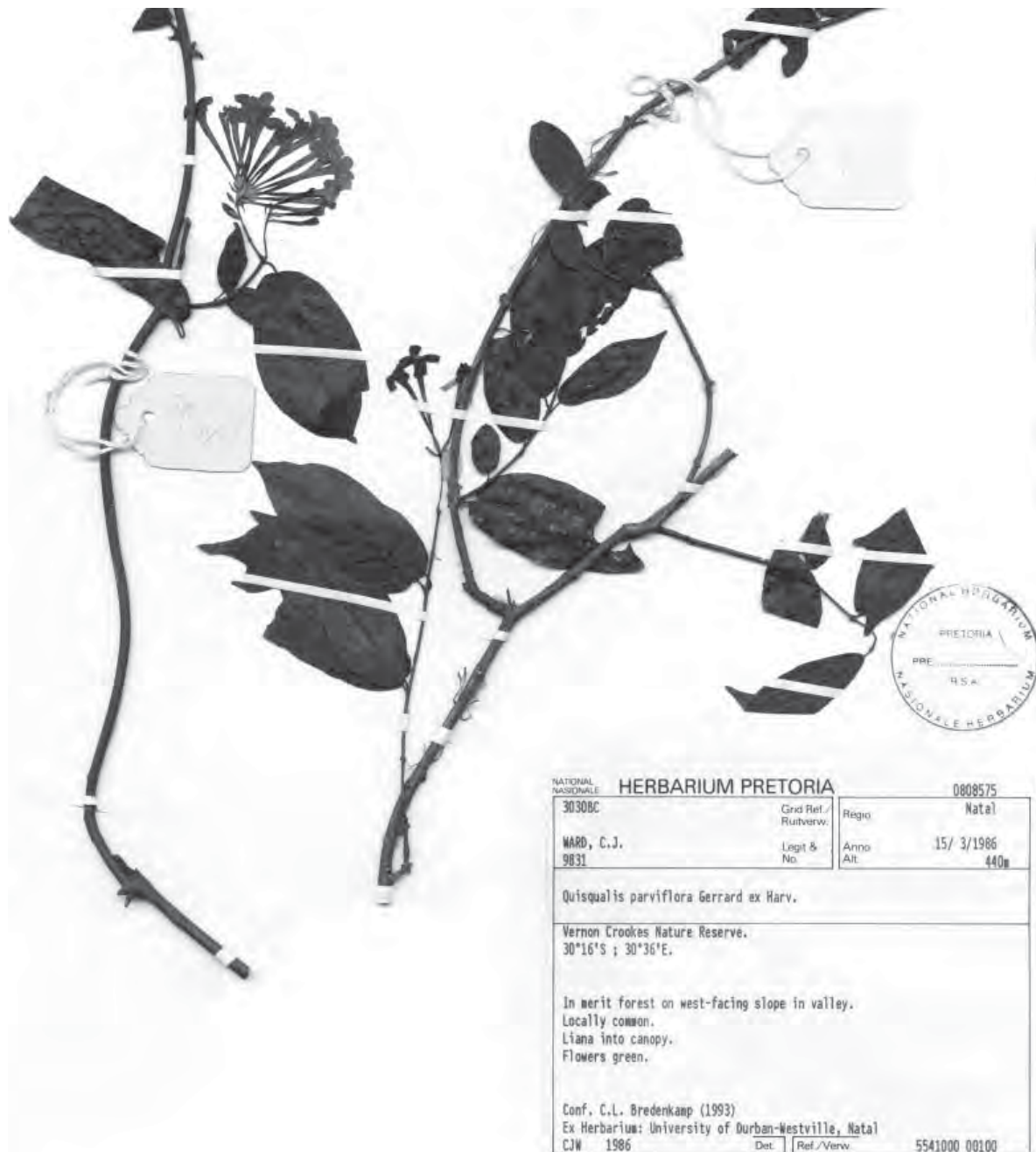
Quisqualis parviflora, according to Carr (1986), has 5-winged fruits. However, we could not find any fruiting material of this species in South African herbaria and it is possible that Carr inferred the fruit morphology from generic descriptions which are based mainly on non-African material. The 4-winged fruit attributed to *Quisqualis parviflora* and depicted in plate 1925 of *The*

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FIGURE 1.—*Quisqualis parviflora*, Ward 9831 in PRE.

Flowering Plants of Africa (Carr 1986) is said to have come from Mariepskop, Mpumalanga. Considering the known distribution of this species in southern Africa (Figure 3), the fruit most probably belonged to a member of *Combretum* and not to *Quisqualis*. Tony Abbott (pers. comm.) has confirmed that he has not seen any fruits on this species in the Umtamvuna Nature Reserve for the last 30 years. As Carr (1986) states, even flowering seems to be a rare event, only a handful of flowering specimens exist in South African herbaria. On the other hand, the paucity of flowering material in herbaria may well be due to the fact that the flowers are inconspicuous and borne in the canopy of tall forest trees well out of the reach of plant collectors. The flowering and reproductive behaviour of *Q. parviflora* is clearly in need of further investigation.

History of the genus *Quisqualis*

The genus *Quisqualis* was established by Linnaeus (1762). Hooker (1867), Lawson (1871) and Brandis (1898) separated *Quisqualis* from *Combretum* on the basis of its elongated, tubular, upper hypanthium which is subterete throughout and not constricted towards the base—a character state absent in typical *Combretum*. They attributed to *Quisqualis* several species from Asia, tropical and southern Africa. Engler & Diels (1900), on the other hand, recognized *Quisqualis* based on the alleged presence of dehiscent fruit, compared to indehiscent fruit in *Combretum*. However, this character proved to be unreliable because many species of *Combretum* have tardily dehiscent fruit.

Exell (1931) proposed a new circumscription of *Quisqualis* and *Combretum* based on the insertion of the style in the upper hypanthium: if the style is adnate to

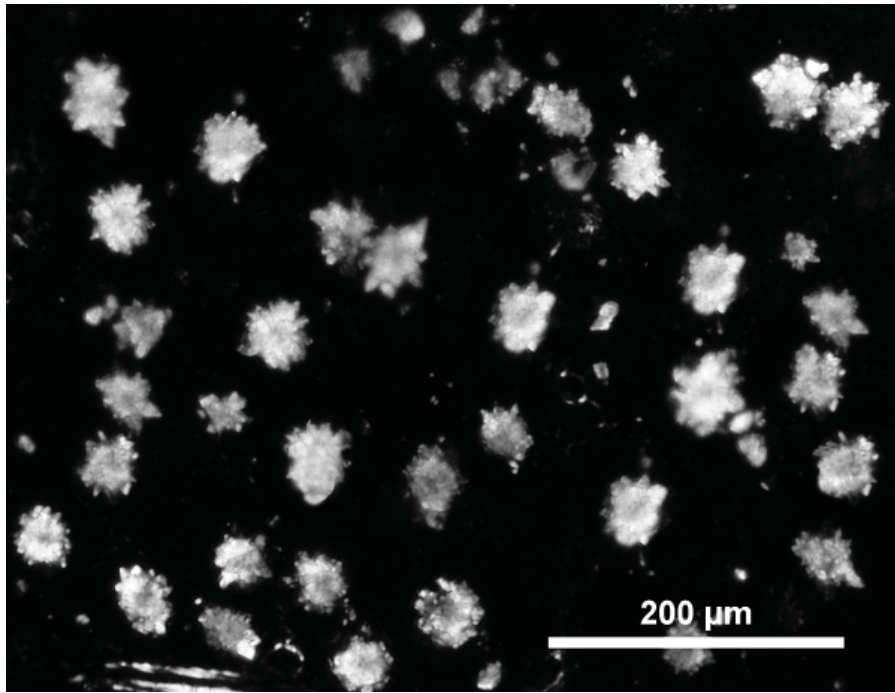


FIGURE 2.—Paradermal section of leaf blade of *Combretum mossambicense* showing subepidermal, crystalliferous idioblasts under polarized light. Each idioblast contains a large druse of calcium oxalate.

the hypanthium, it is a *Quisqualis*. Based on his generic concept, Exell (1931) transferred the following African species to *Quisqualis*: *Combretum hensii* Engl. & Diels, *C. latialatum* Engl. ex Engl. & Diels, *C. littoreum* Engl. and *C. exannulatum* (O.Hoffm.) Engl. & Diels. These species of *Combretum* were earlier classified, together with *C. oxystachyum* Welw. ex M.A.Lawson, in *Combretum* sect. *Campylogyne* (Hemsl.) Engl. & Diels (Engler & Diels 1899). Subsequent to Exell's (1931) new definition of *Quisqualis*, some specimens from tropical Africa classified under *Combretum* were found in which the style is very shortly adnate to the upper hypanthium. To avoid this ambiguity, Exell & Stace (1964, 1966) redefined *Quisqualis* and separated it from *Combretum* by a combination of two characters: 1, adnation of the style to the hypanthium and 2, the non-exsertion of stamens from the flower. Exell & Stace (1964) provided a useful key to distinguish between *Quisqualis* and *Combretum*. Jongkind (1991), on the other hand, proposed the amalgamation of *Quisqualis* with *Combretum* based on the adnation of the style to the upper hypanthium which he encountered in some otherwise undisputed species of *Combretum*. He formally transferred a number of species from *Quisqualis* to *Combretum* (Jongkind 1991, 1992, 1999). Based on leaf anatomical evidence, Tilney (2002) supports the classification of Jongkind (1991). Stace (2007) and Mabberley (2008) follow Jongkind's lumping of the two genera.

Quisqualis in Africa

The style is free from the hypanthium in nearly all species of *Combretum* in Africa and only in a few is there a certain degree of adnation to the upper hypanthium. For example, *C. ghesquierei* Liben from the Democratic Republic of Congo (DRC) has 4-merous (mostly 5-merous in other species) flowers with the style only adnate to the very base of the upper hypanthium, but with long-exserted stamens. Liben (1968) separated this species from all of the other members of *Combretum*

in West Central Africa and placed it in a group of its own. Furthermore, Jongkind (1990) found that the style is fused to the upper hypanthium for more than 2 mm in *C. grandiflorum* G.Don from West tropical Africa (Guinea, Liberia and Sierra Leone, through Ivory Coast to Ghana). It has bright red, 5-merous flowers with the upper hypanthium infundibuliform, 12–20(–25) mm long, glabrous or sparsely hairy, petals 10–15 mm long, glabrous or with few hairs on veins outside, but with the stamens long-exserted. Engler & Diels (1899) placed this species, together with other West African species, in a section of their own, namely sect. *Grandiflorae*, based on the nearly glabrous petals. Stace (1981) placed this section in synonymy with subgen. *Cacoucia* sect. *Poivrea*, a step which seems morphologically poorly supported. Although *C. grandiflorum* also has leaves with abundant crystalliferous idioblasts as in *C. mossambicensis* and *C. bracteosum*, and bright red flowers as in *C. bracteosum*, it has no stalked glands and almost glabrous petals. The petals in the latter two species are densely hairy. With its long-exserted stamens, *C. grandiflorum* still fits better morphologically with *Combretum* than with *Quisqualis*. We suggest it be retained in *Combretum* sect. *Grandiflorae* as proposed by Engler & Diels (1899). Crystalliferous idioblasts in the leaves of *C. grandiflorum* may not be homologous to those in the leaves of members of sect. *Poivrea*, but is perhaps a similarity due to convergence.

Nine species in Africa were at one time or another placed under *Quisqualis* (Liben 1968; Wickens 1973). Six of these are from the most western parts of West Central Africa (Angola, adjacent DRC, Gabon and Cameroon), namely *Q. exannulata* (O.Hoffm.) Exell, *Q. falcata* Welw. ex Hiern, *Q. hensii* (Engl. & Diels) Exell, *Q. latialata* (Engl. ex Engl. & Diels) Exell, *Q. mussaendiflora* (Engl. & Diels) Exell and *Q. pellegriniana* (Exell) Exell. Two species grow along the east coast of Africa, namely *Q. parviflora* in South Africa and *Q. littorea* (Engl.) Exell in Somalia, Kenya and Tanzania. The ninth

TABLE 1.—Comparison of proposed four groups of African *Combretum* and *Quisqualis*. See footnotes for more information on each group

Group	Species	Inflorescence type	Flower		Shape of upper hypanthium	Stalked glands	Scales	Crystal-liferous idioblasts in leaf	Stamen length	Style		
			bracts	maturation (anthesis)						colour	length	orientation
1	<i>Campylogyne exannulata</i>	racemes	large, leafy, along whole axis, $\frac{2}{3}$ length of flower	± synchronous	rose-purple	absent	absent	absent	scarcely exerted	well exerted	geniculate	short
2	See footnote	dense subcapitate racemes	large, ± $\frac{1}{4}$ length of flower, only at base	pronounced acropetal	pale green, yellow and red	present	absent	present	included/scarcely exerted	scarcely exerted	straight	long
3	<i>Quisqualis</i> s.str.	very lax elongated spikes or umbellate	elliptic to linear, along whole axis, much shorter than $\frac{1}{3}$ of flower	± synchronous	greenish, white and red	present	absent	present	included	scarcely exerted	straight	long
4	<i>Quisqualis hensii</i> *	dense capitate racemes	$\frac{2}{3}$ length of flower	± synchronous	?	present	absent	absent	well exerted	well exerted	straight	short
4	<i>Combretum grandiflorum</i> **	subcapitate racemes	leaf-like, elliptic, ± $\frac{1}{3}$ length of flower, early caducous	± synchronous	bright red	absent	absent	absent	well exerted	well exerted	straight	short
4	<i>Combretum</i> subgen. <i>Cacoucia</i> sect. <i>Poivreia</i> ⁺	subcapitate racemes	leaf-like, ovate, ± $\frac{1}{3}$ length of flower, early caducous	± synchronous	bright red or white tinged pink	present	absent	present	well exerted	well exerted	straight	not
4	<i>Combretum</i> s.str. [•]	elongated or subcapitate spikes or racemes	shorter than $\frac{1}{3}$ of flower	± synchronous	yellow, white, red	present or absent	present or absent	absent	well exerted	well exerted	straight	not

Group 1: (= *Quisqualis exannulata*) (Angola, DRC).Group 2: West Central African and East African group: *Combretum inflatum*, *Quisqualis falcata*, *Q. latialata*, *Q. littorea*, *Q. mussaendiflora*, *Q. pellegriniana* (Angola, Gabon, DRC, Nigeria, Cameroon, Tanzania, Kenya, Somalia).Group 3: *Quisqualis parviflora*, *Q. indica* (African form), plus Indian, Asian & Malesian species.Group 4: *(DRC, Gabon); +*Combretum mossambicensis*, *C. bracteosum* (southern & tropical Africa); ** and other members of *Combretum* sect. *Grandiflorae* (Liberia to Ghana); ● (Africa).

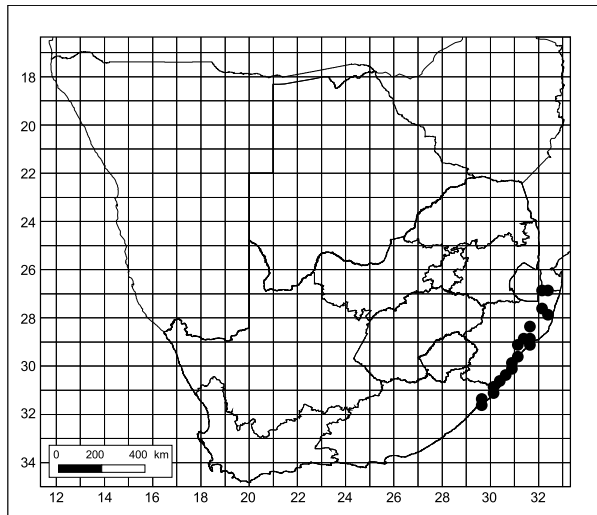


FIGURE 3.—Known distribution of *Quisqualis parviflora*.

species, *Q. indica* L., is reputed to be a native of Asia, but is now widely cultivated as a horticultural subject in the tropics.

In Africa, herbarium specimens attributed to *Quisqualis indica* L. have been recorded from both gardens and the wild in West, East and South Africa. The cultivated Asian form of *Q. indica* has become semi-naturalized in close proximity to human dwellings, such as in the Nairobi Arboretum (e.g. Williams 396, 529 and Greenway 1821, all in PRE). However, a number of herbarium specimens somewhat resembling *Q. indica* were collected from natural habitats (near streams or in damp places) along the woodland escarpment in the Iringa District, Tanzania, e.g. Lovett & Congdon 1093, 300, Taylor et al. 8493 (MO, PRE) and Greenway & Kanuri 14816, Napper 1685 (PRE). These specimens require further study and may well turn out to be an indigenous African form of *Q. indica*, or a new species. The Tanzanian taxon differs in its petals being well developed, up to 23 mm long with abruptly acuminate apices. *Q. indica* in Asia has petals up to 12 mm long with round to blunt apices. Wickens (1973) noted the differences between the indigenous Tanzanian form and typical Asian *Q. indica*, but refrained from taking any formal taxonomic decisions on the status of the African form. In both forms the flowers are white becoming dark red with age, especially on the inside, whereas the leaves have sub-epidermal, crystalliferous idioblasts, stalked glands, and combretaceous hairs, with hair-tuft domatia in the axils of veins beneath.

Leaves of *Quisqualis latialata* have black (in herbarium material) stalked glands and combretaceous hairs on both sides, but lack crystalliferous idioblasts; the petals are yellow becoming red with age with a yellow edge; its upper hypanthium is described as cylindrical-infundibuliform, very short, less than 6 mm long; the inflorescence is always terminal, contracted into a dense subcapitate raceme. Leaves of *Q. littorea* also have black stalked glands, combretaceous hairs and hair-tuft domatia in the axils of veins below; the hypanthium is narrowly tubular, up to 20 mm or occasionally up to 25 mm long, petals 6 mm long and apex rounded. *Q. pel-*

legriniana has very thick pubescent young leaves that become puberulous with age and stems with unusual long, flattened, stalked glands mingled with combretaceous hairs, whereas *Q. littorea* and *Q. falcata*, both have almost papery, puberulous leaves. The stamens and styles are included or very slightly exerted in *Q. falcata*, *Q. latialata*, *Q. pellegriniana* and *Q. littorea*, but the first three species have a short (6–10 mm long) upper hypanthium, whereas in *Q. littorea* the hypanthium can be up to 25 mm long. Liben (1968) lowered the rank of *Q. mussaendiflora* (Engl. & Diels) Exell to a variety of *Q. falcata*. Jongkind (1992, 1999) placed *Q. pellegriniana* and *Q. littorea* in synonymy under *Combretum falcatum* (= *Quisqualis falcata*), resulting in two widely disjunct distribution ranges for the expanded *Q. falcata*, a classification not accepted by us because there are slight, though quite marked differences between these taxa. In 1991, Jongkind described *Combretum inflatum* from Gabon, a species with tubular greenish flowers and an adnate style which seems closely related to *Q. falcata* and *Q. latialata*. Jongkind (1999) provided a key and illustration (pl. 14) to show the differences between *C. inflatum*, *Q. falcata* and *Q. latialata*. They all have greenish flowers, conspicuous floral bracts, whereas the leaves have stalked glands, lacking any scales or idioblasts. The inflorescences of these species are dense, congested capitate racemes with few, long, elliptic to falcate floral bracts, the latter best developed towards the base of the inflorescence axis. The inflorescences also display pronounced acropetal maturation, with the flowers opening sequentially over a period of time from the base to the apex. This phenomenon is so far only displayed by these six species. In essentially all other members of *Combretum* and *Quisqualis* in Africa, floral anthesis in any one inflorescence is more or less synchronous.

Quisqualis hensii and *Q. exannulata* have long (up to 20 mm), protruding styles, the latter twice as long as the stamens in *Q. hensii*, a state not found in any other species of *Quisqualis* examined. *Q. hensii* is also the only member of *Quisqualis* with long, exerted stamens. Although *Q. hensii* has the style adnate to the hypanthium for ± 2 mm, stalked glands on the leaves, stems and flower axis, it has flowers with an infundibuliform upper hypanthium, 9–11 mm long. Initially *Q. hensii* was included in *Combretum* sect. *Campylogyne* by Engler & Diels (1899), then transferred to *Quisqualis* sect. *Combretopsis* Exell (1931), provisionally associated with *Combretum* (Exell & Stace 1964) and subsequently placed in a section of its own, namely *Combretum* sect. *Pseudoquisqualis* by Exell (1968) and Stace (1981). Anatomically, *Q. hensii* has a distinctive type of epidermis, discussed in detail by Stace (1965, 1980) as well as an unusual indumentum, namely: a mixture of stalked glands; normal combretaceous compartmented hairs; and on young leaves, thin-walled non-compartmented unicellular hairs. The indumentum is very rare in the family (Stace 1965). Although *Q. hensii* has some adnation of the style to the hypanthium, it still fits better in *Combretum* because of its short upper hypanthium and long-exserted stamens and style (Table 1).

Quisqualis in Asia, Malesia and eastern Africa

The Asian and Malesian species of *Quisqualis*, namely *Q. caudata* Craib, *Q. conferta* (Jack) Exell, *Q.*

parvifolia Exell, *Q. sulcata* Slooten and *Q. indica* L. (Exell 1954) and the East and southern African species (*Q. indica* and *Q. parviflora*) all have tubular hypanthiums from 10–25 mm long or up to 90 mm long in *Q. indica*, with $\pm$ included or shortly exserted stamens and styles. *Q. parviflora* and *Q. indica* have hairs and occasionally stalked glands on the hypanthium, petiole, midrib and lateral veins of the leaves as well as abundant subepidermal crystalliferous idioblasts similar to those in *Combretum mossambicense* and *C. bracteosum*.

A resolution on the taxonomic status of Quisqualis

From the above overview of *Quisqualis* in Africa and Asia, it is obvious that there is a great need for further comparative studies to try and resolve the many uncertainties still prevailing. In our judgement, there is still ample morphological evidence to distinguish between *Combretum* and *Quisqualis*. The two genera can easily be keyed out in southern and East Africa, Malasia (Exell 1954) and China (Chen & Turland (2007). Chen & Turland (2007), for example, separate *Quisqualis* and *Combretum* on the basis of a combination of characters, namely, 1, length of the hypanthium; 2, degree of stamen exertion; and 3, adnation of the style to the hypanthium. If the hypanthium is (17–)50–90 mm long, the stamens are not or scarcely exerted from the hypanthium and the style is partly adnate to the hypanthium, then it is a *Quisqualis*. *Combretum* on the other hand has the hypanthium usually shorter than 20 mm, the stamens usually well exerted from the hypanthium and the style mostly free or shortly adnate to the inside of the hypanthium.

In the case of the few African species of *Combretum* (*C. hensii*, *C. grandiflorum*, *C. ghesquieri*) where the style is shortly adnate to the hypanthium, the long-exserted stamens and short hypanthiums can still be used to separate these species from *Quisqualis*. These three species can therefore remain in *Combretum*, placed in three different sections in subgen. *Cacoucia* as classified before by Exell (1968) and Stace (1981), Engler & Diels (1899) and Liben (1968), respectively.

We suspect the other six combretaceous species from West Central and East Africa previously placed in *Quisqualis* (Table 1) may well constitute one or more genera of their own. *Quisqualis exannulata* from Angola and the DRC has rose-purple flowers, lacks stalked glands and has leaves without abundant crystalliferous idioblasts. It is most unusual in having a geniculate style which is adnate to the hypanthium and long exerted beyond the petals, whereas the stamens are scarcely exerted. The hypanthium is infundibuliform, slightly curved, 25–35 mm long and has a double constriction, one just above the lower hypanthium and another above the portion where the style bends and becomes free from the hypanthium. The flower bracts are large, leafy, ovate, venose, up to $\frac{2}{3}$ of flower length and present along the whole length of the inflorescence axis, although decreasing somewhat in size towards the apex. It was previously placed in a genus of its own, namely *Campylogyne* by Hemsley (1897), a classification which we support. Differentiation among these four groups in *Quisqualis* and *Combretum* in Africa is presented in Table 1.

Potential shared characters for *Quisqualis* s.l. (if one includes *Q. hensii* and *Q. exannulata* despite their anomalous floral structure), may include the persistent petiole bases that develop into curved spines, petals minutely to densely hairy or pilose, fruits 5-winged or 5-angled, characters also shared with species of *Combretum* subgen. *Cacoucia* sect. *Poivreia*. However, spiny petioles could have evolved independently in these taxa because all are woody climbers or lianas in forest or forest margins where they need to climb over dense vegetation in search of sunlight. It is strongly recommended that all of the taxa mentioned in the above overview be included in future molecular phylogenetic studies.

Molecular phylogeny

Ample leaf and floral morphology (Liben 1968; Exell 1978; Wickens 1973), anatomy (Stace 1965, 1969, 1980; Verhoeven & Van der Schijff 1974; Tilney 2002) and molecular data (Maurin *et al.* 2010) are available for the southern and tropical African species of *Combretum*. Unfortunately, only three species of *Quisqualis*, namely *Q. parviflora* (Africa), *Q. indica* (Asia) and *Q. caudata* (Thailand) have been included in the available molecular studies (Tan *et al.* 2002; Maurin *et al.* 2010). Tan *et al.* (2002) studied the phylogenetic relationships of subfam. Combretoideae (Combretaceae) based on a limited sampling of only two species from each genus. They concluded that *Quisqualis* and *Combretum* are monophyletic sister taxa, but acknowledge that their sampling was insufficient to establish clear generic limits. In subsequent molecular phylogenetic studies based on more comprehensive, though still limited, sampling (Maurin *et al.* 2010), *Quisqualis* as a genus is recovered as a clade embedded within *Combretum* subgen. *Cacoucia*. As a consequence of these results, the third author supports Jongkind (1999), Stace (2007) and Mabberley (2008) in considering *Quisqualis* congeneric with *Combretum*. However, the potentially misleading effects of poor taxon sampling on phylogenetic analyses and their applications should be kept in mind (e.g. Heath *et al.* 2008). To increase the accuracy of phylogenetic estimates in Combretaceae it is strongly recommended that as many as possible of the taxa mentioned in Table 1 be sampled in future studies.

In this paper, however, the first and second authors prefer to retain *Quisqualis* as a separate genus for practical purposes, considering the evolutionary specialization shown by the particular clade. Although there might be intermediate states in the degree of adnation of the style to the upper hypanthium in some species of *Quisqualis* and *Combretum* as noted by Exell & Stace (1966) and Jongkind (1991), there are still enough characters to distinguish between these two genera in East and South Africa and they can easily be keyed out. In *Quisqualis* the upper hypanthium is elongated into a long tube (Figure 1). In *Combretum*, on the other hand, the hypanthium is usually a flattened, short, campanulate, infundibuliform or cupuliform limb above the inferior ovary. In *C. bracteosum* and *C. mossambicense* the upper hypanthium is distally broadly infundibuliform, whereas proximally it is subglobose, the two parts being separated by a slight constriction. Furthermore, in *Quisqualis* the stamens are included or very shortly exerted, whereas in *Combretum* they are always long exerted

(Bredenkamp 2000). The fact that *Combretum* subgen. *Cacoucia* is rendered paraphyletic if *Quisqualis* is maintained as a genus, may be contested by those strictly adhering to Hennigian phylogenetic philosophy, but this is completely acceptable to those prescribing to the more pragmatic evolutionary school of plant classification (Mayr & Bock 2002; Brummitt 2008). Nevertheless, to cater for the alternative point of view, a new combination and new name are provided for *Q. parviflora* below.

Pollination and evolution of adaptive traits in the Combretum–Quisqualis clade

Pollination syndromes have the capacity to predict the types of pollinators of given species based on observations of certain floral traits. To achieve pollination, flowers have evolved suites of convergent floral traits, usually involving flower shape, colour, scent and type of reward (Fenster *et al.* 2004). Stebbins (1970) pointed out that floral diversity has arisen by divergence into different pollination syndromes (evolutionary specialization). In Combretaceae, major adaptations linked to different pollination specializations are evident (Stace 2007). There is, for example, the loss of petals as in *Terminalia*, contrasted with an enlargement of petals in *Quisqualis*. Differences in pollination strategy are most likely responsible for the floral differences between *Combretum* and *Quisqualis*. In the case of *Quisqualis*, the elongation of the hypanthium might represent a modification for pollination by long-proboscid sphingid moths (Stace 2007). This shift towards moth pollination might have occurred independently in different Combretaceae. The white- and yellow-flowered species of *Combretum* with relatively small and reduced petals and with nectaries, suggest pollination by insects with short mouthparts, notably honeybees, whereas those with red flowers and abundant liquid nectar, including the odd-flowered *Quisqualis* (*Campylogene*) *exannulata* are probably bird-pollinated (Faegri & Van der Pijl 1971; Stace 2007). For *Combretum*, this is confirmed by casual observations on the southern African species.

Combretum displays different floral traits indicative of different pollination syndromes and separate evolutionary diversification, patterns supported by molecular (Maurin *et al.* 2010) and morphological data. Some evolutionary trends most probably developed independently within the *Combretum–Quisqualis* clade. In *Combretum* subgen. *Combretum* the leaves all have glandular scales, the flowers have long-exserted stamens, short styles, the colour varies from whitish, yellow or green, the upper hypanthium is short, either little developed and flattened (*C. imberbe* Wawra), campanulate, infundibuliform or cupuliform, all indicative of pollination by insects (Faegri & Van der Pijl 1971).

All species of *Combretum* subgen. *Cacoucia* lack scales on their leaves but have a great diversity in other leaf characters and floral traits. In sect. *Poivreia* the leaves have abundant, subepidermal, crystalliferous idioblasts, stalked glands and flowers with campanulate upper hypanthiums, exserted stamens, pinkish to bright red. In *C.* sect. *Conniventia* the flowers are bright red, with long-exserted stamens and short hypanthiums, suggesting bird pollination. Their leaves lack scales and glands. In sections *Megalantherum* (*C. wattii* Exell) and

Oxystachya (*C. oxystachyum* Welw. ex M.A.Lawson), both endemic to the Kaokoveld (northwestern Namibia and southwestern Angola), the flowers are white or grey-green with a pinkish or reddish tinge and a well-developed nectariferous disc; the leaves are densely pubescent with dark brown stalked glands. The stamens and style are exserted beyond the petals and the upper hypanthium is short.

The flowers of *Quisqualis* in West Central Africa (excluding *Q. hensii* and *Q. exannulata*), East and South Africa as well as India, Asia and Malesia are pendent, $\pm$ zygomorphic, white, yellowish to greenish turning red with age; have narrowly tubular hypanthiums slightly widening at the tip, petals and calyx lobes bent backwards; no nectar guides; included styles which are straight and adnate for some distance to the hypanthium; and stamens inserted in two rows with versatile anthers, the latter included or very slightly exserted. This syndrome suggests pollination by long-proboscid insects such as sphingid moths (Exell 1954; Faegri & Van der Pijl 1971). Exell (1954) also noted that the petals in *Quisqualis* are rather large in the family, much exceeding the calyx lobes and enlarging during anthesis.

Distribution of Quisqualis parviflora

Quisqualis parviflora is endemic to South Africa (Bredenkamp 2000; Jordaan 2003, 2006). Van der Schijff & Schoonraad (1971), Carr (1986) and Bredenkamp (2000) give the distribution of *Q. parviflora* as occurring in Mpumalanga (Mariepskop and Graskop), KwaZulu-Natal and Eastern Cape. Subsequently, all the specimens claimed to be *Q. parviflora* in Mpumalanga, were shown to be *Combretum edwardsii* (Verhoeven & Van der Schijff 1975; McClelland 2002). Sterile material collected from more inland localities in KwaZulu-Natal and previously named *Q. parviflora* also belongs to *C. edwardsii* and/or probably an undescribed species of *Combretum*. Therefore, *Q. parviflora* only grows with certainty as a woody climber in mainly coastal forest from Ndumu Game Reserve in the north, through most of KwaZulu-Natal to the Eastern Cape (Port St Johns) in the south (Figure 3). Although no records have been found in Mozambique, it may well occur there, at least in the far south where it borders KwaZulu-Natal (Carr 1986).

Taxonomy of Quisqualis parviflora

Quisqualis has microscopic stalked glands similar to those in *Combretum* subgen. *Cacoucia*, and the scales so characteristic of *Combretum* subgen. *Combretum* are absent (Exell & Stace 1966; Wickens 1973). Flowers are 5-merous and the fruit of *Quisqualis* are generally 5-winged. The petals are well developed in *Quisqualis*: white, pink or red in *Q. indica* (rangoon creeper), a decorative species originally from Asia and commonly cultivated in gardens, and green in the South African *Q. parviflora*. Specimens seen on the Aluka Library website, <http://www.jstor.org/> (accessed December 2010), are distinguished by the code e! in the citations below. Gerrard gave the material he collected with McKen at Umhloti in KwaZulu-Natal the manuscript name, *Quisqualis natalensis* (now the type of *Quisqualis parviflora*). Sonder (1862) changed the epithet '*natalensis*' to '*parviflora*' and validly published the name *Quis-*

qualis parviflora for the species. Engler & Diels (1900) recorded the name *Quisqualis natalensis*.

***Quisqualis parviflora* Sond.** in Flora capensis 2: 512 (1862); Dummer: 232 (1913); Bews: 147 (1921); J.D.Carr: t. 1925 (1986); Pooley: 362 (1993); M.Coates Palgrave: 809 (2002); Boon: 410 (2010). Type: South Africa, Natal [KwaZulu-Natal], 'Nototi' [Umhloti], *Gerrard & McKen s.n.* (TCD, holo. e!; K, iso. e!).

Q. natalensis Gerrard ex Engl. & Diels (1900), nom. nud.

For description see Carr (1986).

Selected specimens examined

KWAZULU-NATAL.—2632 (Bella Vista): Ndumu Game Reserve, Khondo Sand Forest, (–CD), 03-1968, *P. de Moor* 35 (PRE). 2732 (Ubombo): Mkuzi Station, from Ubombo Magistracy to uGaza Mtn, (–CA), 26-04-1944, *J. Gerstner* 4552 (PRE); Hlabisa Dist., False Bay, lower Mzinene River, (–CD), 26-10-1944, *J. Gerstner* 4963 (PRE). 2831 (Nkandla): Eshowe, Memorial Hill, (–CD), 15-05-1951, *J.G. Lawn* 1974 (PRE); Ngoye Forest Reserve, (–DC), 19-11-1993, *R. Williams* 1106 (NH, PRE). 2930 (Pietermaritzburg): Durban, Burman Bush, (–DD), 11-07-1970, *R.G. Strey* 9839 (NH, PRE), Isipingo, Jeffels Hill South, (–DD), 16-02-1966, *C.J. Ward* 5313 (PRE). 2931 (Stanger): Stanger Dist., 4 miles [6.4 km] from Mapumulo to Kranskop, (–AA), 20-01-1966, *E.J. Moll* 2958 (PRE); Mtunzini Forest, (–BA), 17-02-1961, *M. Wells & D. Edwards* 22 (PRE); Inanda Dist., 5 miles [8 km], W of Verulam, (–CA), 15-09-1965, *E.J. Moll* 2083 (PRE). 3030 (Port Shepstone): Vernon Crookes Nature Reserve, (–BC), 15-03-1986, *C.J. Ward* 9831 (PRE); Port Shepstone, Farm Tigerhole, (–CB), 08-08-1965, *R.G. Strey* 5927 (PRE). 3130 (Port Edward): Umtamvuna Nature Reserve, Bululu River, (–AA), 09-04-1981, *H.B. Nicholson* 2171 (PRE).

EASTERN CAPE.—3129 (Port St Johns): Lotana Forest near Ntafufu, (–DA), 11-04-1991, *K.H. Cooper* 283 (NH, PRE); Port St Johns, on road to Agate terrace, (–DA), 10-03-2001, *P.M. Gavhi, P.J.H. Hurter & E. van Wyk* 39 (PRE).

Alternative taxonomic treatment

If *Quisqualis* is sunk under *Combretum*, a new combination and name is required for *Q. parviflora*. The specific epithet '*parviflorum*' cannot be used in *Combretum* since it was already used by Reichenbach (1825). Exell (1953) pointed out that *Index kewensis* incorrectly attributes *C. parviflorum* to De Candolle (1828), where it was cited as a synonym of *C. micranthum* Don, a mistake still reflected in The International Plant Name Index (IPNI), accessed January 2011. The name *C. parviflorum* was validly published three years earlier by Reichenbach (1825), thus invalidating *C. parviflorum* Eichler (1867). The latter name was proposed for a species from Brazil, but because it is a later homonym, this species is now known by the new name *C. vernicosum* Rusby (1927).

***Combretum sylvicola* O.Maurin, comb. et nom. nov.**

Quisqualis parviflora Sond.: 512 (1862), non *Combretum parviflorum* Rchb.; 46, t. 62 (1825), nec *C. parviflorum* Eichl.: 114 (1867), nom. illegit. Type: South Africa, Natal [KwaZulu-Natal], 'Nototi' [Umhloti], *Gerrard & McKen s.n.* (TCD, holo. e!; K, iso. e!).

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REFERENCES

- BEWS, J.W. 1921. *An introduction to the flora of Natal and Zululand*. City Printing Works, Pietermaritzburg.
- BOON, R. 2010. *Pooley's trees of eastern South Africa: a complete guide*. Flora and Fauna Publications Trust, Durban.
- BRANDIS, D. 1898. Combretaceae. In A. Engler & K. Prantl, *Die natürlichen Pflanzenfamilien* 3,7: 106–130. Engelmann, Leipzig.
- BREDENKAMP, C.L. 2000. Combretaceae. In O.A. Leistner, *Seed plants of southern Africa: families and genera*. *Strelitzia* 10: 228, 229. National Botanical Institute, Pretoria.
- BRUMMITT, R.K. 2008. Evolution in taxonomic perspective. *Taxon* 57: 1049, 1050.
- CARR, J.D. 1986. *Quisqualis parviflora*. *The Flowering Plants of Africa* 49: t. 1925.
- CHEN, J. & TURLAND, N.J. 2007. Combretaceae. *Flora of China*, vol. 13. Online publication: <http://www.eFloras.org/> (accessed December 2010).
- COATES PALGRAVE, M. 2002. *Keith Coates Palgrave Trees of southern Africa*, edn 3. Struik, Cape Town.
- DE CANDOLLE, A.P. 1828. Combretaceae. *Prodromus systematis naturalis regni vegetabilis* 3: 9–24. Treuttel & Würtz, Paris.
- DÜMMER, R.A. 1913. The South African Combretaceae. *The Gardeners' Chronicle*, ser. 3, 53: 231, 232.
- EICHLER, A.G. 1867. Combretaceae. In C.F.P. de Martius & A.G. Eichler, *Flora brasiliensis* 14,2: 77–128. Oldenbourg, Leipzig.
- ENGLER, H.G.A. & DIELS, F.L.E. 1899. Combretaceae—*Combretum*. In H.G.A. Engler, *Monographien afrikanischer Pflanzen-Familien und -Gattungen* 3: 1–116. Engelmann, Leipzig.
- ENGLER, H.G.A. & DIELS, F.L.E. 1900. Combretaceae excluding *Combretum*. In H.G.A. Engler, *Monographien afrikanischer Pflanzen-Familien und -Gattungen* 4: 1–44. Engelmann, Leipzig.
- EXELL, A.W. 1931. The genera of Combretaceae. *Journal of Botany* 69: 113–128.
- EXELL, A.W. 1953. The *Combretum* species of the New World. *Journal of the Linnean Society, Botany* 55: 103–141.
- EXELL, A.W. 1954. Combretaceae. *Quisqualis*. In C.G.G.J. van Steenis, *Flora malesiana*, ser. 1, vol. 4: 544–548. Noordhoff, Groningen.
- EXELL, A.W. 1968. Notes on the Combretaceae of southern Africa. *Boletim da Sociedade Broteriana*, sér. 2, 42: 5–33.
- EXELL, A.W. 1978. Combretaceae. In E. Launert, *Flora zambesiaca* 4: 100–183. Flora zambesiaca Managing Committee, Glasgow.
- EXELL, A.W. & STACE, C.A. 1964. A re-organization of the genus *Quisqualis* (Combretaceae). *Boletim da Sociedade Broteriana*, sér. 2, 38: 139–143.
- EXELL, A.W. & STACE, C.A. 1966. Revision of the Combretaceae. *Boletim da Sociedade Broteriana*, sér. 2, 40: 5–26.
- FAEGRI, K. & VAN DER PIJL, L. 1971. *The principles of pollination ecology*, edn 2. Pergamon Press, Oxford.
- FENSTER, C.B., ARMBRUSTER, W.S., WILSON, P., DUDASH, M.R. & THOMSON, J.D. 2004. Pollination syndromes and floral specialization. *Annual Review of Ecology, Evolution, and Systematics* 35: 375–403.
- HEATH, T.A., HEDTKE, S.M. & HILLIS, D.M. 2008. Taxon sampling and the accuracy of phylogenetic analyses. *Journal of Systematics and Evolution* 46: 239–257.
- HEMSLEY, W.B. 1897. *Campylopyne exannulata*. *Hooker's Icones Plantarum* 26: t. 2550.
- HENNESSY, E.F. 1991. *Combretum bracteosum*. *The Flowering Plants of Africa* 51: t. 2028.
- HOOKE, J.D. 1867. Combretaceae. In G. Bentham & J.D. Hooker, *Genera plantarum* 1: 683–690. Reeve, London.
- JONGKIND, C.C.H. 1990 [1991]. Novitates gabonensis 6. Some critical observations on *Combretum* versus *Quisqualis* (Combretaceae) and description of two new species of *Combretum*. *Bulletin du Museum National d'Histoire Naturelle*, sér. 4, 12, sect. B, *Adansonia* 3–4: 275–280.
- JONGKIND, C.C.H. 1992. Novitates gabonensis 13. Three new species and one new combination in *Combretum* (Combretaceae). *Bulletin du Museum National d'Histoire Naturelle*, sér. 4, 14: 257–262.
- JONGKIND, C.C.H. 1999. Combretaceae. In P. Morat, *Flore du Gabon* 35: 5–115. Muséum National d'Histoire Naturelle, Paris.
- JORDAAN, M. 2003. Combretaceae. In G. Germishuizen & N.L. Meyer, *Plants of southern Africa: an annotated checklist*. *Strelitzia* 14: 369–371. National Botanical Institute, Pretoria.
- JORDAAN, M. 2006. Combretaceae. In G. Germishuizen, N.L. Meyer, Y. Steenkamp & M. Keith, *A checklist of South African plants*.

- Southern African Botanical Diversity Network Report No. 41: 329, 330. SABONET, Pretoria.
- JORDAAN, M., VAN WYK, A.E. & MAURIN, O. 2011. A conspectus of *Combretum* (Combretaceae) in southern Africa, with taxonomic and nomenclatural notes on species and sections. *Bothalia* 41: 135–160.
- LAWSON, M.A. 1871. Combretaceae. In D. Oliver, *Flora of tropical Africa* 2: 413–436. Reeve, London.
- LIBEN, L. 1968. Combretaceae. *Flore du Congo du Rwanda et du Burundi*. Jardin Botanique National de Belgique, Bruxelles.
- LINNAEUS, C. 1762. *Species plantarum*, edn 2,1. Salvius, Stockholm.
- MABBERLEY, D.J. 2008. *Mabberley's plant-book: a portable dictionary of the vascular plants*, edn 3. Cambridge University Press, Cambridge.
- MAURIN, O., CHASE, M.W., JORDAAN, M. & VAN DER BANK, M. 2010. Phylogenetic relationships within Combretaceae inferred from nuclear and plastid DNA sequence data: implications for generic classification. *Botanical Journal of the Linnean Society* 162: 453–476.
- MAYR, E. & BOCK, W.J. 2002. Classifications and other ordering systems. *Journal of Zoological Systematics and Evolutionary Research* 40: 169–194.
- McCLELAND, W. 2002. Combretaceae. In E. Schmidt, M. Lötter & W. McClelland, *Trees and shrubs of Mpumalanga and Kruger National Park*. Jacana, Johannesburg.
- POOLEY, E. 1993. *The complete field guide to trees of Natal, Zululand and Transkei*. Natal Flora Publications Trust, Durban.
- REICHENBACH, H.G.L. 1825. *Combretum parviflorum*. *Iconographia Botanica Exotica* 1: 46, t. 62. Hofmeister, Leipzig.
- RUSBY, H.H. 1927. Descriptions of new genera and species of plants collected on the Mulford biological exploration of the Amazon Valley. *Memoirs of the New York Botanical Garden* 7: 205–384.
- SONDER, O.W. 1862. Combretaceae. In W.H. Harvey & O.W. Sonder, *Flora capensis* 2: 507–513. Hodges & Smith, Dublin.
- STACE, C.A. 1965. The significance of the leaf epidermis in the taxonomy of the Combretaceae. I. A general review of tribal, generic and specific characters. *Botanical Journal of the Linnean Society* 59: 229–252.
- STACE, C.A. 1969. The significance of the leaf epidermis in the taxonomy of the Combretaceae. II. The genus *Combretum* subgenus *Combretum* in Africa. *Botanical Journal of the Linnean Society* 62: 131–168.
- STACE, C.A. 1980. The significance of the leaf epidermis in the taxonomy of the Combretaceae V. The genus *Combretum* subgenus *Cacoucia* in Africa. *Botanical Journal of the Linnean Society* 81: 185–203.
- STACE, C.A. 1981. The significance of the leaf epidermis in the taxonomy of the Combretaceae: conclusions. *Botanical Journal of the Linnean Society* 81: 327–339.
- STACE, C.A. 2007. Combretaceae. In K. Kubitzki, *The families and genera of vascular plants* 9: 67–82. Springer-Verlag, Berlin.
- STEBBINS, G.L. 1970. Adaptive radiation of reproductive characteristics in angiosperms. 1. Pollination mechanisms. *Annual Review of Ecology and Systematics* 1: 307–326.
- TAN, F.X., SHI, S.H., ZHONG, Y., GONG, X. & WANG, Y.G. 2002. Phylogenetic relationships of Combretaceae (Combretaceae) inferred from plastid, nuclear gene and spacer sequences. *Journal of Plant Research* 115: 475–481.
- TILNEY, P.M. 2002. A contribution to the leaf and young stem anatomy of the Combretaceae. *Botanical Journal of the Linnean Society* 138: 163–196.
- TILNEY, P.M. & VAN WYK, A.E. 2004. Extrafloral nectaries in Combretaceae: morphology, anatomy and taxonomic significance. *Bothalia* 34: 115–126.
- VAN DER SCHIJFF, H.P. & SCHOONRAAD, E. 1971. The flora of the Mariepskop Complex. *Bothalia* 10: 461–500.
- VERHOEVEN, R.L. & VAN DER SCHIJFF, H.P. 1974. Anatomical aspects of Combretaceae in South Africa. *Phytomorphology* 24: 158–164.
- VERHOEVEN, R.L. & VAN DER SCHIJFF, H.P. 1975. A short note on *Combretum edwardsii* Exell. *Journal of South African Botany* 41: 39, 40.
- WICKENS, G.E. 1973. Combretaceae. In R.M. Polhill, *Flora of tropical East Africa, Combretaceae*: 2–10. Royal Botanic Gardens Kew, London.

Websites:

- ALUKA. <http://plants.jstor.org/> (accessed December 2010).
- eFLORAS. <http://www.eFloras.org/> (accessed December 2010).
- INTERNATIONAL PLANT NAMES INDEX (IPNI). Published on the Internet: <http://www.ipni.org/> (accessed January 2011).
- TROPICOS. <http://www.tropicos.org/> (accessed January 2011).

Notes on African plants

VARIOUS AUTHORS

IRIDACEAE

TRITONIA CEDARMONTANA AND *T. LINEARIFOLIA* (CROCOIDEAE), TWO NEW SPECIES FROM THE CAPE FLORISTIC REGION; *T. LINEATA* VAR. *PARVIFOLIA* INCLUDED IN *T. GLADIOLARIS*; AND THE CORRECT AUTHOR CITATION FOR *T. STRICTIFOLIA*

INTRODUCTION

Tritonia Ker Gawl. is a genus of ± 30 species widely distributed throughout eastern sub-Saharan Africa but concentrated in the South African winter rainfall region (De Vos 1999; Goldblatt & Manning 2008). Its relationships lie with a small group of genera in tribe Ixieae (= Croceae) that includes *Dierama* K.Koch, *Duthieastrum* M.P.de Vos, *Ixia* L. and *Sparaxis* Ker Gawl., all of which have $\pm$ smooth, shiny, subglobose seeds with an excluded vascular bundle. *Tritonia* is defined within this alliance by its membranous to dry, $\pm$ translucent floral bracts, with the outer bract often 3-toothed (Goldblatt & Manning 2008), and (with rare exceptions in two species with unusual, succulent leaves) by its anatomically specialized leaves that lack a marginal vein or strand of subepidermal sclerenchyma at the margins, and in which mechanical strengthening is provided instead by narrow, thick-walled marginal epidermal cells (Rudall 1994).

This specialized leaf margin anatomy also characterizes *Duthieastrum* and *Sparaxis* but not the two remaining genera of the alliance, *Dierama* and *Ixia*, which have the plesiomorphic leaf margin anatomy. These two genera have membranous to dry floral bracts, with the outer bracts of *Ixia* also typically 3-toothed and thus similar to those in *Tritonia*. Unlike *Tritonia*, however, both *Dierama* and *Ixia* have actinomorphic flowers borne on $\pm$ wiry, capillary stems as the plesiomorphic state.

Tritonia was thoroughly revised by De Vos (1982, 1983, 1999) and the following two new species are the first to be described since then. *T. cedarmontana* is named for the only known locality of the species in the Cedarberg [the form of the epithet, although a compound of English and Latin, matches that of other species in Iridaceae], and *T. linearifolia* is named for its unusually narrow leaves, most species in the genus having lanceolate leaves. The latter species is undoubtedly a member of sect. *Subcallosae* M.P.de Vos but the relationships of the former are less clear, and our placement of it in the same section is provisional. Collections at BOL, NBG, PRE and SAM, the main herbaria with good representation of collections of Cape species, were consulted for records of the two new species (herbarium acronyms after Holmgren *et al.* 1990).

Recent study of some early types of species of Iridaceae resulted in the identification of *Ixia gladiolaris* Lam. as an earlier name for *Tritonia lineata*, which was accordingly placed in synonymy under the new combination *T. gladiolaris* (Lam.) Goldblatt & J.C.Manning (Goldblatt & Manning 2006). The requisite transfer of *T. lineata* var. *parvifolia* M.P.de Vos to *T. gladiolaris* was

not done at the time. We have subsequently examined material of both varieties and conclude that var. *parvifolia*, which was recognized solely by its shorter leaves, is not worthy of taxonomic recognition, and the name is reduced to synonymy here.

***Tritonia cedarmontana* Goldblatt & J.C.Manning, sp. nov.**

Plantae (50–)150–300 mm altae, cormo conico-globo 7–10 mm diam., tunicis fibris tenuibus reticulatis, caule usitate eramoso, foliis 4–6 omnibus $\pm$ basilibus usitate 1.5–2.0 mm latis, spica inclinata 2–5-flora, bracteis sicco-membranaceis translucentibus ad apicem brunneomaculatis, bractea externa 3-venosa 4–6 mm longa, interna $\pm$ aequilonga 2-venosa ad apicem furcata, floribus zygomorphis salmoneo-aurantiacis, tubo perianthii oblique infundibuliformi 9–10 mm longo, tepalis pauciter inaequalibus, tepalo dorsali ovato 13–14 $\times$ 7.0–7.5 mm, aliis ellipticis $\pm$ 13 $\times$ 5.5–6.5 mm, staminibus unilateralibus arcuatis, filamentis 4–5 mm longis $\pm$ 1 mm exsertis, antheris 3.5–4.0 mm longis, stylo ad apicem antherarum diviso, ramis $\pm$ 3 mm longis.

TYPE.—Western Cape: 3219 (Wuppertal): southern Cedarberg, Krom River Kloof, 4000' [1 220 m], (–CA/CC), 13 Dec. 1950, Esterhuysen 18009 (BOL, holo.; NBG, PRE, iso.).

Plants (50–)150–300 mm high; corm conical-globose, 7–10 mm diam., tunics of fine, netted fibres, extending in a papery or fibrous neck; stem $\pm$ erect, usually unbranched, rarely with 1 small branch in axil of a membranous cauline bract enclosed in uppermost leaf sheath. Leaves 4–6, all $\pm$ basal, linear, usually $\pm$ as long as stem, mostly 1.5–2.0 mm wide, uppermost largely sheathing, usually shorter than others, central vein moderately thickened. Spike inclined, 2–5-flowered, moderately lax; bracts dry-membranous, translucent with some brown speckling apically, outer with 3 main veins, shallowly 3-toothed at apex, 4–6 mm long, inner $\pm$ as long, 2-veined and forked at apex. Flowers zygomorphic, salmon-orange; perianth tube obliquely funnel-shaped, 9–10 mm long, lower cylindrical portion 4–5 mm long; tepals slightly unequal, dorsal ovate, 13–14 $\times$ 7.0–7.5 mm, other tepals elliptical, $\pm$ 13 $\times$ 5.5–6.5 mm. Stamens unilateral and arcuate; filaments 4–5 mm long, inserted 5–6 mm within tube thus included $\pm$ 1 mm; anthers 3.5–4.0 mm long, partially included in upper part of tube, yellow. Ovary $\pm$ 2 mm long; style arched over stamens, dividing opposite anther tips, branches filiform, $\pm$ 3 mm long. Immature capsules subglobose or obovoid, 3-lobed, $\pm$ 4.5 mm diam. Immature seeds globose. Flowering time: December. Figure 1.

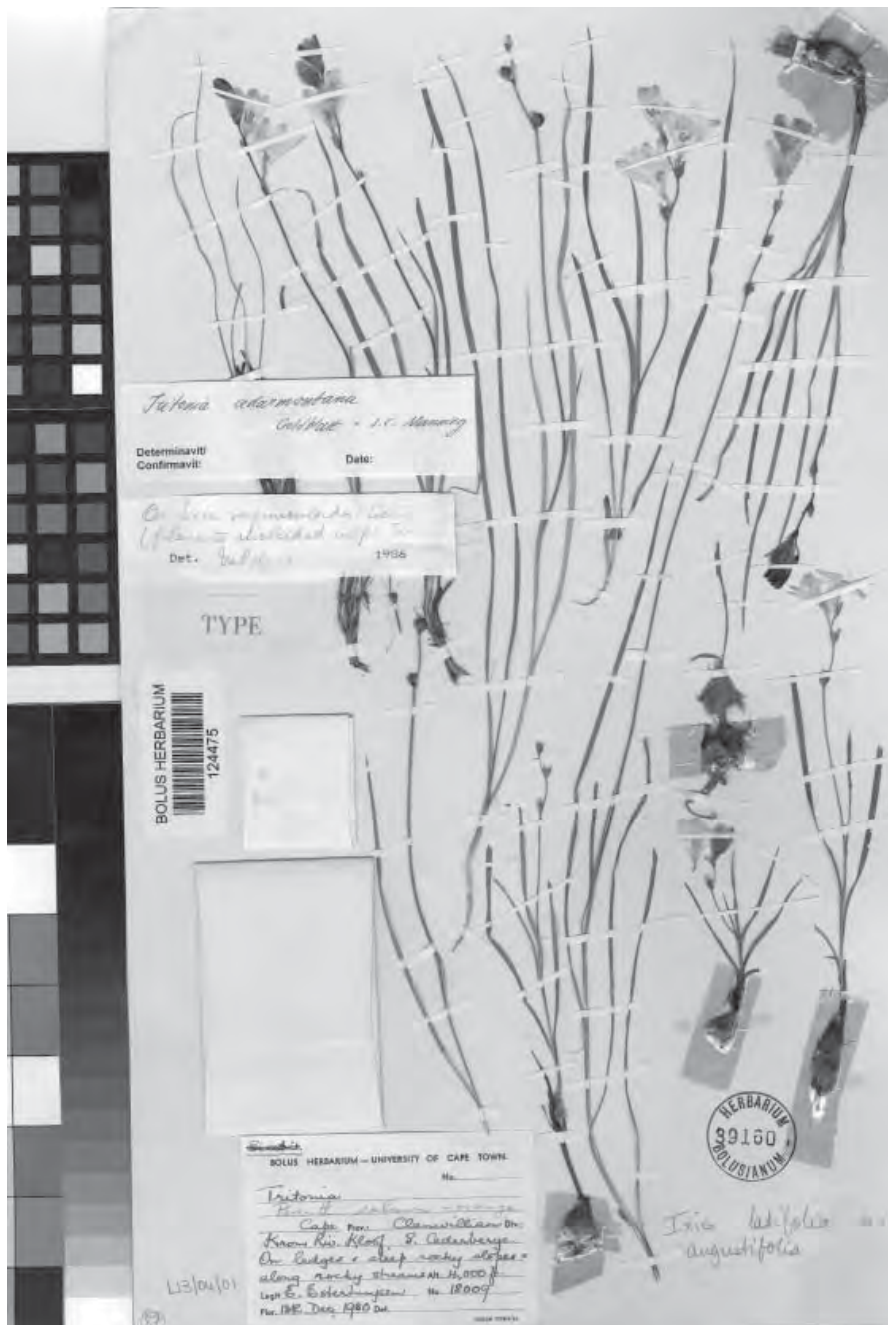


FIGURE 1.—*Tritonia cedarmontana*, Esterhuysen 18009 (BOL).

Distribution and ecology: *Tritonia cedarmontana* is known only from the extensive type collection made in Krom River Kloof in the southern Cedarberg by the late Cape Town botanist, Elsie Esterhuysen (Figure 2). The species was collected on ledges and steep sandstone slopes along streams.

Diagnosis and relationships: *Tritonia cedarmontana* is a diminutive species with narrow, linear leaves mostly 1.5–2.0 mm wide and a moderately lax, few-flowered spike of small, salmon-orange flowers without evident calluses on the lower tepals. The dorsal tepal is subpatent, rather than arched and hooded as in most species of *Tritonia* and the filaments are short, 4–5 mm long, with the anthers half-included in the funnel-shaped tube that is 9–10 mm long. The species has a remarkable superficial similarity in the dry state to *T. parvula* N.E.Br., sect. *Montbretia* (DC.) Pax, from the Little Karoo, notably in its small stature, narrow leaves, and small, orange flow-

ers, and the single collection was assigned to this species by De Vos despite the considerable geographical disjunction. The three lower tepals in *T. parvula* are, however, strongly flexed downwards, and each has the high, $\pm$ oblong, median tooth-like callus or ridge that is diagnostic of the section (De Vos 1982, 1983). These calluses are not developed in *T. cedarmontana*, which also differs from *T. parvula* in its subpatent dorsal tepal not strongly differentiated from the lower tepals, and in its shorter filaments, 4–5 mm vs 6–10 mm.

On the basis of its zygomorphic, pinkish orange flowers without callus ridges on the lower tepals, *Tritonia cedarmontana* is placed in sect. *Subcallosae* but its immediate relationships are not clear. Sect. *Subcallosae* currently comprises six species that fall into two distinct groups. The first comprises four species from the southwestern Cape and Little Karoo, *T. bakeri* Klatt, *T. pallida* Ker Gawl., *T. flabellifolia* (D.Delaroche) G.J.Lewis

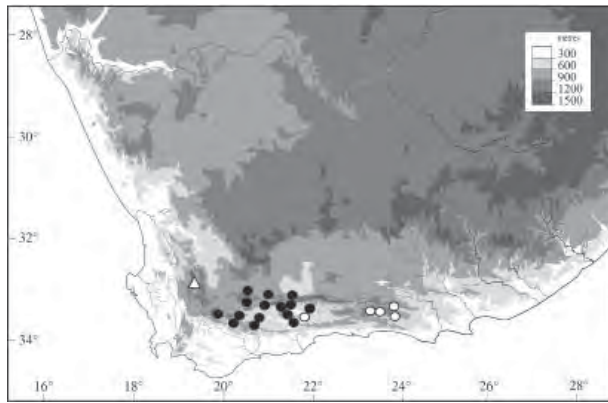


FIGURE 2.—Known distribution of *Tritonia cedarmontana*, △; *T. linearifolia*, ○; *T. pallida*, ●.

and *T. linearifolia* (described here), all with white or cream-coloured flowers with elongate perianth tubes longer than the tepals. The second group comprises two species from the southern Cape and southeastern summer rainfall region, *T. gladiolaris* (Lam.) Goldblatt & J.C.Manning (= *T. lineata* (Salisb.) Ker Gawl.) and *T. disticha* (Klatt) Baker, both with short-tubed, funnel-shaped flowers and leaves with a prominent submarginal vein. Florally, *T. cedarmontana* is most similar to orange-flowered *T. disticha* but it is vegetatively unlike this species, and since this flower type may be plesiomorphic in the genus, its relationships to the other species in the section, and even its sectional assignment, remain uncertain.

***Tritonia linearifolia* Goldblatt & J.C.Manning, sp. nov.**

Plantae (100–150–500(–600) mm altae a *Tritonia pallida* cormelis in sobolibus brevibus fasciatis productis, foliis per anthesin siccis suberectis vel trahentibus, laminis linearibus 1–2 mm latis caulem aequantibus vel paulo superantibus recedit.

TYPE.—Eastern Cape: 3323 (Steytlerville): Joubertina, Kouga Mountains, valley of Dwarsrivier west of Kransfontein Farm, (–CA), 12 December 2009, Manning 3244 (NBG, holo.; MO, iso.).

Plants (100–150–500(–600) mm high; corm subglobose or depressed-globose, 10–20 mm diam.; tunics somewhat papery, of fine-textured fibres, extending in a papery or fibrous neck; developing clusters of cormels at base on short, appressed, flattened, fasciated stolons; stem ± erect below, usually unbranched but with up to 2 branches. *Leaves* 7–12, dry at flowering, suberect or trailing and slightly twisted, ± as long as stem or slightly longer, linear, (10–)20–60 × 1–2 mm, soft-textured with central vein moderately thickened. *Spike* inclined, (2–)4–8-flowered; bracts soft-textured and membranous, lanceolate, 8–12 mm long, translucent or straw-coloured and lightly flushed or speckled brownish distally with darker brown veins, minutely trifid or median tooth obsolete, inner bracts slightly shorter, bifid. *Flowers* zygomorphic, white with purple veins on reverse, lower three tepals with narrow, median, yellowish green longitudinal mark at base, unscented; perianth tube slender and tubular but expanded and bell-shaped

distally, 35–45 mm long, straight but slightly curved in upper part; tepals unequal with uppermost largest, dorsal and lower median tepals suberect but remaining tepals spreading in distal half, dorsal tepal ovate-elliptic, 18–20 × 10–12 mm, remaining tepals oblong, 18–20 × 5–7 mm, lower three tepals with low, median, ridge-like callus. *Stamens* arcuate and unilateral; filaments 13–16 mm long, inserted 5–6 mm within tube; anthers 5–6 mm long, apiculate, purple with purple pollen. *Style* arching over stamens, dividing opposite middle or apex of anthers, branches ± 2 mm long. *Capsules* and *seeds* unknown. *Flowering time*: early to middle December. Figure 3A–D.

Distribution and ecology: *Tritonia linearifolia* is largely restricted to the lower slopes of the Kouga and Baviaanskloof Mountains but is also recorded from the northern foothills of the Fouriesberg at the western end of the Outeniqua Mountains (Figure 2). Although poorly collected, the species does not appear to be uncommon on the southern slopes of the Kouga Mountains, where it occurs in colonies on cooler, south-trending, rocky sandstone slopes. The corms are wedged among the rocks in loamy soil, and the leaves are dry and withered at flowering, which takes place in early summer, in December. The unscented, white flowers with purple anthers conform to the *Moegistorhynchus*–*Philoliche* long-proboscid fly pollination guild (Goldblatt & Manning 2000). Other local species that we predict to be members of this guild are *Tritonia bakeri* Klatt and *T. pallida* Ker Gawl. (Iridaceae), *Pelargonium peltatum*, and *P. tetragonum* (Geraniaceae), and *Dianthus caespitosus* subsp. *caespitosus* (Caryophyllaceae). Populations of the *Dianthus* from the Little Karoo constitute a distinct race with an exceptionally long calyx, cream-coloured petals, purple anthers, and flowers that are unscented at night, unlike subsp. *pectinatus*, which has a shorter calyx, pink petals with pale anthers and are scented at night (unpublished obs.).

Diagnosis and relationships: *Tritonia linearifolia* is recognized by its inclined spikes of white, long-tubed, zygomorphic flowers with low, greenish yellow, ridge-like calluses in the throat, and linear, grass-like leaves, 1–2 mm wide and dry at flowering. The reduced, linear callus ridges and linear leaves place it in sect. *Subcallosae*.

The relationships of *Tritonia linearifolia* lie with *T. pallida*, from which it is practically indistinguishable in its flowers (Figure 3E), and the two may comprise a vicariant species pair. They are readily separated vegetatively and in their ecology. *T. pallida* has noticeably wider, lanceolate leaves, 8–15 mm wide, and often longer floral bracts, up to 20 mm long, and is centred in the western and central Little Karoo, between Oudtshoorn and Montagu, with outlying populations north of the Swartberg from Whitehill to Laingsburg. *T. pallida* occurs on shale slopes, primarily in renosterveld or transitional vegetation types, flowering from mid-September to late October. *T. linearifolia*, in contrast, has very narrow, linear leaves, 1–2 mm wide, and is known mainly from the Longkloof and Baviaanskloof, with a single collection to the west from Fouriesberg in the Little Karoo south of Calitzdorp. The species is restricted to rocky sandstone slopes, in arid and grassy fynbos veg-

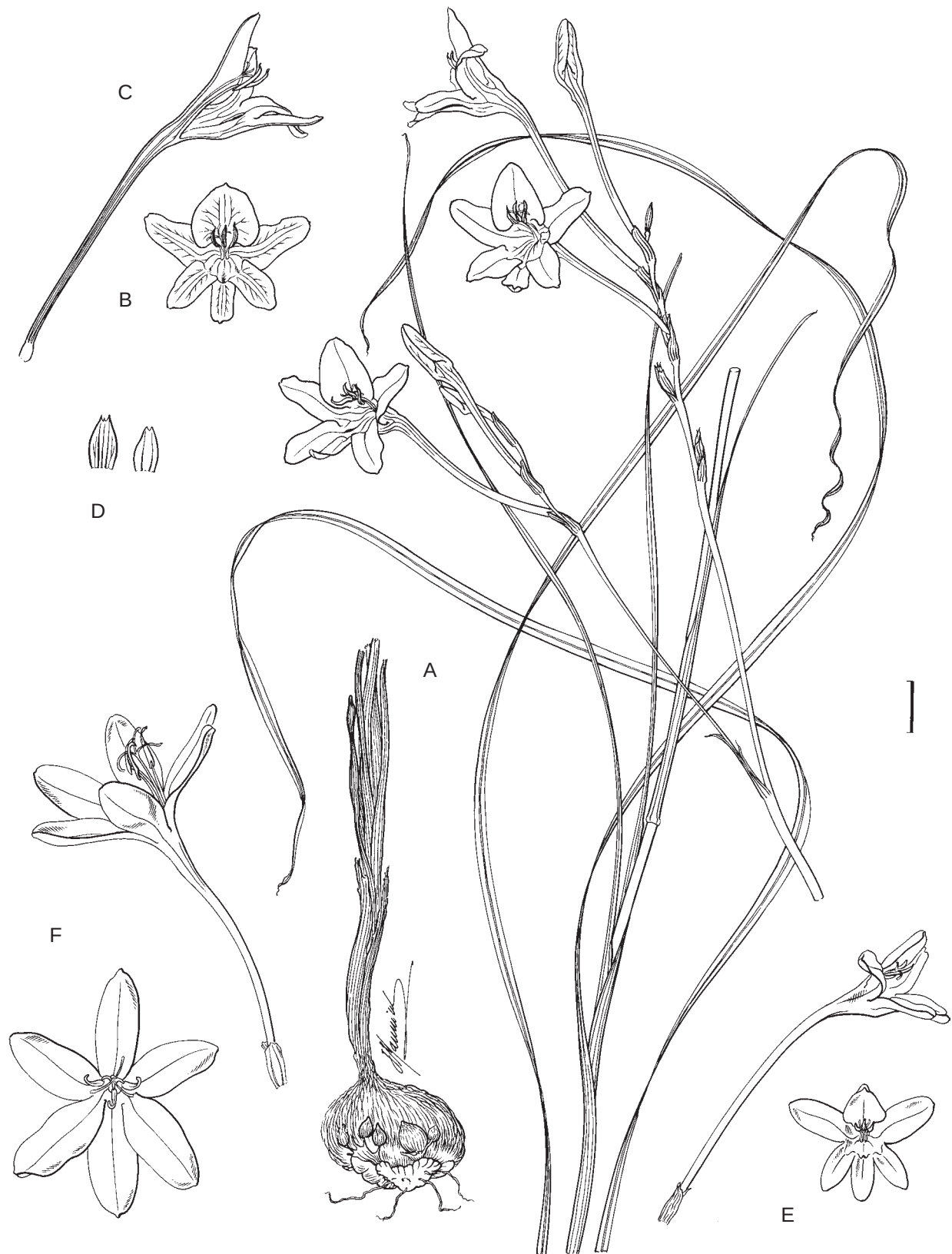


FIGURE 3.—A–D, *Tritonia linearifolia*, Manning 3244: A, flowering plant; B, flower, front view; C, half flower; D, bracts, outer (left) and inner (right). E, *T. pallida*, Goldblatt & Manning 10760 (NBG): flower, front and side view. F, *T. bakeri*, Manning 2909 (NBG): flower, front and side view. Scale bar: A–F, 10 mm. Artist: John Manning.

etation, flowering much later than *T. pallida*, in December.

Collections of *Tritonia linearifolia* have until now been misidentified as *T. bakeri*, another long-tubed spe-

cies widespread through the Little Karoo from Ladismith to the Langkloof, on the basis of the long, linear leaves but the resemblance between the two is superficial. The leaves of *T. bakeri* are highly characteristic, being fleshy and semi-terete in section when fresh,

without an evident midrib or true margins (De Vos 1999: fig. 29). Flowering in this species takes place somewhat earlier, mainly October to November, at which time the foliage is still green. This contrasts with the $\pm$ plane, thin-textured leaves of *T. linearifolia*, in which the midrib is thickened and evident, and which are quite dry at flowering time, in December. The two species are florally quite different, although this is best seen when they are fresh. Both species have inclined spikes but the flowers are differently orientated in the two: *T. linearifolia* has a clearly zygomorphic perianth and conventional floral orientation, with the dorsal tepal in the uppermost position and the stamens arched above the entrance to the floral tube, thus pollen deposition is nototribic; *T. bakeri*, in contrast, has an almost actinomorphic perianth with the flowers curved or slightly twisted at the base so that the morphologically dorsal tepal assumes a ventral position, with the stamens almost central and the anthers facing the spike apex, and pollen deposition thus $\pm$ sterotribic (Figure 3F).

Additional specimens

WESTERN CAPE.—3321 (Ladismith): Outeniqua Mtns, lower northern slopes of Fouriesberg, 1600' [1 000 m], (–DD), 13 Dec. 1987, Viviers & Vlok 369 (NBG).

EASTERN CAPE.—3324 (Steytlerville): Baviaanskloof Mtns, next to track at Bosrug, 3800' [2 375 m], (–CA), 20 Dec. 1985, Vlok 1333 (MO, NBG, PRE); Farm Joubertkraal, (–CC), 17 Dec. 1997, Van Jaarsveld 15601 (NBG).

Tritonia gladiolaris (= *T. lineata*) is a widespread species ranging from Mossel Bay in Western Cape through Eastern Cape and KwaZulu-Natal to Mpumalanga (De Vos 1983). A few collections of smaller plants in the southeast of the range between Jeffrey's Bay and Port Elizabeth were segregated as var. *parvifolia* by De Vos (1983) based on their smaller size (up to 300 mm tall) and shorter leaves (< 150 × 5 mm). The two varieties are florally identical (De Vos 1983) and we have encountered several depauperate plants among collections of the typical variety that match var. *parvifolia* in their reduced size and foliage. We conclude that the taxon does not deserve taxonomic rank.

***Tritonia gladiolaris* (Lam.) Goldblatt & J.C. Manning** in *Bothalia* 36: 57 (2006). *Ixia gladiolaris* Lam.: 341 (1789). Type: South Africa, Cape of Good Hope, cultivated in Paris, original collector unknown (P–Herb. Lamarck, holo.).

T. lineata var. *parvifolia* M.P. de Vos: 374 (1983), syn. nov. Type: South Africa, [Eastern Cape], Jeffrey's Bay, *Fourcade* 3345 (NBG, holo.); K, MO, PRE, iso.).

Tritonia strictifolia is currently cited (De Vos 1983) as *T. strictifolia* (Klatt) Benth. & Hook.f. (1883). However, although Benth. & Hooker's account of *Tritonia* mentions the basionym *Crococsmia strictifolia* Klatt as belonging to *Tritonia*, they do not cite the combination by name, and their inferred combination is thus invalid (McNeill *et al.* 2006: Art. 33.1). A combination (autonyms excepted) is not validly published unless the author definitely associates the final epithet with the name of the genus or species, or with its abbreviation. Article 33.1 Example 2 provides a parallel example. The valid combination *T. strictifolia* Benth. & Hook.f. is provided in *Index kewensis* by the editor, B.D. Jackson,

who also provided reference to the Benth. & Hooker treatment of *Tritonia* in which the basionym is cited. The correct author citation for the species is thus as follows:

***Tritonia strictifolia* (Klatt) Benth. & Hook.f. ex B.D. Jacks.** in *Index kewensis* 2: 1129 (1895). *Montbretia strictifolia* Klatt: 753 (1864). *T. laxifolia* var. *strictifolia* (Klatt) Baker: 195 (1892). Type: South Africa, [Eastern Cape], Uitenhage, Kalkhoogte between the Swartkops and Sundays Rivers, *Ecklon & Zeyher* 100 (B, lecto., designated by De Vos: 118 (1999); G, S, SAM, Z, iso.).

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REFERENCES

- BAKER, J.G. 1892. *Handbook of the Iridaceae*. Bell, London.
- BENTHAM, G. & HOOKER, J.D. 1883. *Genera plantarum* 3(1). Reeve, London.
- DE VOS, M.P. 1982. The African genus *Tritonia* Ker Gawl. (Iridaceae): part 1. *Journal of South African Botany* 48: 105–163.
- DE VOS, M.P. 1983. The African genus *Tritonia* Ker Gawl. (Iridaceae): part 2. Sections *Subcallosae* and *Montbretia*. *Journal of South African Botany* 49: 347–422.
- DE VOS, M.P. 1999. *Tritonia*. In M.P. de Vos & P. Goldblatt, *Flora of southern Africa* 7, 2: 89–128. National Botanical Institute, Pretoria.
- GOLDBLATT, P. & MANNING, J.C. 2000. The long-proboscid fly pollination system in southern Africa. *Annals of the Missouri Botanical Garden* 87: 146–170.
- GOLDBLATT, P. & MANNING, J.C. 2006. Notes on the systematics and nomenclature of *Tritonia* (Iridaceae: Crocoideae). *Bothalia* 36: 57–61.
- GOLDBLATT, P. & MANNING, J.C. 2008. *The iris family: natural history and classification*. Timber Press, Oregon.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index herbariorum*. Part. 1: the herbaria of the world. New York Botanical Garden, New York.
- JACKSON, B.D. 1895. *Index kewensis* 2. Clarendon, Oxford.
- KLATT, F.W. 1862. *Revisio Iridearum*. *Linnaea* 32: 689–784.
- LAMARCK, J.B.A.P.M. 1789. *Encyclopédie méthodique Botanique* 3. Paris.
- MCNEILL, J., BARRIE, F.R., BURDET, H.M., DEMOULIN, V., HAWKSWORTH, D.L., MARHOLD, K., NICOLSON, D.H., PRADO, J., SILVA, P.C., SKOG, J.E., WIERSMA, J.H. & TURLAND, N.J. (eds). 2006. International Code of Botanical Nomenclature (Vienna Code) adopted by the seventeenth International Botanical Congress, Vienna, Austria, July 2005. Gantner, Liechtenstein. *Regnum Vegetabile* 146.
- RUDALL, P. 1994. Anatomy and systematics of Iridaceae. *Botanical Journal of the Linnean Society* 114: 1–21.

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ASTERACEAE

VERNONIA (TRIBE VERNONIEAE) AND RELATED GENERA IN SOUTHERN AFRICA: UPDATES AND CORRECTIONS

INTRODUCTION

When we compiled the Asteraceae account for *Strelitzia* 10 (Herman *et al.* 2000), *Strelitzia* 14 (Herman *et al.* 2003) and the *Southern African Botanical Diversity Network Report* No. 41 (Herman *et al.* 2006), the publication of Robinson (1999) on research and changes in the classification of the large genus *Vernonia* Schreb., was not available to us. This reclassification resulted in numerous name changes. A list of names of new genera and new combinations relevant to southern African *Vernonia sens. lat.* is presented here. The format followed in this article is based on that of Germishuizen & Meyer (2003), Germishuizen *et al.* (2006) and Herman (2008): the number(s) after the synonyms refer to the literature reference(s) where the synonymy was published, and the ^E indicates whether the taxon is endemic to South Africa. A key to the subtribes and genera can be found in Robinson (2007).

BACKGROUND

Since the early classification by Bentham in 1873, the tribe Vernonieae contained a large core genus, *Vernonia* Schreb., and various satellite genera based mostly on variations in morphological characters (Robinson 1996, 2007). This classification was followed for most of the previous century. It was only from the 1970s that revisional studies included pollen, chromosome numbers and chemistry, together with the traditional morphological characters, which led to the changing of the genus and species delimitations, and the genera were split off from the large, heterogeneous core genus (Robinson 1996).

The study by Isawumi (1996) showed that the genus *Vernonia* is paraphyletic and has two centres of origin: one in South America and the second in Africa and southeastern Asia. Many scientists have found that *Vernonia* species from the eastern and western hemispheres are different and should be placed in different genera (Isawumi 1996; Robinson 1996). The following arguments support these views:

1. The eastern hemisphere or the Old World is where almost all the Vernonieae with chromosome numbers $x = 9$ or 10 occur, whereas the American or the New World Vernonieae have chromosome numbers $x = 16$ or 17 (Isawumi 1996; Robinson 1996). Recent studies showed that it is not always the case but the chromosome numbers in the Old World species showed much less variation than those in the New World (Keeley & Robinson 2009).

2. The flavonoids of American Vernonieae species are more complex and consist of flavones or flavonols or both (Isawumi 1996; Robinson 1996), whereas the Vernonieae in the eastern hemisphere or Old World produce only flavones (Isawumi 1996).

3. There are differences in the pollen of the *Vernonia* species occurring in the eastern and western hemispheres. Robinson (1996) reported pollen type A in *Vernonia* in the western hemisphere (North America, the Bahamas, south to central Mexico and temperate South America) while Keeley & Jones (1979) reported pollen type D only in the western hemisphere *Vernonia* and pollen types E and F exclusively in the eastern hemisphere *Vernonia*.

4. DNA evidence presented in the phyletic tree by Keeley & Robinson (2009), shows a definite gap between the Vernonieae of the eastern and western hemispheres.

However, members of the genus *Vernonia* cannot simply be divided into two genera, one for each hemisphere. Many segregates are needed for each hemisphere (Robinson 1990, 1996, 1999). In an attempt to refine the genus *Vernonia sens. lat.* from both the Old and New Worlds by segregating new genera, Robinson (1990) resurrected the genera *Baccharoides* Moench and *Cyanthillium* Blume, and Robinson & Kahn (1986) resurrected and made some transfers into the genus *Distephanus* Cass. from the Old World *Vernonia*. Pollen, style bases, raphids, inflorescence form, involucre, anther appendage, chromosome numbers, geography and chemistry were some of the additional characters used in the reclassification of the genus *Vernonia* (Robinson 1996).

In a study by Robinson (1999), fourteen palaeotropical (eastern hemisphere) genera have been described, raised from lower rank, resurrected, enlarged or reduced with 110 new combinations. *Hilliardiella* H. Rob., *Orbivestus* H. Rob. and *Vernoniastrum* H. Rob. are some of the newly described genera. Some of the resurrected genera are *Centrapalus* Cass., *Linzia* Sch. Bip. ex Walp. and *Polydora* Fenzl. Some species were transferred to *Cyanthillium* and *Gymnanthemum* Cass. Recent publications support this new classification (Robinson 2007; Keeley & Robinson 2009). More combinations were made by Isawumi (2008). The genus *Vernonella* Sond. is also in the process of being reinstated by Robinson & Skvarla (in press).

Half the tribe in the western hemisphere has been delimited into workable and phylogenetically acceptable genera. The members in the eastern hemisphere, however, need more work (revision) as the paraphyletic core genus *Vernonia sens. lat.* and paraphyletic or polyphyletic segregates are not congeneric with *Vernonia sens. str.* (Robinson 1999). There are no species of *Vernonia sens. str.* in the eastern hemisphere (Isawumi 1996). Some *Vernonia* species names are still used in Africa and the continued use of the name *Vernonia* for species in this area, is simply there until further revisions have been completed.

LIST OF TAXA

CYANTHILLIUM Blume 8751050
(3) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

vernonioides (Muschl.) H.Rob.
Erlangea vernonioides Muschl. not *Vernonia vernonioides* (A.Gray) Bacigalupo, 1931 (3)
Vernonia meiostephana C.Jeffrey (3)
Annual. Herb. Ht 0.6–1.5 m. Alt. 350–850 m. LIM, M, S

GYMNANTHEMUM Cass. 8751130
(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

amygdalinum (Delile) Sch.Bip. ex Walp.
G. abyssinicum Sch.Bip. ex Walp. (1)
Vernonia amygdalina Delile (1)
V. randii S.Moore (1)
Perennial. Tree or shrub. Ht up to 8 m. Alt. 130–1 065 m. B, LIM, M, S, KZN

coloratum (Willd.) H.Rob. & B.Kahn *sens. lat.*

Baccharis senegalensis Pers. (1)
Decaneurum senegalense (Pers.) DC. (1)
Eupatorium coloratum Willd. (1)
G. cupulare Cass. (1)
G. senegalense (Pers.) Sch.Bip. ex Walp. (1)
Vernonia colorata (Willd.) Drake subsp. *colorata* (1)
V. senegalensis (Pers.) Less. (1)
Perennial. Tree or shrub. Ht 0.9–9 m. Alt. 20–975 m. B, LIM, M, S, KZN

corymbosum (L.f.) H.Rob.

Cacalia corymbosa (L.f.) Kuntze (1)
Plectreca corymbosa (Thunb.) Raf. (1)
Staehelina corymbosa L.f. (1)
Vernonia corymbosa (L.f.) Less. (1)
V. neocorymbosa Hilliard (1)
V. tigna Klatt (1)
Perennial. Shrub. Ht 0.5–3 m. Alt. 0–2 000 m. LIM, M, S, FS, KZN, EC

crataegifolium (Hutch.) H.Rob.

Vernonia crataegifolia Hutch. (1)
V. mespilifolia Less. var. *subcanescens* DC. (1)
V. pseudo-corymbosa Thell. (1)
Perennial. Shrub. Ht 0.6–2 m. Alt. 60–2 000 m. LIM, M, S, KZN, EC

mespilifolium (Less.) H.Rob.

Cacalia mespilifolia (Less.) Kuntze (1)
Vernonia mespilifolia Less. (1)
Perennial. Shrub, climber or scrambler. Ht 0.6–9 m. Alt. 0–1 830 m. LIM, M, S, KZN, WC, EC

myrianthum (Hook.f.) H.Rob.

Vernonia ampla O.Hoffm. (1)
V. myriantha Hook.f. (1)
V. podocoma Sch.Bip. ex Vatke (1)
V. stipulacea Klatt (1)
Perennial. Shrub. Ht 1.2–7 m. Alt. 430–1 920 m. LIM, M, S, KZN

HILLIARDIELLA H.Rob. 8751070

(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

aristata (DC.) H.Rob.

Cacalia aristata (DC.) Kuntze (1)
Vernonia aristata (DC.) Sch.Bip. (1)
V. natalensis Sch.Bip. ex Walp. (1)
V. pseudonatalensis Wild (1)
Webbia aristata DC. (1)
Perennial. Herb. Ht 0.1–1.2 m. Alt. 5–2 200 m. LIM, NW, G, M, S, FS, KZN, L, EC

hirsuta (DC.) H.Rob.

Vernonia hirsuta (DC.) Sch.Bip. ex Walp. (1)
V. hirsuta (DC.) Sch.Bip. ex Walp. var. *obtusifolia* Harv. (1)

Webbia hirsuta DC. (1)

Perennial. Herb. Ht 0.3–1.5 m. Alt. 5–2 285 m. LIM, NW, G, M, S, FS, KZN, L, EC

nudicaulis (DC.) H.Rob.

Cacalia nudicaulis (DC.) Kuntze (1)
Vernonia dregeana Sch.Bip. (1)
Webbia nudicaulis DC. (1)
Perennial. Herb, geophyte. Ht 0.3–0.8 m. Alt. 0–1 920 m. M, KZN, EC

oligocephala (DC.) H.Rob.

Cacalia elaeagnoides (DC.) Kuntze (1)
Vernonia elaeagnoides (DC.) Sch.Bip. (1)
V. kraussii Sch.Bip. ex Walp. (1)
V. oligocephala (DC.) Sch.Bip. ex Walp. (1)
Webbia elaeagnoides DC. (1)
W. oligocephala DC. (1)
Perennial. Herb. Ht 0.08–1 m. Alt. 15–2 338 m. N, B, LIM, NW, G, M, S, FS, KZN, L, NC, EC

pinifolia (Lam.) H.Rob.

Cacalia capensis (Houtt.) Kuntze (1)
Conyza canescens L.f. (1)
C. pinifolia Lam. (1)
Erigeron capense Houtt. (1)
Vernonia capensis (Houtt.) Druce (1)
V. pinifolia (Lam.) Less. (1)
Webbia pinifolia (Lam.) DC. (1)
Perennial. Herb, geophyte. Ht 0.2–1 m. Alt. 15–2 100 m. M, S, FS, KZN, L, WC, EC

LINZIA Sch.Bip. ex Walp. 8751030

(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

(2) Isawumi. 2008. *Compositae Newsletter* 46: 38–40.

gerberiformis (Oliv. & Hiern) H.Rob. subsp. **macrocy-
anus** (O.Hoffm.) Isawumi

Vernonia gerberiformis Oliv. & Hiern subsp. *macrocyanus* (O.Hoffm.) C.Jeffrey (2)
V. macrocyanus O.Hoffm. (1, 2)
V. primulina O.Hoffm. (1, 2)
Perennial. Herb. Ht 0.04–0.75 m. Alt. ± 700 m. N, B, LIM

glabra Steetz *sens. lat.*

L. glabra Steetz var. *glabra* (1)
L. glabra Steetz var. *laxa* Steetz (1)
Vernonia glabra (Steetz) Vatke *sens. lat.* (1)
V. obconica Oliv. & Hiern (1)
V. ondongensis Klatt (1)
Perennial. Herb. Ht 1.2–3 m. Alt. 900–1 158 m. N, B, LIM

melleri (Oliv. & Hiern) H.Rob. *sens. lat.*

Vernonia melleri Oliv. & Hiern *sens. lat.* (1)
Perennial. Herb. Ht 0.3–1.5 m. Alt.? B

ORBIVESTUS H.Rob. 8751080

(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

(2) Robinson. 2009. *Phytologia* 91,3: 482–492.

cinerascens (Sch.Bip.) H.Rob.

Vernonia cinerascens Sch.Bip. (1)
V. luederitziana O.Hoffm. (1)
V. porta-taurinae Dinter ex Merxm. (1)
V. squarrosa Dinter ex Merxm. (1)
Perennial. Shrub. Ht 0.5–3 m. Alt. 360–1 200 m. N, B, LIM, M?

POLYDORA Fenzl 8751090

(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

angustifolia (Steetz) H.Rob.

Crystallopollen angustifolium Steetz (1)
Vernonia erinacea Wild (1)
V. rhodanthoidea Muschl. (1)

POLYDORA Fenzl (cont.)**angustifolia (Steetz) H. Rob. (cont.)**

Annual. Herb. Ht 0.1–2 m. Alt. ± 1 000 m. LIM, NW, G

bainesii (Oliv. & Hiern) H. Rob. sens. lat.

Vernonia bainesii Oliv. & Hiern sens. lat. (1)

Perennial. Herb. Ht 0.6–1.2 m. Alt.? 'Tvl'?

poskeana (Vatke & Hildebr.) H. Rob. sens. lat.

Vernonia poskeana Vatke & Hildebr. sens. lat. excl. *V. poskeana* Vatke & Hildebr. var. *chlorolepis* (Steetz) O. Hoffm. (1)

Annual. Herb. Ht 0.1–1.5 m. Alt. 300–1 850 m. N, B, LIM, NW, G, M, S, FS

steetziana (Oliv. & Hiern) H. Rob.

Vernonia poskeana Vatke & Hildebr. var. *chlorolepis* (Steetz) O. Hoffm. (1)

V. steetziana Oliv. & Hiern (1)

Annual. Herb. Ht 0.2–1 m. Alt. 305–1 030 m. N, B, LIM, M, S, KZN

VERNONELLA Sond.

8751120

(1) Robinson & Skvarla. In press. *Proceedings of the Biological Society of Washington* 123,3.

†africana Sond.

Centropalus africanus (Sond.) H. Rob. (1)

Vernonia africana (Sond.) Druce (1)

V. vernonella Harv. (1)

Perennial. Herb. geophyte. Ht up to 0.5 m. Alt. 75–150 m. KZN

VERNONIASTRUM H. Rob.

8751100

(1) Robinson. 1999. *Proceedings of the Biological Society of Washington* 112: 220–247.

latifolium (Steetz) H. Rob.

Crystallipollen latifolium Steetz (1)

Vernonia petersii Oliv. & Hiern ex Oliv. (1)

Annual. Herb. Ht 0.1–1.2 m. Alt. up to 1 160 m. N, B

nestor (S. Moore) H. Rob.

Vernonia nestor S. Moore (1)

Perennial. Herb. Ht up to 0.9 m. Alt.? KZN

REFERENCES

- BENTHAM, G. 1873. Compositae. In G. Bentham & J.D. Hooker, *Genera plantarum* 2. Reeve, London.
- GERMISHUIZEN, G. & MEYER, N.L. (eds). 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. (eds). 2006. *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41. SABONET, Pretoria.
- HERMAN, P.P.J. 2008. Asteraceae in *Strelitzia* 14 (2003) and *Southern African Botanical Diversity Network Report* No. 41 (2006):

updates and corrections. *Bothalia* 38: 125–129.

- HERMAN, P.P.J., RETIEF, E., KOEKEMOER, M. & WELMAN, W.G. 2000. Asteraceae. In O.A. Leistner, *Seed plants of southern Africa: families and genera*. *Strelitzia* 10: 101–170. National Botanical Institute, Pretoria.
- HERMAN, P.P.J., WELMAN, W.G., RETIEF, E., KOEKEMOER, M. & NETNOU, N. 2003. Asteraceae. In G. Germishuizen & N.L. Meyer, *Plants of southern Africa: an annotated checklist*. *Strelitzia* 14: 178–310. National Botanical Institute, Pretoria.
- HERMAN, P.P.J., WELMAN, W.G., RETIEF, E., KOEKEMOER, M. & NETNOU, N. 2006. Asteraceae. In G. Germishuizen, N.L. Meyer, Y. Steenkamp & M. Keith, *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41: 155–277. SABONET, Pretoria.
- ISAWUMI, M.A. 1996. Infrageneric classification of *Vernonia* (Vernonieae: Compositae) in West Africa. In D.J.N. Hind & H.J. Beentje, *Compositae: systematics*. Proceedings of the International Compositae Conference, Kew, 1994, vol. 1: 531–544. Royal Botanic Gardens, Kew.
- ISAWUMI, M.A. 2008. The status of generic revision in the African Vernonieae (Asteraceae). *Compositae Newsletter* 46: 27–48.
- KEELEY, S.C. & JONES, S.B. 1979. Distribution of pollen types in *Vernonia* (Vernonieae: Compositae). *Systematic Botany* 4: 195–202.
- KEELEY, S.C. & ROBINSON, H. 2009. Vernonieae. In V.A. Funk, A. Susanna, T.F. Stuessy & R.J. Bayer, *Systematics, evolution and biogeography of Compositae*: 439–469. International Association for Plant Taxonomy, Vienna.
- ROBINSON, H. 1990. Six new combinations in *Baccharoides* Moench and *Cyanthillium* Blume (Vernonieae: Asteraceae). *Proceedings of the Biological Society of Washington* 103: 248–253.
- ROBINSON, H. 1996. The status of generic and subtribal revisions in the Vernonieae. In D.J.N. Hind & H.J. Beentje, *Compositae: systematics*. Proceedings of the International Compositae Conference, Kew, 1994, vol. 1: 511–529. Royal Botanic Gardens, Kew.
- ROBINSON, H. 1999. Revisions in paleotropical Vernonieae (Asteraceae). *Proceedings of the Biological Society of Washington* 112: 220–247.
- ROBINSON, H. 2007. VI. Tribe Vernonieae Cass. In K. Kubitzki, *The families and genera of vascular plants. VIII. Flowering plants—Eudicots, Asterales* (eds J.W. Kadereit & C. Jeffrey): 149–174. Springer, Berlin.
- ROBINSON, H. 2009. Additions to the genus *Orbivestus* H. Rob. (Asteraceae: Vernonieae) and neotypification of *Vernonia tetensis* O. Hoffm. *Phytologia* 91,3: 482–492.
- ROBINSON, H. & KAHN, B. 1986. Trinervate leaves, yellow flowers, tailed anthers and pollen variation in *Distephanus* Cass. (Vernonieae: Asteraceae). *Proceedings of the Biological Society of Washington* 99: 493–501.
- ROBINSON, H. & SKVARLA, J.J. In press. The restoration of the genus *Vernonella* Sond. (Vernonieae: Asteraceae). *Proceedings of the Biological Society of Washington* 123,3.

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CAMPANULACEAE

A NEW SPECIES OF *WAHLENBERGIA* FROM WESTERN CAPE, SOUTH AFRICA

INTRODUCTION

Wahlenbergia Schrad. ex Roth with 260 species (Lammers 2007a, b) is the largest genus of Campanulaceae in the southern hemisphere and is most abundant in South Africa where about 65 % of species occur. Other areas in the southern hemisphere with significant species numbers are Australia (28 spp., Smith 1992; Plunkett *et al.* 2009) and New Zealand (10 spp., Petterson 1997). *Wahlenbergia*, as currently circumscribed, includes the genus *Lightfootia* L'Hér. nom. illegit.,

which comprised shrubby species with deeply divided corolla lobes (Thulin 1975; Lammers 1995). Von Brehmer (1915) revised *Wahlenbergia* for almost the entire African continent. He provided a subgeneric classification and keys to all species of *Wahlenbergia* and also proposed a subgeneric classification for *Lightfootia*, which was an improvement on that of Sonder (1865). More than 50 % of the species accepted by Von Brehmer were based on single collections. Thulin (1975) who revised *Wahlenbergia* for tropical Africa and Madagas-



FIGURE 4.—*Wahlenbergia suffruticosa*, inflorescences. Photograph: C.N. Cupido.

car, expressed doubt on the validity of many of them. The most recent comprehensive revision of *Lightfootia* was published by Adamson (1955) in which he recognized 46 species and followed to a great extent the subgeneric treatment of Von Brehmer (1915). Since Adamson's treatment, new species and subspecies of the genus formerly treated as *Lightfootia* have been described for tropical Africa (Lambinon & Duvigneaud 1961; Duvigneaud & Denaeyer-De Smet 1963; Wild 1964) but none for South Africa.

During field work, while collecting material for phylogenetic studies of the Campanulaceae, an undescribed species of *Wahlenbergia* was discovered. Vegetative and floral characters displayed by this species, place it in the *Lightfootia*-type group of the genus. This is also confirmed by the phylogenetic analyses, using chloroplast and nuclear DNA sequences, where these shrubby species were grouped separately from the 'typical' *Wahlenbergia* species (Cupido 2008). The new species meets the criteria of the monophyletic species concept, under which species can be diagnosed by at least one autapomorphy (Donoghue 1985). The species is described and illustrated here.

***Wahlenbergia suffruticosa* Cupido, sp. nov.**, herba perennis a congeneribus rhizomate capsulaque loculicide secus rimas longitudinales inter valvas apicales depressas in segmenta 5 secedenti. W. subulatae (L'Hér.) Lammers affinis sed floris colore, hypanthii forma amplitudineque, disci epigyni forma et capsulae dehiscencia differt.

TYPE.—Western Cape, 3318 (Cape Town): Malmesbury, Chatsworth, southern end of Chamberlain Road, (–DA), 5 Dec. 2007, C.N. Cupido 325 (NBG, holo.; K, PRE).

Perennial rhizomatous herb with suffruticose habit, up to 200 mm tall, hispid, tufted, initially with taproot, lateral rhizomes develop later from which new shrublets arise. *Stems* erect, slender, unbranched, occasionally with lateral branches. *Leaves* alternate, scattered, spreading, sessile, linear, up to 10 mm long, subulate, apex hyaline, sparsely hispidulous on abaxial surface; margins sparsely ciliate or ciliate-dentate; axillary cluster of smaller leaves present. *Inflorescence* 3-flowered, 1 terminal, lateral 2 rudimentary, on highly reduced lateral branches with leaf-like bracts, aggregated into raceme-like synflorescences toward ends of main branches. *Flowers* shortly pedicellate, axillary, actinomorphic; bracts 2, leaf-like, 1.2–3.6 mm long, opposite, succulent, subulate, apex hyaline, sparsely hispidulous on abaxial surface, margins sparsely ciliate or ciliate-dentate, subtending each of rudimentary flowers, absent in terminal flower. *Hypanthium* hemispherical, hispidulous. *Calyx*: lobes 5, alternating with corolla lobes, 1.2–2.5 mm long, triangular, apex hyaline, sparsely hispidulous, margins sparsely ciliate-dentate. *Corolla* stellate, white or mauve; tube 0.1–1.0 mm long; lobes 5, 2.3–3.6 mm long, linear, outer surface hispidulous along midrib and inner surface near base. *Stamens* 5, free, inserted at base of corolla tube; filament 1.0–2.2 mm long, base dilated, margin ciliate, upper part tapering, forming a dome; anthers linear, basifixed. *Ovary* inferior, 5-locular, each containing 3 or 4 erect ovules situated at base of ovary, epigynous disc fleshy, occasionally hairy; style cylindrical, 2.0–3.6 mm long, eglandular, mauve-purple, sparsely hairy; stigma 3(4)-lobed. *Fruit* a capsule with depressed apical valves, dehiscing loculicidally by 5 longitudinal slits, 1 seed develops in 1 or 2 locules. *Flowering time*: November to January. Figures 4, 5.

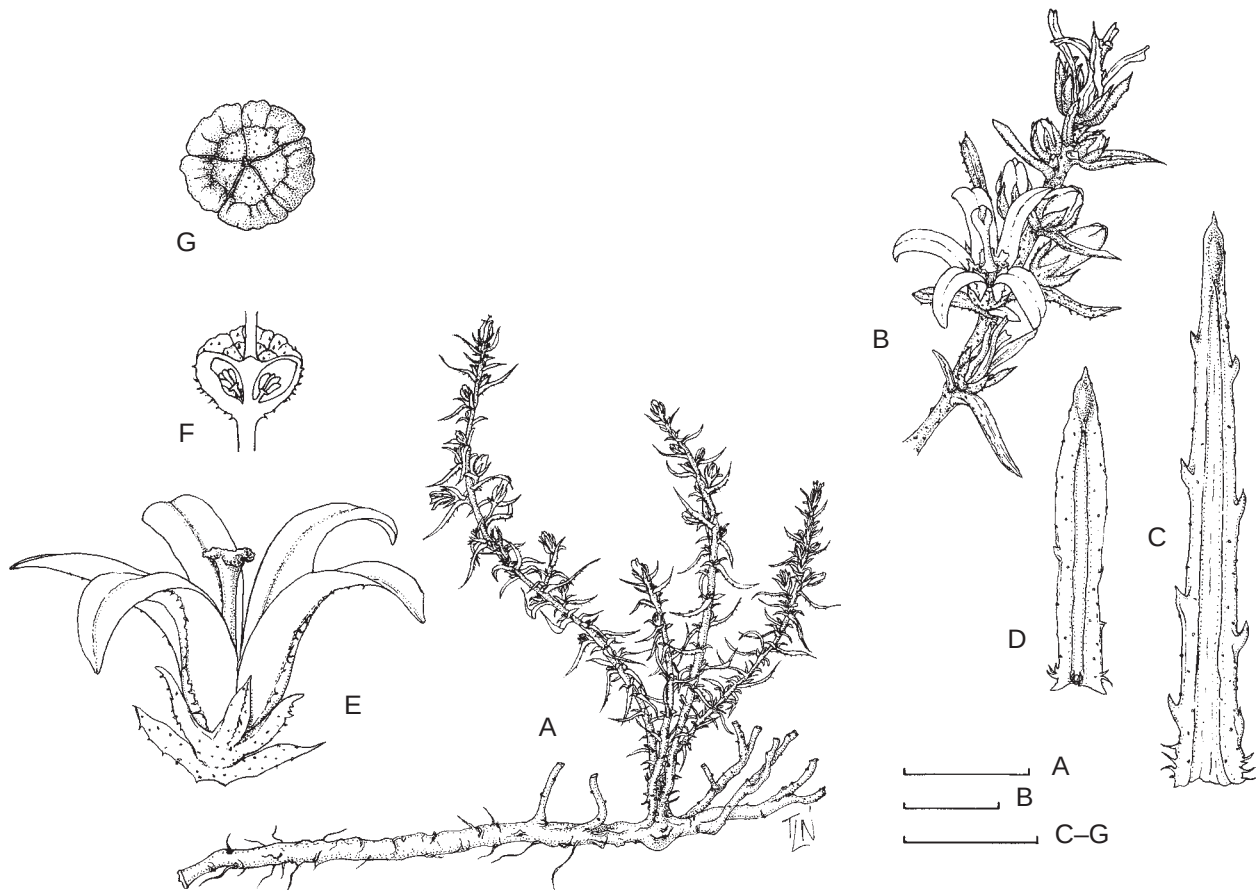


FIGURE 5.—*Wahlenbergia suffruticosa*, Cupido 325. A, portion of plant; B, flowering branch; C, leaf; D, leaf-like bract with rudimentary flower; E, flower with two leaf-like bracts; F, base of flower longitudinally opened, showing ovary and basal part of style; G, capsule (aerial view). Scale bars: A, 20 mm; B, 4 mm; C–G, 2 mm. Artist: Tracey Nowell.

Conservation status: known from a single population in Chatsworth, Malmesbury. The habitat of this species is under serious threat from invasive *Acacia saligna* trees and housing developments. Plots adjacent to the population are already being cleared for housing. It must be considered as Critically Endangered [A3c; B1 ab (i,ii,iii,iv,v) + 2ab (i,ii,iii,iv,v); C1+ 2a (i,ii); D, World Conservation Union (IUCN) 2001].

Diagnostic features and affinities: the ‘*Lightfootia*’ clade in which *Wahlenbergia suffruticosa* is nested, is largely unresolved (Cupido 2008) and is of limited use in inferring relationships among species. The placement of *W. suffruticosa* is therefore uncertain, but morphological investigations suggest a strong affinity of this species to *W. subulata* L’Hér.

Vegetatively, the two species resemble each other in their spreading, often tufted habit, leaf shape and the presence of smaller leaves in the axils. The flowers of *Wahlenbergia subulata* are generally deep purple and on pedicels of longer than 1 mm, and larger than those of *W. suffruticosa*. In contrast, the smaller almost inconspicuous white flowers of *W. suffruticosa* are on pedicels shorter than 1 mm. The ovary in *W. subulata* is almost superior, thereby reducing the size of the hypanthium which is obscured by bulges at the base of the calyx lobes. *W. suffruticosa* differs from it in having an almost semi-inferior ovary, a well-developed hypanthium and no bulges at the base of the calyx lobes. Both species

have three or more basal ovules in each of the five locules of the ovary. Usually in the Campanulaceae, the ovary locule number and style lobe number are correlated (Thulin 1975; Eddie & Ingrouille 1999), but this is not the case in this population of *W. suffruticosa*, in which the style lobe number (three) is smaller than the ovary locule number (five). The locule number, however, appears constant within the population. The style base in *W. subulata* is expanded, fusing with the dome-shaped epigynous disc, whereas in *W. suffruticosa* it is not expanded but embedded in a fleshy, flattened epigynous disc. In all species of *Wahlenbergia*, except *W. acaulis* E.Mey., the capsule characteristically dehisces by erect apical valves, which are formed by the dome-shaped epigynous disc. In *W. acaulis* dehiscence takes place via protruding intercalyx folds. *W. suffruticosa* has also departed from the typical *Wahlenbergia* pattern by evolving a unique mode of dehiscence in which slits develop between the depressed apical valves and extend longitudinally, separating the capsule into five segments (Figure 5G). This mode of dehiscence is an autapomorphy for the species. The uncorrelated style lobe and ovary locule numbers appear unique to this species, but could be a result of phenotypic plasticity, a phenomenon common in the Campanulaceae (Eddie & Ingrouille 1999). The consistency of these character states within the species needs to be confirmed when more populations are found.

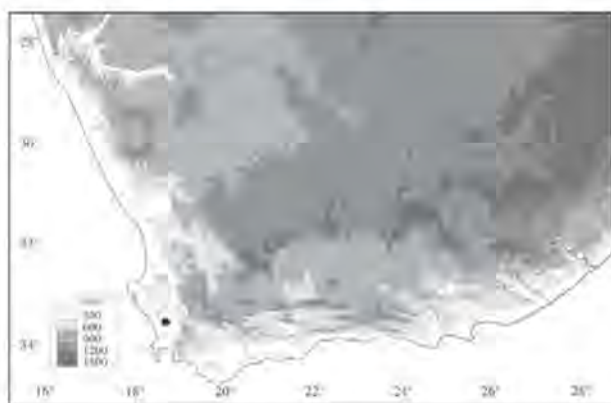


FIGURE 6.—Known distribution of *Wahlenbergia suffruticosa*.

In previous studies in the South African Campanulaceae, little or no attention has been given to below-ground plant structures as a potential source of taxonomic characters. The rhizomatous habit found in *Wahlenbergia suffruticosa* is documented here for the first time. It would appear from some herbarium specimens that rhizomes are also found in *W. subulata*.

Distribution and habitat: this species is only known from Chatsworth, a small town 15 km from Malmesbury off the N7 road from Cape Town (Figure 6). It grows in full sunlight in sand fynbos on sandy flats at an altitude of about 100 m. The soils are well drained and more than 2 m deep. The annual rainfall range is between 290 and 660 mm, with precipitation peaking from May to August. Additional precipitation is provided by mists which are common in winter. Frost occurs about three days per year (Rebelo *et al.* 2006).

Etymology: the epithet refers to the habit of the plant (*suffruticosus* = somewhat woody).

Additional specimen examined

WESTERN CAPE.—3318 (Cape Town): Malmesbury, Chatsworth, vacant plot SW of the Morris Brown AME Church, (–DA), 22 Nov. 2001, Cupido 209 (NBG).

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REFERENCES

- ADAMSON, R.S. 1955. South African species of *Lightfootia*. *Journal of South African Botany* 21: 155–221.
- CUPIDO, C.N. 2008. *Systematic studies of the South African Campanulaceae (Campanuloideae) with an emphasis on generic delimitations*. Ph.D. thesis, University of Cape Town.
- DONOGHUE, M.J. 1985. A critique of the biological species concept and recommendations for a phylogenetic alternative. *Bryologist* 88: 172–181.
- DUVIGNEAUD, P. & DENAEYER-DE SMET, S. 1963. Cuivre et végétation au Katanga. *Bulletin de la Société Royale Botanique de Belgique* 96: 93–231.
- EDDIE, W.M.M. & INGROUILLE, M.J. 1999. Polymorphism in the Aegean 'five-lobed' species of the genus *Campanula*, Section *Quinqueloculares* (Campanulaceae). *Nordic Journal of Botany* 19: 153–169.
- LAMBINON, J. & DUVIGNEAUD, P. 1961. Étude systématique et phytogéographique d'un groupe de *Lightfootia* à inflorescence contractée. *Bulletin de la Société Royale Botanique de Belgique* 93: 41–53.
- LAMMERS, T.G. 1995. Transfer of the southern African species of *Lightfootia* nom. illeg., to *Wahlenbergia*. *Taxon* 44: 333–339.
- LAMMERS, T.G. 2007a. Campanulaceae. In K. Kubitzki, *The families and genera of vascular plants*, vol. 8. Asterales (J. Kadereit & C. Jeffrey, eds): 26–56. Springer, Berlin.
- LAMMERS, T.G. 2007b. *World checklist and bibliography of Campanulaceae*. Royal Botanic Gardens, Kew.
- PETERSON, J.A. 1997. Revision of the genus *Wahlenbergia* (Campanulaceae) in New Zealand. *New Zealand Journal of Botany* 33: 9–54.
- PLUNKETT, G.T., BRUHL, J.J. & TELFORD, I.R.H. 2009. Two new, sympatric species of *Wahlenbergia* (Campanulaceae) from the New England Tableland escarpment, New South Wales, Australia. *Australian Systematic Botany* 22: 319–331.
- REBELO, A.G., BOUCHER, C., HELME, N., MUCINA, L. & RUTHERFORD, M.C. 2006. Fynbos Biome. In L. Mucina & M.C. Rutherford, *The vegetation of South Africa, Lesotho and Swaziland*. *Strelitzia* 19: 53–219. South African National Biodiversity Institute, Pretoria.
- SMITH, P.J. 1992. A revision of the genus *Wahlenbergia* (Campanulaceae) in Australia. *Telopea* 5: 91–175.
- SONDER, O.W. 1865. Campanulaceae. In W.H. Harvey & O.W. Sonder, *Flora capensis* 3: 530–605. Hodges, Smith, Dublin.
- THULIN, M. 1975. The genus *Wahlenbergia* s.l. (Campanulaceae) in tropical Africa and Madagascar. *Symbolae Botanicae Upsalien-sis* 21: 1–223.
- VON BREHMER, W. 1915. Über die systematische Gliederung und Entwicklung der Gattung *Wahlenbergia* in Afrika. In A. Engler, *Beiträge zur Flora von Afrika*, XLIV. *Botanische Jahrbücher* 53: 9–143.
- WILD, H. 1964. New and interesting species. *Kirkia* 4: 159–164.
- WORLD CONSERVATION UNION (IUCN). 2001. *IUCN Red list categories and criteria: version 3.1*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

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PTERIDOPHYTES

NEW PTERIDOPHYTE RECORDS FOR THE FLORA OF SWAZILAND

The most recent enumeration of the pteridophytes of Swaziland is that of Roux (2003a), nomenclatural aspects of which have been updated (Roux 2009). The 2003 checklist reflected new discoveries based on intense field work conducted during May 2002, and was complemented by a country-focused treatment (Roux

2003b) that provided distribution maps for each taxon. The new records were included in the Swaziland flora checklist produced shortly thereafter by Braun *et al.* (2004). We report on three subsequent pteridophyte discoveries made in Swaziland, which increase the total documented number of fern taxa occurring there to

115. Protologue citations and synonymy for these new records—*Asplenium cordatum* (Thunb.) Sw., *Cheilanthes inaequalis* (Kunze) Mett. var. *buchananii* (Baker) Schelpe and *Ophioglossum costatum* R.Br.—are provided by Roux (2009).

Asplenium cordatum

It is somewhat surprising that no ceterachoid aspleniums have been found earlier in Swaziland, given the extent of suitable xeric habitat and close proximity to South African localities of the two regional species [for map see information under *Ceterach cordatum sensu* Burrows (1990)]. Plants of *Asplenium cordatum* [Aspleniaceae, syn. *Ceterach cordatum* (Thunb.) Desv.] were found in typical habitat near Mbabane (Figure 7), as chasmophytic saxicoles (Jacobsen 1983) on granite boulders amongst clumps of *Strelitzia caudata*. The vegetation at the site forms part of the KaNgwane Montane Grassland (Gm 16) (Mucina *et al.* 2006).

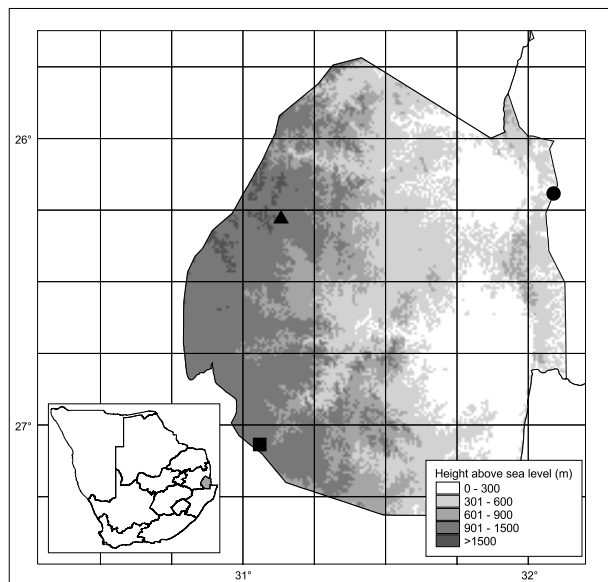


FIGURE 7.—Distribution of *Asplenium cordatum*, ▲; *Cheilanthes inaequalis* var. *buchananii*, ■; and *Ophioglossum costatum*, ●, in Swaziland.

Specimen examined

SWAZILAND.—2631 (Mbabane): on ledge of granite boulders, northeastern aspect, towards top of kopje on Van der Meers Farm, Mbabane, 1 346 m, (–AC), 29-12-2009, L. Loffler 1179 (BNRH, PRE).

Cheilanthes inaequalis var. *buchananii*

Within its distribution range, *Cheilanthes inaequalis* var. *buchananii* (Sinopteridaceae) is usually associated with a quartz substrate, growing on moist soil in the shade of rocks. The current finding of this taxon at Mahamba Gorge (Figure 7) in the lee of quartzitic rocks in mid-altitude grassland is fully consistent with its known ecological requirements. Plants were uncommon and localized on a northern aspect. The Swaziland plants link disjunct subpopulations near Graskop in Mpumalanga with those in central KwaZulu-Natal (Burrows 1990), in much the same way that plants of *Pellaea pectiniformis* Baker (Sinopteridaceae) from the

Mahamba Gorge site do for that species (Roux 2003a). *Cheilanthes inaequalis* var. *buchananii* may be superficially confused with *C. eckloniana* (Kunze) Mett., the lamina underside of which is similarly covered with a felt-like layer of hairs. However, the former taxon may be distinguished readily by the absence of broad, shiny, cream-coloured scales along the abaxial surface of the costae and costules (Burrows 1990). The typical variety of *C. inaequalis* has not yet been collected in Swaziland; this taxon has a tomentose rather than pilose dorsal lamina indumentum. The fronds are less dissected and narrowly ovate to lanceolate in outline rather than broadly ovate as with *C. inaequalis* var. *buchananii*. The hairs of the typical variety are also shorter and matted, whereas those of var. *buchananii* are longer and straighter (Anthony 1984; Burrows 1990). The vegetation at Mahamba Gorge corresponds to Ithala Quartzite Sourveld (Gs2) (Mucina *et al.* 2006).

Specimen examined

SWAZILAND.—2731 (Louwsburg): Mahamba Gorge, ± 7 m from water tank supplying rest camp, on north-facing aspect in soil between vertical quartzitic rocks, growing together with *Pellaea pectiniformis*, 984 m, (–AA), 22-11-2009, N. Crouch 1259 (NH).

Ophioglossum costatum

Ophioglossum costatum (Ophioglossaceae) is widespread in the Old World tropics, stretching from northern Australia through Indonesia, India to Africa and Madagascar. In Africa it occurs widely in tropical and subtropical deciduous woodland and open savanna, always confined to seasonally wet habitats such as stream banks, next to springs, and in seasonally wet seepage areas over sheetrock. Although widespread in tropical Africa, *O. costatum* is somewhat more rare in the *Flora of southern Africa* region and, up until now, had not been recorded further south than 25° S, in the Witbank and Nelspruit Districts of Mpumalanga Province (Burrows 1992).

This latest collection was made in the Umbeluzi Gorge which cuts through the Lubombo Mountains that form the border between Swaziland and Mozambique. It was found growing among short grasses in a wet area next to a small stream near the Umbeluzi River, just before it flows out into Mozambique (Figure 7). The vegetation at the site forms part of the Southern Lebombo Bushveld (SV1 16) (Rutherford *et al.* 2006). This collection therefore represents the first record of the species from Swaziland, as well as a range extension southwards for the species in Africa.

Specimen examined

SWAZILAND.—2632 (Bela Vista): Umbeluzi Gorge, Mlawula Game Reserve, 100 m, (–AA), 3-12-2006, J.E. Burrows & S.M. Burrows 9654 (BNRH).

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REFERENCES

- ANTHONY, N.C. 1984. A revision of the southern African species of *Cheilanthes* Swartz and *Pellaea* Link (Pteridaceae). *Contributions from the Bolus Herbarium* 11: 33–42.
- BRAUN, K.P., DLAMINI, S.D.V., MDLADLA, D.R., METHULE, N.P., DLAMINI, P.W. & DLAMINI, M.S. 2004. *Swaziland flora checklist*. Southern African Botanical Diversity Network Report No. 27. SABONET, Pretoria.
- BURROWS, J.E. 1990. *Southern African ferns and fern allies*. Frandsen, Sandton.
- BURROWS, J.E. 1992. *The taxonomy of the genus Ophioglossum L. (Ophioglossaceae) in southern Africa*. M.Sc. thesis, Natal University, Pietermaritzburg.
- JACOBSEN, W.B.G. 1983. *The ferns and fern allies of southern Africa*. Butterworths, Durban.
- MUCINA, L., HOARE, D.B., LÖTTER, M.C., DU PREEZ, J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDENKAMP, G.J., POWRIE, L.W., SCOTT, L., CAMP, K.G.T., CILLIERS, S.S., BEZUIDENHOUT, H., MOSTERT, T.H., SIEBERT, S.J., WINTER, P.J.D., BURROWS, J.E., DOBSON, L., WARD, R.A., STALMANS, M., OLIVER, E.G.H., SIEBERT, F., SCHMIDT, E., KOBISI, K. & KOSE, L. 2006. Grassland Biome. In L. Mucina & M.C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland. *Srelitzia* 19: 349–436.
- ROUX, J.P. 2003a. An annotated checklist of the pteridophyte flora of Swaziland. *Bothalia* 33: 53–57.
- ROUX, J.P. 2003b. *Swaziland ferns and fern allies*. Southern African Botanical Diversity Network Report No. 19. SABONET, Pretoria.
- ROUX, J.P. 2009. Synopsis of the Lycopodiophyta and Pteridophyta of Africa, Madagascar and neighbouring islands. *Srelitzia* 23. South African National Biodiversity Institute, Pretoria.
- RUTHERFORD, M.C., MUCINA, L., LÖTTER, M.C., BREDENKAMP, G.J., SMIT, J.H.L., SCOTT-SHAW, C.R., HOARE, D.B., GOODMAN, P.S., BEZUIDENHOUT, H., SCOTT, L., ELLIS, F., POWRIE, L.W., SIEBERT, F., MOSTERT, T.H., HENNING, B.J., VENTER, C.E., CAMP, K.G.T., SIEBERT, S.J., MATTHEWS, W.S., BURROWS, J.E., DOBSON, L., VAN ROOYEN, N., SCHMIDT, E., WINTER, P.J.D., DU PREEZ, J., WARD, R.A., WILLIAMSON, S. & HURTER, P.J.H. 2006. Savanna Biome. In L. Mucina & M.C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland. *Srelitzia* 19: 438–538.

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ASPHODELACEAE: ALOOIDEAE

GASTERIA CROUCHERI SUBSP. *PONDOENSIS*, A NEW CREMNOPHYTE FROM PONDOLAND, SOUTH AFRICA

We describe a new subspecies of *Gasteria croucheri* (Hook.f.) Baker from northern Pondoland, Eastern Cape, an obligate cremnophyte belonging to *Gasteria* Duval sect. *Longiflorae* Haw. ser. *Longiflorae* Haw. The members of this series are all characterized by narrow, elliptical, comparatively dull-coloured flowers in which the swelling in the upper half approximates the rather unpronounced basal gasteriform portion (Van Jaarsveld *et al.* 1994). Mature specimens of the new taxon produce both leaves (up to 1.5 m long) and flowers (up to 50 mm long) that are exceptionally long in the genus. To date, plants have only been found in the Msikaba and Mtentu River systems adjacent to Mkambati Game Reserve (Figure 8), the topography of which is characterized by rugged plateaux of 100–500 m, dissected deeply by narrow river gorges. This distribution falls within the Pondoland Centre of Plant Endemism (Van Wyk & Smith 2001). Specimens grow on cliffs both fully exposed on southern aspects, as well as within the shaded margins of riverine forest. It is a clump-forming species with long, angular and often sickle-shaped leaves, most of which are pendulous in mature specimens (Figure 9).

***Gasteria croucheri* (Hook.f.) Baker subsp. *pondoensis* N.R.Crouch, Gideon F.Sm. & D.G.A.Styles, subsp. nov.**

A subsp. *croucheri* differt foliis pendulis et a subsp. *pendulifolia* foliis usque ad 1.5 m longis, dum flores sui 50 mm longi longitudines antea in ceteris duabus subspeciebus recognitas excedentes. Subspecies nova ad habitationem specialem in regio geographica speciei restricta.

TYPE.—Eastern Cape, 3130 (Port Edward): rocky ledge alongside Lukabeni stream, 4.5 km upstream of

Mtentu River mouth, (–AA), 04-01-2009, N. Crouch & D. Styles 1149 (NH, holo.).

Plants acaulescent, decumbent to rarely erect, 250–400 mm tall, up to 600 mm diam., solitary, dividing or proliferating from base to form dense groups. *Roots* succulent, up to 6 mm diam. *Leaves* rosulate, erectly spreading, rarely patent or recurved, triangular, linear-lanceolate to falcate, rarely lorate, 200–1 500 mm long, 30–100 mm broad at base; adaxial surface broadly canaliculate, plane towards apex, abaxial surface somewhat convex with a distinctly tuberculate-serrulate excentric keel; both surfaces dark green, often glaucous, with dense white to concolorous spots arranged hap-

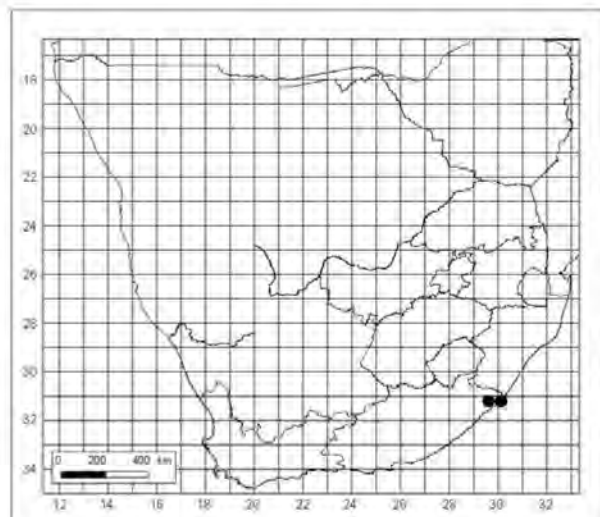


FIGURE 8.—Known distribution of *Gasteria croucheri* subsp. *pondoensis*, ●.



FIGURE 9.—Flowering plant of *Gasteria croucheri* subsp. *pondoensis* along the Lukabeni stream, tributary of Mtentu River, Eastern Cape Province. Photograph: N. Crouch.

hazardly or in transverse bands; surface smooth, rarely slightly asperulous; margin tuberculate-serrulate, rarely denticulate; apex obtuse or acute, mucronate. *Juvenile leaves* distichous, lorate, patent to erectly spreading, smooth; apex acute, rarely obtuse, mucronate. *Inflorescence* racemose, up to 900 mm tall, ascending, at first drooping, with or without a pair of side branches; scape 10–14 mm broad at base, flattened; floral bracts 6–11 mm long, piliferous; pedicel 10–11 mm long, pink. *Perianth* 42–50 mm long, stipitate for up to 9 mm, gasteriform proximally (narrow-elliptic) for half its length; basal gasteriform portion pink, 7 mm wide (often triangular in cross section), upper portion light pink with green striations, inflated to nearly same diam. as basal portion (with slight constriction in middle); apex erect becoming erectly spreading, obtuse; margins of inner segments free and channelled at base for 8–12 mm, diverging gradually towards apex. *Stamens* 33 mm long; anthers 2.5–4.0 mm long, shortly exserted at anthesis. *Ovary* 9–10 × 3 mm; style 17–19 mm long, lengthening considerably during female phase of flower; stigma capitate, included or slightly exserted, curved upwards, minute. *Capsule* 20–22 mm long, obtuse at apex. *Seeds* 3–4 × 2–3 mm. *Flowering time*: December to February.

In the latest revision of *Gasteria* (Van Jaarsveld 1994), over 100 available names (Schelpe 1958) were consolidated to 16 species, with a total of 22 taxa. A subsequent synopsis (Van Jaarsveld 2007) indicated that further research had by that date resulted in the recognition of an additional seven species, bringing the total number of taxa to 34. Included in this revised number

were two new taxa described from KwaZulu-Natal, the most recent of which was *G. tukhelensis* Van Jaarsv. from the lower Tukhela River near Kranskop (Van Jaarsveld & Van Wyk 2005). Forms of *G. croucheri* previously referred to as cultivars ‘Shongweni’ and ‘Umgeni’ from near Durban (Van Jaarsveld 1994) were also collectively described as *G. pendulifolia* Van Jaarsv. (Van Jaarsveld & Van Wyk 2001), but were subsequently reduced to subspecific rank (*G. croucheri* subsp. *pendulifolia* (Van Jaarsv.) Zonn.) following total nuclear DNA analyses (Zonneveld & Van Jaarsveld 2005). Van Jaarsveld & Van Wyk (2001) considered the distribution range of *G. croucheri* subsp. *pendulifolia* to extend along the subtropical coast, northwards from Durban to just south of Mkuze. Zonneveld & Van Jaarsveld (2005) distinguished *G. croucheri* subsp. *pendulifolia* from the typical subspecies on account of its smaller size, prolific clustering habit, and pendulous leaves that are narrow, glaucous and with an entire margin. The flowers are also predominantly white infused pink basally, whereas those of subsp. *croucheri* are pinker throughout, with more prominent green striations apically. The typical subspecies has been reported as larger, with leaves ascending to spreading, and a lower propensity for cluster-forming (Van Jaarsveld & Van Wyk 2001; Van Jaarsveld 2007). Based on their somewhat broader concept for *G. croucheri* subsp. *croucheri*, Van Jaarsveld & Van Wyk (2001) reported the typical subspecies to occur from Durban southwards to the Msikaba River in the Eastern Cape. Subspecies *croucheri* is presently not known from the Msikaba and Mtentu River gorges, but has been observed beyond the range of subsp. *pondoensis* to as far south as the Mzimvubu River where plants were found on shale cliffs ± 15 km inland of the coast (Van Jaarsveld & Van Wyk 2003). Populations of subsp. *pondoensis* occur towards the southern end of the range of subsp. *croucheri*, and are separated geographically from the similarly pendulous-leaved subsp. *pendulifolia* by a distance of 150 km. The three subspecies of *Gasteria croucheri* are thus allopatric. As stated above, the leaves of subsp. *pondoensis* are often significantly longer than those of both other subspecies, for they may attain lengths of up to 1.5 m. By comparison, those of subsp. *croucheri* are only 0.36 m long, whereas those of subsp. *pendulifolia* are little more than 0.45 m long (Van Jaarsveld & Van Wyk 2001). The perianth size of subsp. *pondoensis* is longer too than both its closest relatives, attaining 50 mm compared to 40 mm; they are similar in colour to subsp. *croucheri*.

Gasteria croucheri subsp. *pondoensis* occurs in a summer rainfall coastal region, where it is associated with Scarp Forest (FOz 5), a vegetation unit which today exists as an archipelago of scattered patches ranging in altitude from near sea level to 600 m (Rutherford *et al.* 2006). This *Gasteria* has, however, not yet been found at altitudes higher than 200 m. Particularly fine specimens may be seen on cliffs at the Superbowl on the Msikaba, and along the Mtentu fringe about 3.5 km upstream of the mouth. Both these two deep gorges have likely provided stable forest refugia for this and other endemic taxa, which have been unable to escape their enclave as a result of susceptibility to, *inter alia*, hot seasonal fires in the surrounding sourveld grasslands (Edwards 2005). *G. croucheri* subsp. *pondoensis* grows on cliff

faces and on rock ledges in dense subtropical vegetation that includes the following shrub and tree species: *Helichrysum populifolium*, *Dracaena aletiformis*, *Encephalartos altensteinii*, *Grewia pondoensis*, *Commiphora harveyi*, *Jubaeopsis caffra*, *Strelitzia nicolai*, and *Tarchonanthus trilobus*. Associated cremnophytic succulents include *Aeollanthus parvifolius*, *Aloe arborescens*, *Bulbine* sp., *Crassula multicava* subsp. *multicava*, *C. orbicularis*, *C. pellucida*, *C. streyi*, *Delosperma* sp., *Ischnolepis natalensis*, *Plectranthus saccatus* subsp. *pondoensis*, *Rhipsalis baccifera* subsp. *mauritiana*, *Senecio medley-woodii* and *S. oxydontus*.

At species level, the Red List status for *Gasteria croucheri* has recently been evaluated as Vulnerable (A2d) (Van Jaarsveld & Raimondo 2009) based on extensive and unsustainable harvesting for the trade in traditional medicine (Crouch *et al.* 2000). For this purpose, subsp. *pondoensis* will undoubtedly be as sought after as its sister taxa. In favour of its conservation, *G. croucheri* subsp. *pondoensis* should find refuge in suitable habitats along both the northern and southern boundaries of the Mkambati Game Reserve.

The subspecific epithet *pondoensis* is a geographic indicator of the presently known distribution of this Pondoland endemic.

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REFERENCES

- CROUCH, N., SMITH, G., SYMMONDS, R. & TOMALIN, M. 2000. *Gasteria croucheri*—the magical *impundu* of the Zulu. *British Cactus and Succulent Journal* 18: 70–78.
- EDWARDS, T.J. 2005. Two new *Plectranthus* species (Lamiaceae) and new distribution records from the Pondoland Centre of Plant Endemism, South Africa. *Bothalia* 35: 149–152.
- RUTHERFORD, M.C., POWRIE, L.W., LÖTTER, M.C., VON MALTITZ, G.P., EUSTON-BROWN, D.I.W. MATTHEWS, W.S., DOBSON, L. & MCKENZIE, B. 2006. Afrotemperate, Subtropical and Azonal Forests. In L. Mucina & M.C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: 584–614.
- SCHHELPE, E.A.C.L.E. 1958. *Gasteria*—a problem genus of South African succulent plants. *The Journal of the Botanical Society of South Africa* 44: 17–21.
- VAN JAARSVELD, E.J. 1994. *Gasterias of South Africa. A new revision of a major succulent group*. Fernwood Press, Cape Town.
- VAN JAARSVELD, E.J. 2007. The genus *Gasteria*; a synoptic review (new taxa and combinations). *Aloe* 44: 84–103.
- VAN JAARSVELD, E.J. & RAIMONDO, D. 2009. *Gasteria croucheri*. In D. Raimondo, L. von Staden, W. Foden, J.E. Victor, N.A. Helme, R.C. Turner, D.A. Kamundi & P.A. Manyama, Red List of South African plants. *Strelitzia* 25: 92.
- VAN JAARSVELD, E.J., SMITH, G.F. & VAN WYK, B-E. 1994. A cladistic analysis of *Gasteria* (Aloaceae). *South African Journal of Science* 90: 467–470.
- VAN JAARSVELD, E.J. & VAN WYK, A.E. 2001. *Gasteria pendulifolia*, a new species from KwaZulu-Natal. *Cactus and Succulent Journal (US)* 73: 68–70.
- VAN JAARSVELD, E.J. & VAN WYK, A.E. (Braam) 2003. New cliff-dwelling Crassulaceae from the Eastern Cape: a new *Cotyledon* and two new *Adromischus* taxa from the Mbashe and Mzimvubu Rivers, South Africa. *Aloe* 40: 36–40.
- VAN JAARSVELD, E.J. & VAN WYK, A.E. 2005. *Gasteria tukhelenensis*, a new species from KwaZulu-Natal, South Africa. *Bothalia* 35: 164–166.
- VAN WYK, A.E. & SMITH, G.F. 2001. *Regions of floristic endemism in southern Africa. A review with emphasis on succulents*. Umdaus Press, Hatfield, Pretoria.
- ZONNEVELD, B.J.M. & VAN JAARSVELD, E.J. 2005. Taxonomic implications of genome size for all species of the genus *Gasteria* Duval (Aloaceae). *Plant Systematics and Evolution* 251: 217–227.

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MARCHANTIOPHYTA

NEW LIVERWORT DISTRIBUTION RECORDS IN SOUTH AFRICA

New provincial records of thallose liverworts, identified since the publication of the latest checklist of South African liverworts (Perold 2006) are reported here. The new records are based on specimens in the bryophyte collection of the National Herbarium, Pretoria (PRE). Taxonomy and nomenclature follow Perold (2006). The thallose liverworts of southern Africa were revised by Perold (1999).

1. *Asterella wilmsii* (Steph.) S.W. Arnell

FREE STATE.—2828 (Bethlehem): Fouriesburg, Meiringspoort Nature Park, (–CA), 28°36'19"S, 28°13'46"E, 1 381 m, on soil at edge of pool, 15 July 2001, *M. Koekemoer* 2057 (PRE). 2829 (Harrismith): Oliviershoek, Blydschap Farm, stream bank, on rock, (–CA), 17 July 1999, *H.M. Anderson* 1424 (PRE).

2. *Dumortiera hirsuta* (Sw.) Nees

FREE STATE.—2828 (Bethlehem): Fouriesburg, Meiringspoort Nature Park, 28°36'19"S, 28°13'46"E, 1 381 m, on soil under rock overhang in moist bog, (–CA), 15 July 2001, *M. Koekemoer* 2061 (PRE).

3. *Exorhiza pustulosa* Mitt.

KWAZULU-NATAL.—2929 (Underberg): about 4 km down Sani Pass, 2 956 m, on vertical soil bank at roadside, (–CB), 5 Jan. 2000, *S.M. Perold* & *M. Koekemoer* 4341 (PRE).

NORTHERN CAPE.—2822 (Glen Lyon): ± 51 km N of Griekwastad, Rudisheim Farm, on soil, (–DD), June 1999, *P.M. Burgoyne* CH13732 (PRE).

WESTERN CAPE.—3320 (Montagu): just outside Montagu at the arched rock, above outspan, 33°48'32"S, 20°05'55"E, 223 m, on soil,

(–CC), 10 Sept. 2002, *M. Koekemoer* 2391(PRE). 3321 (Ladismith): Vleirivier, Manie se Kloof, Gamkaberg Reserve, dry river bed, small area sheltered and shaded by rocks and plants, flat on ground, grey-green, (–DB), 13 Mar. 2003, *Y. van Wijk* 2963 (PRE). 3322 (Oudts-hoorn): Wilderness, Kleinplaats-Vanrooyenskraal, Bergplaas State Forest, 300 m, steep N-facing rocky cliff, on soil in cracks and under overhangs, (–DC), 20 Apr. 2003, *Y. van Wijk* 2972B, 2973A, 2974 (all PRE).

EASTERN CAPE.—3027 (Lady Grey): Barkley East Dist., road to Rhodes from Barkley Pass, 30°52'22"S, 27°47'11"E, 1 590 m, steep SE-facing slope in grassland, green liverwort on moist soil, (–DD), 19 Mar. 1996, *J.E. Victor* 1750B (PRE).

4. *Lunularia cruciata* (L.) Dumort. ex Lindb.

FREE STATE.—2627 (Potchefstroom): Dist. Sasolburg, 'Elysium', Plot 12, Wonderfontein Road, 26°46'52"S, 27°46'18"E, 1 440 m, cultivated garden, abundant and a menace in shade house on soil of pot plants and on floor of cement bricks, green thallose liverwort, (–DD), 12 May 2001, *N.V. Kroon* 16480 (PRE).

5. *Marchantia pappeana* Lehm. subsp. *pappeana*

WESTERN CAPE.—3318 (Cape Town): Claremont, Kirstenbosch Botanical Gardens, 150 m, edge of pond, (–CD), 17 Mar. 1995, *T. Arts* RSA03/31 (PRE); stream near guest house, 12 Mar. 1994, *M. Koekemoer* 1050 (PRE); on earth bank at edge of streamlet, 12 Jan. 1987, *S.M. Perold* 1220 (PRE); on sandstone, at water's edge of small stream, 1 Sept. 1993, *S.M. Perold* 2926 (PRE); on earth walls of water furrows, 12 Oct. 1995, *S.M. Perold* 3323 (PRE); at edge of streamlet, 5 Jan. 1998, *S.M. Perold* 3954 (PRE).

6. *Plagiochasma appendiculatum* Lehm. & Lindenb.

LIMPOPO.—2427 (Thabazimbi): 26 km E of Thabazimbi on road to Alma, in gully about halfway up Bakker's Pass, at base of large rocks, (–BC), 6 Mar. 1985, *S.M. Perold* 854 (PRE); about 4 km E of Rooiberg to Hoopdal, and Thabazimbi to Alma crossroads, in Bakker's Pass, in gully near road at large *Ficus* tree and boulders, 16 Dec. 1993, *S.M. Perold* & *M. Koekemoer* 3135 (PRE).

MPUMALANGA.—2430 (Pilgrim's Rest): Blydepoort, along stream to Tufa Waterfall, on rock, (–DB), 27 May 2001, *S.M. Perold* & *M. Koekemoer* 4715 (PRE).

7. *Plagiochasma rupestre* (J.R.Forst. & G.Forst.) Steph. var. *volkii* Bischl.

MPUMALANGA.—2529 (Witbank): Mapoch's Grounds ± 8 km NE from Roossenekal, 25°10'32"S, 29°57'14"E, 1 410 m, in grassland on soil, thallus greyish green with black edges, (–BB), 19 Jan. 2005, *S.P. Bester* 5505 (PRE).

FREE STATE.—2728 (Frankfort): Warden, just N of turn-off to town, at rocks near roadside (N3), with *Exormothea pustulosa* Mitt., (–DD), 13 Jan. 1992, *S.M. Perold* 2799 (PRE).

8. *Riccia albovestita* O.H.Volk

NORTHERN CAPE.—3025 (Colesberg): 10 km S of Colesberg on N9, between Noupoot and Colesberg, 30°49'09"S, 25°04'33"E, 1 453 m, plant growing flat on ground, thalli greyish green, mixed with fragments of *Riccia runssorensis* Steph., (–CC), 24 Apr. 2006, *J.J. Meyer* 4785 (PRE).

9. *Riccia argenteolimbata* O.H.Volk & Perold

EASTERN CAPE.—3225 (Somerset East): Mountain Zebra National Park, 32°14'14"S, 25°27'49"E, 1 245 m, on sandy soil of mountain slope, South-eastern Mountain Grassland, thallus dry and whitish, (–AB), 12 Dec. 2005, *S.P. Bester* 6297 (PRE).

10. *Riccia crinita* Taylor

MPUMALANGA.—2529 (Witbank): Mapoch's Grounds ± 8 km NE from Roossenekal, drainage line immediately N of camping site at Mapoch's Caves, 25°10'21"S, 29°57'29"E, 1 519 m, on thin soil layer over rock sheets on edge of river line, North-eastern Mountain Grassland, thallus green with 'hairy' edges, (–BB), 17 Jan. 2005, *S.P. Bester* 5439 (PRE).

11. *Riccia curtisii* (James ex Austin) Austin

EASTERN CAPE.—3324 (Steytlerville): Baviaanskloof, second river crossing after Kudu Kaia, Ysriver Farm, 33°39'52"S, 24°32'11"E, 190 m, on soil in partial shade, (–DA), 8 Sept. 2002, *M. Koekemoer* 2355 (PRE).

12. *Riccia lanceolata* Steph.

GAUTENG.—2529 (Witbank): 20 km N of Witbank railway station on dirt road to Zaaihoek, turn-off to Kwartspuit Farm and ± 5 km along rough track to Olifants River, on soil between grass in vlei, (–CA), 20 Feb. 1994, *S.M. Perold*, 3189, 3194 (both PRE).

13. *Riccia nigrella* DC.

LIMPOPO.—2430 (Pilgrim's Rest): southern portion of Leolo (Lulu) Mountains, Tama Kgoshi Peak, Soupiana Farm, 24°43'29"S, 30°02'58"E, 1 912 m, on humus-rich soil in North-eastern Mountain Grassland, thallus blue-green, (–CA), 2 Dec. 2004, *S.P. Bester* 5316 (PRE).

14. *Riccia purpurascens* Lehm.

EASTERN CAPE.—3324 (Steytlerville): Baviaanskloof, along banks of Witrivier, (–DA), 9 May 2000, *J. Perold* 106 (PRE).

15. *Riccia runssorensis* Steph.

KWAZULU-NATAL.—2830 (Dundee): Dannhauser, ± 5 km from Bismarck, farm of David Watson, 28°00'35"S, 30°00'11"E, 1 274 m, common on black turf soil in North-eastern Mountain Grassland, thallus blackish green, submerged in standing water, (–AA), 11 Feb. 2006, *S.P. Bester* 6565 (PRE).

NORTHERN CAPE.—3123 (Victoria West): Central Karoo, Rietpoort Farm, 34 km N of Victoria West, on main road, good rains after drought, flat top of koppie in damp area between bossies, (–AA), 14 Mar. 1988, *L. Smook* 6962 (PRE).

EASTERN CAPE.—3225 (Somerset East): Mountain Zebra National Park, 32°14'14"S, 25°27'49"E, 1 245 m, at foot of mountain, on soil at base of boulders, South-eastern Mountain Grassland, thallus bluish, with *Riccia crinita* Taylor, (–AB), 12 Dec. 2005, *S.P. Bester* 6300 (PRE).

16. *Riccia volkii* S.W. Arnell

EASTERN CAPE.—3027 (Lady Grey): Rhodes, gravel road/jeep track between Naudesnek and Ben Macdhu, Marsfield Farm, 30°39'23"S, 27°59'01"E, on soil among grass tufts, (–DB), 11 Dec. 1999, *M. Koekemoer* 1615 (PRE).

17. *Symphyogyna brasiliensis* Nees & Mont.

NORTHWEST.—2527 (Rustenburg): Rustenburg Nature Reserve, stream bank at bridge, on soil, (–CA), 18 Feb. 1997, *S.M. Perold* 3666 (PRE).

NORTHERN CAPE.—2822 (Glen Lyon): Griekwastad Dist., Rudesheim Farm, SW of town, 1 279 m, Kalahari thornveld invaded by karoo, (–DD), 19 June 1999, *J.J. Meyer* 2007 (PRE).

REFERENCES

- PEROLD, S.M. 1999. *Flora of southern Africa*, Hepatophyta, Part 1: Marchantiopsida, Fasc. 1: Marchantiidae. National Botanical Institute, Pretoria.
- PEROLD, S.M. 2006. Hepatophyta. In G. Germishuizen, N.L. Meyer, Y. Steenkamp & M. Keith, *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41: 31–49. SABONET, Pretoria.

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ASTERACEAE

THE TRUE IDENTITY OF *OXYLAENA ACICULARIS*

The genus *Oxylaena* Benth. ex Anderb. with its single species *O. acicularis* (Benth.) Anderb. has intrigued many scientists over the last few years, and many collectors have wanted to re-collect this species. It was classified in the tribe Gnaphalieae and rested in an informal basal group (*Macowania* group) that was not assigned to a subtribe (Anderberg 1991; Bayer *et al.* 2007). It was known only from the type specimen, *Burchell 5159*, collected between Cloete's Kraal and Paardekraal in the George District, Cape Province, in March 1814. The genus *Oxylaena* has subsequently been excluded from the Gnaphalieae and moved to the Calenduleae when *O. acicularis* was found to be conspecific with *Gibbaria scabra* (Thunb.) Norl. (Ward *et al.* 2009).

In Fourcade's (1944) notes on Burchell's travels, he stated that on the afternoon of 26 March 1814, Burchell travelled on the road between Cloete's Kraal and Paardekraal and collected 17 specimens (numbers 5151–5167). Furthermore, Fourcade (1944) wrote: 'Burchell continued down the Cloete's Kraal ridge, south of the river, to the only crossing of the Diep River that was possible before the new main road was constructed, there being a succession of precipitous cliffs higher up, and reached Paardekraal, on the farm Roodemuur, in the division of Knysna'.

In March 2003, almost two centuries later, an attempt was made to re-collect the plant (Koekemoer & Steyn 2004) on a section of Burchell's route that was discovered by Mr Katot Meyer on his Farm Pietersrivier. Even in a modern vehicle this route, where it deviates from the main road, is only for the very adventurous. It was easier searching for the plant on foot rather than trying to manoeuvre a vehicle over the rocks and dongas, but despite searching a wide area around the track, only one species which resembled the illustration of *Oxylaena acicularis* was seen. Very few plants were flowering at the time and I was convinced that it was *Oxylaena* but a local botanist, Jan Vlok, identified it as *Gibbaria scabra* (Thunb.) Norl.

This led to a deeper investigation into the two species. Upon inspection of the type specimens at Kew, it became apparent that *Oxylaena acicularis* and *Gibbaria scabra* are conspecific. Bentham's (1876) description failed to describe the flower colour and cypsel structure, which contributed to the confusion. Although the rays of fresh flowers are bright yellow above and brownish below, the florets and bracts turn brick-red in older specimens. Careful observation of the type specimen of *Oxylaena* revealed a single incurvate cypsel that undoubtedly identifies the plant as *Gibbaria scabra*.

De Candolle (1836) described the genus *Anaglypha* with *A. aspera* as type, which is now a synonym of *Gibbaria scabra* (Hilliard & Burt 1976).

Bentham (1876) described a new species *Anaglypha acicularis*. He did not, however, recognize the genus and had it figured under the name *Oxylaena acicularis*.

The genus *Oxylaena* was only formalized much later by Anderberg (1991), based on *Anaglypha acicularis* Benth. (1876).

Up to a few years ago the genus *Gibbaria* consisted of two species (Norlindh 1943): *G. scabra* and *G. ilicifolia* (L.) Norl. The latter species was transferred to a new monotypic genus, *Nephrotheca*, in the tribe Calenduleae (Nordenstam *et al.* 2006). Nordenstam & Källersjö (2009) then restored the number of species in *Gibbaria* to two by transferring *Osteospermum glabrum* N.E.Br. to the genus.

The revised synonymy for *Gibbaria scabra*, adding *Oxylaena acicularis* is:

***Gibbaria scabra* (Thunb.) Norlindh**, Studies in the Calenduleae: 360 (1943). *Osteospermum scabrum* Thunb.: 166 (1800). Type: in Herb. Thunberg (UPS; K, photo!).

G. bicolor Cass.: 139 (1817). Type: unknown.

Xerothamnus ecklonianus DC.: 311 (1836). Type: Caput Bonae Spei in Uitenhage Dist., Ecklon & Zeyher 1851 (G-DC).

Anaglypha aspera DC.: 311 (1836). Type: Africae capensis, Albany Dist., Drège s.n. (G-DC).

Anaglypha acicularis Benth.: 9 (1876). *Oxylaena acicularis* (Benth.) Anderb.: 53 (1991), syn. nov. Type: South Africa, Cape Colony, George Dist., between Cloete's Kraal and Paardekraal, *Burchell 5159* (K, holo!).

This example of *Oxylaena* shows how critical it is for taxonomists to investigate the specimens and types and to clarify the classification. In turn the name *Oxylaena* can now be removed from checklists and the Red Data List (Raimondo *et al.* 2009) where the status is indicated as Unsure or Data Deficient.

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REFERENCES

- ANDERBERG, A.A. 1991. Taxonomy and phylogeny of the tribe Gnaphalieae (Asteraceae). *Opera Botanica* 104: 53.
- ANDERBERG, A.A. 1994. Gnaphalieae. In K. Bremer, *Asteraceae: clistics and classification*. Timber Press, Portland, Oregon.
- BAYER, R.J., BREITWIESER, I., WARD, J.M. & PUTTOCK, C. 2007. Gnaphalieae. In K. Kubitzki, *The families and genera of vascular plants. Flowering plants—Dicotyledons: Compositae*. Springer-Verlag, Berlin.
- BENTHAM, G. 1876. *Anaglypha acicularis*. *Hooker's Icones Plantarum*, vol. 2: 9, t. 1109.
- CASSINI, H. 1817. *Gibbaria bicolor*. *Bulletin des Sciences, par la Société Philomatique* 2: 139. Paris.
- CASSINI, H. 1820. *Dictionnaire des Sciences Naturelles* 18: 526. Le Normant, Paris.

- DE CANDOLLE, A.P. 1836. *Prodromus systematis naturalis regni vegetabilis* 5. Treuttel & Würtz, Paris.
- FOURCADE, H.G. 1944. Notes on Burchell's *Catalogus geographicus*, middle portion. *Journal of South African Botany* 10: 145–161.
- HILLIARD, O.M. & BURTT, B.L. 1976. Notes on some plants from southern Africa chiefly from Natal: V. *Notes from the Royal Botanic Garden Edinburgh* 34: 253–286.
- KOEKEMOER, M. & STEYN, H.M. 2004. Burchell's tracks retraced in search of *Oxylaena*. *SABONET News* 8,2: 120.
- NORDENSTAM, B., KÄLLERSJÖ, M. & ELDENÄS, P. 2006. *Nephrolepis*, a new monotypic genus of the Compositae–Calenduleae from the southwestern Cape Province. *Compositae Newsletter* 44: 32–37.
- NORDENSTAM, B. & KÄLLERSJÖ, M. 2009. Calenduleae. In V.A. Funk, A. Susanna, T.E. Stuessy & R.J. Bayer, *Systematics, evolution, and biogeography of Compositae*. International Association of Plant Taxonomists (IAPT).
- NORLINDH, T. 1943. *Studies in the Calenduleae I: monograph of the genera Dimorphotheca, Castalis, Osteospermum, Gibbaria and Chrysanthemoides*. Gleerup, Lund.
- RAIMONDO, D., VON STADEN, L., FODEN, W., VICTOR, J.E., HELME, N.A., TURNER, R.C., KAMUNDI, D.A. & MANYAMA, P.A. (eds). 2009. Red List of South African plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.
- THUNBERG, C.P. 1800. *Osteospermum scabrum*. *Prodromus plantarum capensium*. Edman, Uppsala.
- WARD, J., BAYER, R.J., BREITWIESER, I., SMISSEN, R., GALBANY-CASALS, M. & UNWIN, M. 2009. Gnaphalieae. In V.A. Funk, A. Susanna, T.E. Stuessy & R.J. Bayer, *Systematics, evolution, and biogeography of Compositae*. International Association of Plant Taxonomists (IAPT).

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BRYOPHYTES

NEW AND INTERESTING RECORDS OF MOSSES IN THE FLORA OF SOUTHERN AFRICA AREA: 5. NEW PROVINCIAL RECORDS

New provincial distribution records in the moss flora of South Africa, identified since the publication of the latest checklist for the country (Van Rooy 2006) are reported here. The new records are based on specimens in the bryophyte collection of the National Herbarium, Pretoria (PRE). Taxonomy and nomenclature follow Van Rooy (2006).

1. *Braunia secunda* (Hook.) Bruch & Schimp.

NORTHERN CAPE.—3119 (Calvinia): Nieuwoudtville Area, Oorlogskloof Nature Reserve, along path from entrance to river, Fynbos vegetation along edge of scarp, 31°26'50"S, 19°11'30"E, ± 700 m, on shaded rock, (–AC), T.A.J. Hedderson 14332 (BOL, PRE).

2. *Bryum cellulare* Hook.

EASTERN CAPE.—3029 (Kokstad): Bizana, Ndunge Forest, N of town, small stream through forest, on soil, with *Philonotis* sp., (–DD), 29 Dec. 2006, N. Phephu 38 (PRE). 3129 (Port St. Johns): Ntabankulu, KuGomo Forest, about 6.5 km S of town, on soil, (–AB), 3 May 2007, N. Phephu 99 (PRE).

3. *Bryum viridescens* Welw. & Duby

NORTHERN CAPE.—3220 (Sutherland): Tankwa Karoo National Park, top of Gannaga Pass about 2 km on plateau NE of Agterkop Farm, 32°06'05"S, 20°07'48"E, 1 249 m. Succulent Karoo, on sandy soil in partial shade, (–AA), 5 Aug. 2006, S.P. Bester 7074A (PRE).

4. *Chamaebryum pottiioides* Thér. & Dixon

EASTERN CAPE.—3028 (Matatiele): ± 15 km E of Rhodes, Mavis Bank Farm, on Klopershoek turn-off, W-facing rocky ridge near house at base of cliff, 30°42'51"S, 28°00'47"E, 2 106 m, on soil in rock crevices, with *Plagiochasma rupestre* (J.R.Forst. & G.Forst.) Steph. var. *rupestre* and *Riccia* sp., (–CA), 8 Dec. 1999, M. Koekemoer 1506 (PRE).

5. *Crossidium spiralifolium* Magill

WESTERN CAPE.—3319 (Worcester): Worcester Dist., Fairy Glen, (–CB), Aug. 1932, C.W. Thorne CH50306 (PRE).

6. *Didymodon australasii* (Hook. & Grev.) R.H.Zander

EASTERN CAPE.—3325 (Port Elizabeth): Port Elizabeth, Summerstrand, at top of Richardson road among Port Jackson trees and other shrubs, on dump of bricks and stones, (–DC), 1 Aug. 1991, E.B. Evenwel 32 (PRE).

7. *Ephemerum rehmannii* (Müll.Hal.) Broth.

GAUTENG.—2528 (Pretoria): Bronkhorstspuit Dist., Ezemvelo Nature Reserve, along stream running into dam at reception centre, 1 400 m, grassland with exotic poplar and wattle trees, on soil among grass, (–DB), 10 May 1999, J. van Rooy 3908, 3917 (both PRE).

8. *Fabronia pilifera* Hornsch.

NORTHERN CAPE.—2920 (Boomrivier): Kenhardt Dist., T'Oubeep Farm, ± 80 km S of Kakamas, T'Oubeep portion A, 29°19'13"S, 20°13'12"E, 886 m, Bushmanland vegetation, on stony soil in light shade, (–AC), S.P. Bester 6887, 6888 (both PRE).

9. *Fissidens asplenioides* Hedw.

GAUTENG.—2528 (Pretoria): Bronkhorstspuit Dist., Ezemvelo Nature Reserve, along Grootspuit, tributary of Wilge River, 1 350 m, Bankenveld, on soil bank of stream, (–DB), 10 May 1999, J. van Rooy 3919, 3924 (both PRE).

10. *Fissidens borgenii* Hampe

GAUTENG.—2528 (Pretoria): Little Eden, NNE of Cullinan on Sybrandskraal road, along river banks in kloof, 1 300 m, on soil in rock overhang, (–DA), 29 Mar. 2001, J. van Rooy 4014 (PRE); Bronkhorstspuit Dist., Ezemvelo Nature Reserve, along Grootspuit, tributary of Wilge River, 1 350 m, Bankenveld, on soil in rock overhang and crevice, (–DB), 10 May 1999, J. van Rooy 3938, 3951 (both PRE).

11. *Fissidens megalotis* Schimp. ex Müll.Hal.

WESTERN CAPE.—3319 (Worcester): McGregor Area, Kranz Nature Reserve, 33°56'59"S, 19°48'51"E, 250–300 m, succulent (karroid) vegetation over shales and patchy Fynbos on sandstones, (–DD), 5 Aug. 2001, T.A.J. Hedderson 14113 (BOL, PRE).

12. *Fissidens pygmaeus* Hornsch.

GAUTENG.—2528 (Pretoria): Bronkhorstspuit Dist., Ezemvelo Nature Reserve, wooded area along stream running into dam opposite reception centre, on vertical earth wall, (–DB), 10 May 1999, S.M. Perold 4095 (PRE).

13. *Gigaspermum repens* (Hook.) Lindb.

EASTERN CAPE.—3028 (Matatiele): ± 15 km E of Rhodes, Lamont Farm, on Klopershoek turn-off from Rhodes-Maclear road, 30°43'19"S, 28°00'26"E, 1 987 m, grassland, on moist soil in partial shade, with species of *Tortula*, *Pseudocrossidium* and *Grimmia*, (–CA), Dec. 1999, M. Koekemoer 1657 (PRE).

14. *Leptodontium brachyphyllum* Broth. & Thér.

LIMPOPO.—2329 (Pietersburg): Louis Trichardt, ± 10 km N of town, behind Mountain View Hotel, on mountain below krantz, with *Hypnum cupressiforme* Hedw., (–BB), 4 Aug. 1989, S.E. Strauss 16 (PRE).

15. *Micromitrium perexiguum* (Müll.Hal.) Crosby

LIMPOPO.—2427 (Thabazimbi): 34 km E of Thabazimbi on Bakker's Pass road, 2 km before Hartebeesfontein Farm, on damp soil at small stream near road, (–BC), 6 Mar. 1985, S.M. Perold 859 (PRE).

16. *Mittenothamnium reptans* (Hedw.) Cardot

EASTERN CAPE.—3129 (Port St. Johns): Ntabankulu, KuGomo Forest, about 6.5 km S of town, on tree trunk, with *Aerobryopsis capensis* (Müll.Hal.) M.Fleisch., *Entodon macropodus* (Hedw.) Müll.Hal., *Thuidium* sp. and leafy liverworts, (–AB), 3 May 2007, N. Phephu 65, 70, 157 (all PRE); on dead log, with *Papillaria africana* (Müll.Hal.) A.Jaeger, N. Phephu 109 (PRE); on rock, with *Porotrichum madagasum* Kiaer ex Besch., N. Phephu 69, 79, 101, 117 (all PRE).

17. *Oedipodiella australis* (Wager & Dixon) Dixon

WESTERN CAPE.—3322 (Oudtshoorn): George Div., Wilderness Nature Park, Half-collared Kingfisher Trail, 20 m, on soil, frequent, (–DC), 19 Aug. 1994, H.F.Glen 3672 (PRE).

18. *Pohlia baronii* Wijk & Margad.

NORTHWEST.—2527 (Rustenburg): Magaliesberg, Rustenburg Nature Reserve, along small wooded kloof W of Visitor's Centre, 1 500 m, on soil of stream bank, (–CA), 18 Feb. 1997, J. van Rooy 3740 (PRE).

19. *Pohlia cruda* (Hedw.) Lindb.

MPUMALANGA.—2530 (Lydenburg): Buffelskloof Nature Reserve, high mist forest, 1 600 m, on soil bank of road cut, (–BC), 24 Jan. 2007, J. van Rooy 4098 (PRE); along wooded High Forest Stream near cottages, 1 700 m, on soil bank, with *Philonotis africana* (Müll.Hal.) Rehmann ex Paris and *Ditrichum brachypodium* (Müll.Hal.) Broth., J. van Rooy 4180 (PRE).

EASTERN CAPE.—3027 (Lady Grey): ± 15 km E of Rhodes, Mavis Bank Farm, on Kloppershoek turn-off, slope of highest peak NW of house, 30°42'23"S, 27°59'88"E, 2 346 m, on soil under rock overhang, with *Bartramia* sp., (–DB), 9 Dec. 1999, M. Koekemoer 1573 (PRE); Rhodes, gravel road/jeep track between Naudesnek and Ben Macdhuil, Marshfield Farm, 30°39'23"S, 27°59'01"E, 2 500 m, grassland, on soil, 11 Dec. 1999, M. Koekemoer 1619 (PRE).

20. *Ptychomitrium exaratifolium* H. Rob.

EASTERN CAPE.—3027 (Lady Grey): Joubert's Pass, at Sentec Tower, rocky ridges near mountain peak, 30°41'52"S, 27°16'04"E, 2 377 m, with *Ptychomitrium cucullatifolium* (Müll.Hal.) A.Jaeger and *Tortella xanthocarpa* (Schimp. ex Müll.Hal.) Broth., (–CB), 27 Feb. 2007, C.L. Bredenkamp & D. von Staden 88A (PRE).

21. *Rhodobryum commersonii* (Schwägr.) Paris

GAUTENG.—2527 (Rustenburg): Hartebeeshoek Satellite Tracking Station, wooded area at main tracking station, 1 450 m, on humus and humus-rich soil, (–DC), 22 Mar. 2001, J. van Rooy 3976, 3985 (both PRE).

22. *Rigodium toxarion* (Schwägr.) A.Jaeger

LIMPOPO.—2430 (Pilgrim's Rest): Wolkberg Wilderness Area, Serala Peak, in deep shade on quartzite boulders, on forest floor in stream, (–AA), F. Venter 11376 (PRE).

23. *Schlotheimia percuspidata* Müll.Hal.

EASTERN CAPE.—3129 (Port St. Johns): Ntabankulu, KuGomo Forest, about 6.5 km S of town, on tree trunk in forest, (–AB), 3 May 2007, N. Phephu 72 (PRE).

24. *Syntrichia ammonsiana* (H.A.Crum & L.E.Anderson) Ochyra

NORTHWEST.—2527 (Rustenburg): Magaliesberg, Rustenburg Nature Reserve, along small wooded kloof W of Visitor's Centre, 1 500 m, on tree trunk, (–CA), 18 Feb. 1997, J. van Rooy 3736 (PRE).

25. *Syntrichia papillosa* (Wilson) Jur.

NORTHERN CAPE.—3119 (Calvinia): Nieuwoudtville Area, Oorlogskloof Nature Reserve, along path from entrance to river, Fynbos vegetation along edge of scarp, 31°26'50"S, 19°11'30"E, ± 700 m, (–AC), 5 Oct. 2001, T.A.J. Hedderson 14354 (BOL, PRE).

26. *Trematodon longicollis* Michx.

MPUMALANGA.—2531 (Komatipoort): near Hazyview, grounds of Hippo Hollow Hotel, on muddy banks of Sabie River, (–AA), 25 Aug. 1996, S.M. Perold & M. Koekemoer 3572 (PRE).

EASTERN CAPE.—3029 (Kokstad): Bizana, KwaNikhwe, 10 km from Bizana to Port Edward along R61, along stream opposite Small-bird Store, on soil, (–DD), 23 Dec. 2006, N. Phephu 10 (PRE).

REFERENCES

VAN ROOY, J. 2006. Bryophyta. In G. Germishuizen, N.L. Meyer, Y. Steenkamp & M. Keith, *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41: 1–30. SABONET, Pretoria.

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MOLLUGINACEAE

ADENOGRAMMA NATANS, A REMARKABLE NEW AQUATIC SPECIES FROM WESTERN CAPE, SOUTH AFRICA

INTRODUCTION

A small, primarily tropical family, Molluginaceae comprises 11 genera and ± 90 species (Heywood *et al.* 2007). The genera are primarily polycarpellate with capsular fruits, and only *Adenogramma* Rehb. has a unilocular, uniovulate carpel ripening into a nutlet. This small genus is confined to southern Africa and currently comprises ± 10 species of annual or perennial herbs with leaves in false whorls and subtended by filiform stipules (Adamson 1955; Dreyer & Jordaan 2000). The

small, white and green flowers lacking petals are borne in sessile, seemingly axillary cymes. *Adenogramma* is largely confined to the coastal plain and lower mountain slopes of the winter rainfall parts of Northern and Western Cape (Adamson 1955) and divides readily into a group of perennial species with stems ± woody, at least towards the base, and another of delicate, herbaceous annuals. The latter are characteristic of seasonally damp or shaded situations (Adamson 1955; Goldblatt & Manning 2000).

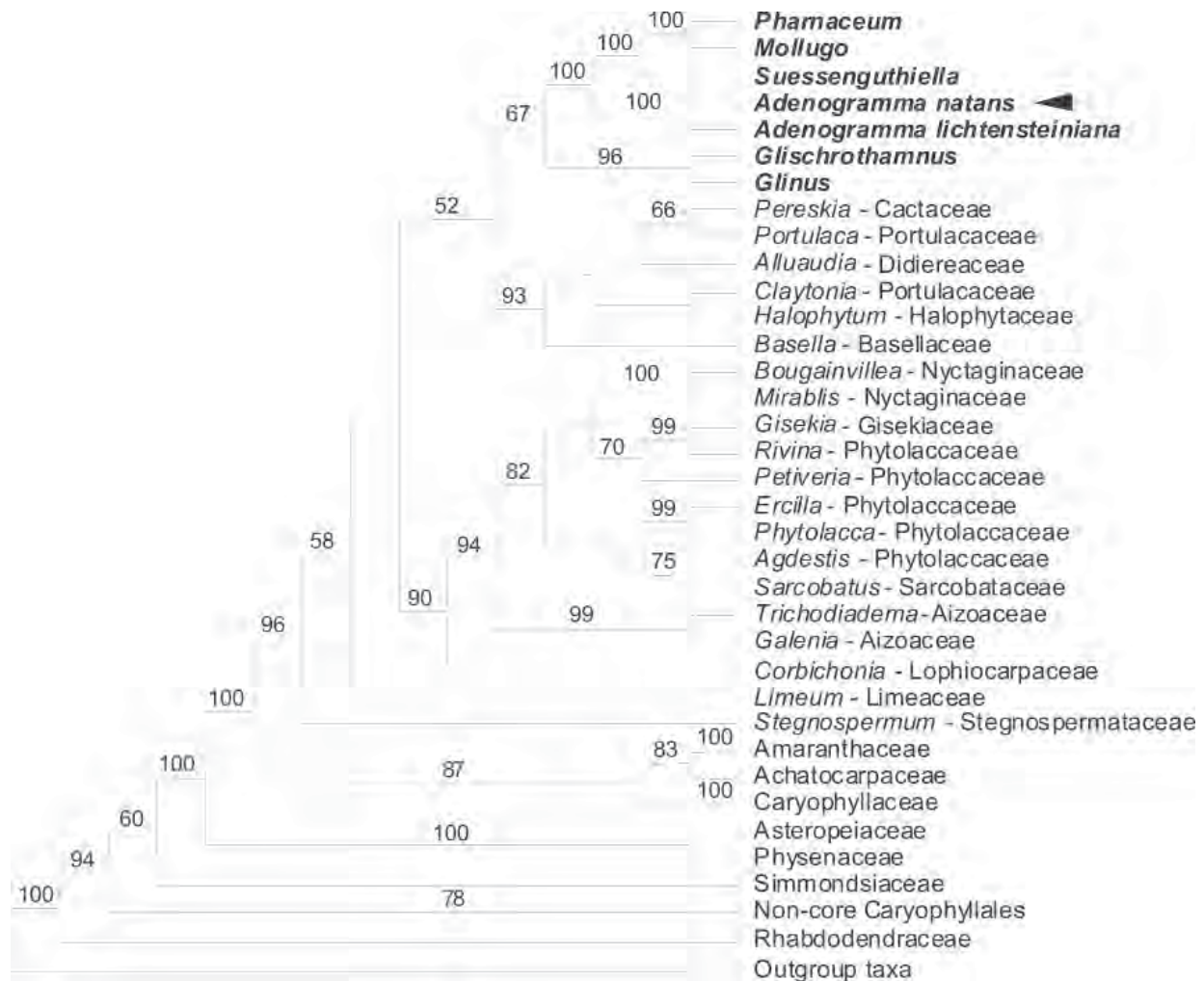


FIGURE 10.—One of the two most parsimonious phylogenetic trees obtained from the analysis of Caryophyllales based on *rbcL* and *matK* (5 310 steps; CI=0.34; RI=0.62). Bootstrap percentages above 50% are shown above branches. Species currently assigned to family Molluginaceae are in bold. The arrow points to the new species *Adenogramma natans*.

Recent intensive exploration of Elandsberg Nature Reserve near Wellington in Western Cape resulted in the discovery of an unknown, emergent aquatic herb. This delicate, bottom-rooted annual produces long, wiry stems with floating clusters of whorled leaves at the branch tips. It conforms to the genus *Adenogramma* in essential morphological features of the foliage and flowers but differs strikingly in its truly aquatic habit. The growth form of the species is so anomalous in the genus that a plastid molecular analysis was undertaken to corroborate its phylogenetic and taxonomic placement.

No earlier collections of the species could be located in local herbaria and it is described here as *Adenogramma natans* in allusion to its unique aquatic habit. It is the second unusual aquatic to be described from the southwestern coastal plain in recent years (Manning *et al.* 2008). Elandsberg Nature Reserve itself includes the largest remaining areas of Swartland Alluvial Fynbos and Renosterveld plant communities (Mucina & Rutherford 2006). The fynbos vegetation unit in particular, especially the wetlands, includes several endemic species, a number of which have only recently been described, notably *Brunsvigia elandsmontana* (Amaryllid-

daceae), *Marasmodes spinosa* (Asteraceae) and *Lotononis complanata* (Fabaceae).

MATERIALS AND METHODS

Morphology: the description and illustration were prepared from freshly collected material. Examination of herbarium collections at BOL, NBG, PRE and SAM, failed to reveal additional collections (herbarium acronyms after Holmgren *et al.* 1990).

Molecular analysis: DNA extraction, polymerase chain reaction (PCR) amplification, and DNA sequencing were performed as in Manning *et al.* (2009). The *rbcL* sequence obtained for *Adenogramma natans* was incorporated into a published *rbcL-matK* combined analysis of order Caryophyllales (Cuénoud *et al.* 2002). The other Molluginaceae accessions included in the study of Cuénoud and colleagues for which only *matK* was available, as well as the only other available *rbcL* sequence for *Adenogramma* (*A. lichtensteiniana*; GenBank accession number AM235030), were also included in our analysis. The program SEQUENCHER 4.1 (Gene Codes Corp., Ann Arbor, Michigan, USA) was used

to assemble complementary strands and verify base-calling. The *rbcL* sequence was readily aligned by eye in PAUP* (version 4.0b10; Swofford 2002). Phylogenetic analyses were performed using the maximum parsimony criterion as implemented in PAUP* (Swofford 2002); a heuristic search was conducted using 1 000 random addition replicates, tree bisection and reconnection (TBR) branch swapping, and saving 10 trees per replicate. Support for each clade was assessed using the bootstrap method (Felsenstein 1985) as implemented in PAUP* with 1 000 bootstrap replicates, TBR branch swapping, simple addition sequence with MulTrees option in effect (keeping only 10 trees per replicate).

RESULTS

Molecular analysis: the combined *rbcL*-*matK* matrix comprises 2 356 characters of which 1 057 are constants, 1 299 are variable and 943 (40 %) are potentially parsimonious informative. The analysis resulted in only two most parsimonious trees, of 5 310 steps with a consistency index of 0.34 (excluding uninformative sites) and a retention index of 0.62 (Figure 10). The only difference between these two trees does not concern the family Molluginaceae. Most of the genera traditionally included in Molluginaceae, with the exception of *Limeum* (now Limeaceae) and *Corbichonia* (now Lophiocarpaceae), comprise a weakly supported clade (66 % bootstrap support) corresponding to the modern, narrow circumscription of the family (e.g. Haston *et al.* 2007). *Adenogramma nutans* is retrieved as sister to the other species of *Adenogramma* that was included (*A. lichtensteiniana*; 100 % bootstrap support), both nested within the family, and sister to a clade comprising genera *Pharnaceum* L., *Mollugo* L. and *Suessenguthiella* Friedr. The phylogenetic analysis thus supports the identification of the newly described species as a member of genus *Adenogramma*.

***Adenogramma natans* J.C.Manning & Goldblatt, sp. nov.**

Herba annua subtilis aquatica caulibus submersis ramis ex nodis superioribus productis, foliis 3 in verticillum dispositis sessilibus ovato-lanceolatis 3–5 × 1.5–2.0 mm planis pallide viridibus marginibus membranaceis angustis, stipulis subulatis minutis ± 0.5 mm longis, floribus 1(2) axillaribus folio mediano oppositis, pedicello 0.5–0.75 mm longo, sepalis (4)5 imbricatis obovate-cucullatis ad basem arcte connatis 1.5–2 × 0.5–1.0 mm, marginibus latis translucetibus, in fructu persistentibus, staminibus (4)5 ad basem connatis filiformibus ± 1 mm longis quam perianthio brevioribus, antheris ± 0.2 mm longis rubro-aurantiacis, ovario oblique compresso-ovoido ± 1 mm longo ruguloso uniloculari, ovulo solitario lateraliter affixo, fructu oblique pyriformi vel virguliformi ± 2 × 1 mm, acuto nec manifeste rostrato, incluso vel vix ex perianthio exserto, granulato-ruguloso brunneo.

TYPE.—Western Cape, 3319 (Worcester): Bo-Hermon, Elandsberg Farm, seasonal streams, (–AC), 16 Oct. 2009, *Parker sub Manning* 3233 (NBG, holo.; MO, K, PRE, iso.).

Delicate aquatic annual with submerged stems and

floating apical leaf clusters. *Stems* filiform-capillary, up to 200 mm long, glabrous, leafy only near tips, often flushed pinkish, becoming dry and wiry later, simple below and branching from upper nodes. *Leaves* in whorls of 3, sessile, ovate-lanceolate, 3–5 × 1.5–2.0 mm, flat, incurved when young, later spreading, apiculate-mucronulate but not aristate, truncate-cordate at base, congested apically and more distant below, median leaf inserted immediately below lateral pair, soft-textured, pale green with narrow membranous margins, persistent but soon decaying. *Stipules* minute, awl-like, ± 0.5 mm long. *Flowers* 1(2), axillary, arising opposite median leaf between lateral leaf pair, shortly pedicellate; pedicel 0.5–0.75 mm long, not elongating in fruit. *Sepals* (4)5, imbricate, obovate-cucullate, connate basally, 1.5–2 × 0.5–1 mm, with narrow, fleshy, green median region ± $\frac{3}{4}$ total length and broad, translucent membranous margins flushed pink in distal half, remaining tightly furled and persistent in fruit. *Stamens* (4)5, connate at base in ring, filiform, ± 1 mm long, shorter than perianth; anthers ± 0.2 mm long, orange-red. *Ovary* obliquely compressed-ovoid, ± 1 mm long, rugulose, 1-chambered with solitary, laterally attached ovule; style falcate, curving away from placental side, scarcely 0.5 mm long, pink, stigmatic in distal half. *Fruit* obliquely pyriform or comma-shaped, compressed, ± 2 × 1 mm, with narrow marginal keel in distal half, acute but not evidently beaked, included or just protruding from perianth, granular-rugulose, brown, soon deciduous and falling with enveloping perianth. *Flowering time*: July–October. Figure 11.

Distribution and ecology: currently known only from Elandsberg Nature Reserve near Bo-Hermon in Western Cape (Figure 12), where it occurs at the foot of the Elandskloof Mtns in shallow, seasonal streams draining the western slopes of the mountains. The streams begin to run during the winter with the onset of the seasonal rains but are entirely dry during the summer months. *Adenogramma natans* co-occurs in some streams with other locally restricted hydrophytes, including *Oxalis natans* (Oxalidaceae) and *Lachenalia bachmannii* (Hyacinthaceae), both of which are endemic to seasonal ponds and streams along the West Coast between Piketberg and the Cape Peninsula (Goldblatt & Manning 2000).

Adenogramma natans is evidently cleistogamous, as the flowers remain closed, with the anthers dehiscing directly onto the stigma within the perianth, and all flowers develop ripe nutlets. As such, the species is extremely inconspicuous, which probably explains why it has been overlooked until now. We have not encountered the species in our investigation of vernal pools along the West Coast and it thus appears to be restricted to seasonally flowing streams.

Diagnosis and relationships: *Adenogramma natans* is instantly recognizable as the only aquatic species in the genus. The thread-like stems of this annual herb are rooted in the bottom substrate of shallow seasonal streams, with the terminal leafy portions of the stems floating on the surface. Increasing inundation of the stems leads to loss of the submerged foliage so that only the terminal portions of the stems remain leafy. The ovate, pale green, thin-textured leaves are borne in whorls of three at the nodes, with one or two minute, cleistogamous flowers at each of the upper nodes. Plants are unbranched at the base but develop one or two

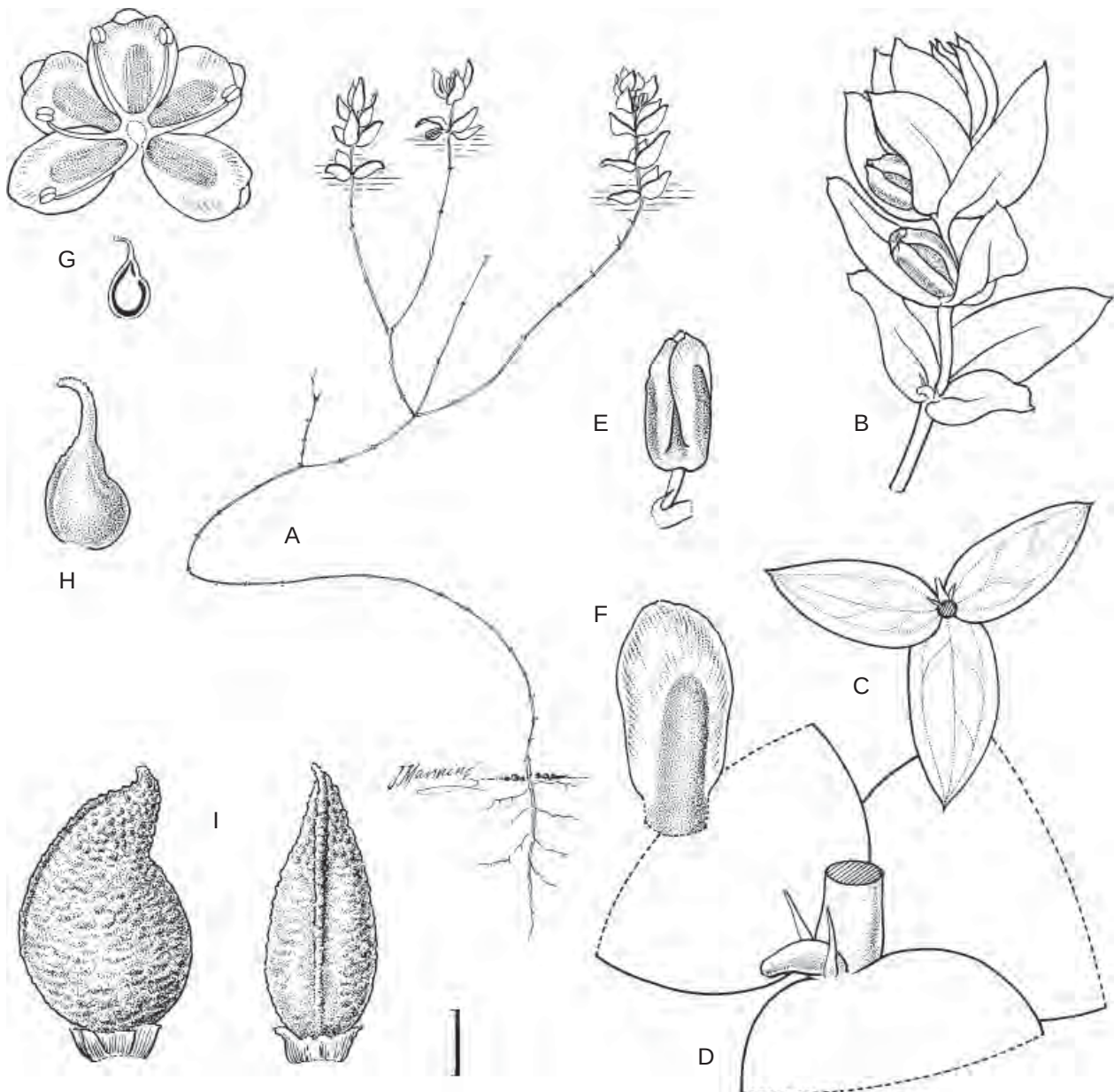


FIGURE 11.—*Adenogramma natans*, Parker sub Manning 3233 (NBG). A, whole plant; B, stem apex; C, single leaf whorl; D, detail of stipules and pedicel insertion; E, single flower at anthesis; F, sepal; G, flattened perianth and l/s of pistil; H, pistil, side view; I, nutlet. Scale bar: A, 10 mm; B, C, 1.5 mm; E, G, 1 mm; D, F, H, I, 0.5 mm. Artist: J. Manning.

branches from some of the nodes along the stem. The species is morphologically unusual in the genus in having the leaves in whorls of 3, and in its highly reduced axillary cymes, producing mostly one (sometimes two) flowers at each node. Other species mostly have whorls of 4–6 leaves and typically develop three or more flowers at each node.

The immediate relationships of *Adenogramma natans* are unclear but the species most closely resembles two other annual, herbaceous species, *A. glomerata* (L.f.) Druce and *A. littoralis* Adamson. In all three species the perianth is persistent in fruit, remaining wrapped around the nutlets, which have poorly developed or very short apical beaks. Both *A. glomerata* and *A. littoralis*, however, are truly terrestrial species, favouring seasonally damp sandy flats. *A. natans* most closely approaches *A. littoralis* in its relatively broad, flat, ovate-lanceolate,

acute-mucronulate leaves lacking the characteristic apical arista of all other members of the genus. The leaves of *A. littoralis*, however, are distinctly narrowed towards the base, unlike the truncate-cordate leaves of *A. natans*, and they are borne in whorls of four to six rather than in whorls of three. *A. glomerata* has whorls of mostly six, narrower, linear-lanceolate leaves with an apical arista. In fruit *A. natans* is also more similar to *A. littoralis*, both species developing compressed-pyriform nutlets with acute apices, although the nutlets in *A. littoralis* have a characteristic punctuate-reticulate sculpturing rather than the more irregular granular-rugulose sculpturing of *A. natans*.

Several of the known *Adenogramma* species are evidently rarely collected. *A. littoralis*, for instance, although cited by Adamson (1955) as occurring from Hondeklip Bay to Cape Hangklip, is still unrepresented

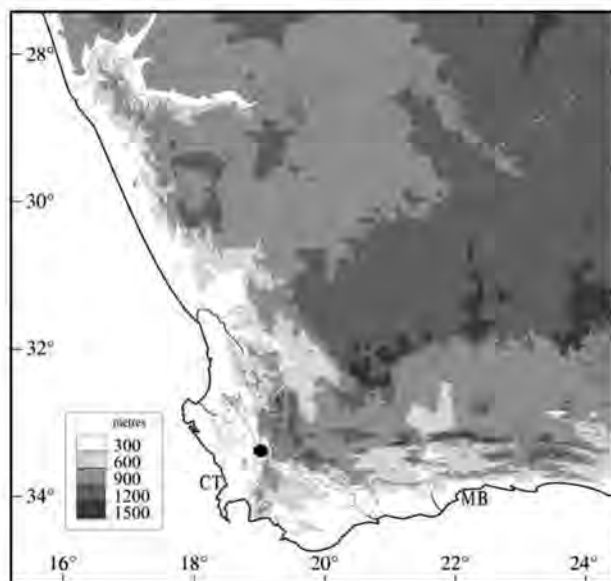


FIGURE 12.—Known distribution of *Adenogramma natans*.

at NBG, and *A. physocalyx* Fenzl. is another poorly known species. The insignificant character of many of the species is likely to be a partial explanation for their poor representation in herbaria but they may also be truly rare.

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REFERENCES

- ADAMSON, R.S. 1955. The South African species of Aizoaceae. 1. *Adenogramma* and *Polpoda*. *Journal of South African Botany* 21: 83–95.
- CUÉNOUD, P., SAVOLAINEN, V., CHATROU, L.W., POWELL, M., GRAYER, R.J. & CHASE, M.W. 2002. Molecular phylogenetics of Caryophyllales based on nuclear 18S rDNA and plastid *rbcL*, *atpB*, and *matK* DNA sequences. *American Journal of Botany* 89: 132–144.
- DREYER, L.L. & JORDAAN, M. 2000. Molluginaceae. In O.A. Leistner, Seed plants of southern Africa: families and genera. *Strelitzia* 10: 410–413. National Botanical Institute, Pretoria.
- FELSENSTEIN, J. 1985. Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* 39: 783–791.
- GOLDBLATT, P. & MANNING, J.C. 2000. Cape plants. A conspectus of the Cape flora. *Strelitzia* 9. National Botanical Institute, Pretoria & Missouri Botanical Garden, St. Louis.
- HASTON, E., RICHARDSON, J.E., STEVENS, P.F., CHASE, M.W. & HARRIS, D.J. 2007. A linear sequence of Angiosperm Phylogeny Group II families. *Taxon* 56: 7–12.
- HEYWOOD, V.H., BRUMMITT, R.K., CULHAM, A. & SEBERG, O. 2007. *Flowering plant families of the world*. Royal Botanic Gardens, Kew.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index herbariorum*, part 1: the herbaria of the world. New York Botanical Garden, New York.
- MANNING, J.C., FOREST, F., DEVEY, D.S., FAY, M.F. & GOLDBLATT, P. 2009. A molecular phylogeny and a revised classification of Ornithogaloideae (Hyacinthaceae) based on an analysis of four plastid DNA regions. *Taxon* 58: 77–107.
- MANNING, J.C., GOLDBLATT, P., SIEBEN, E.J.J. & ROUX, J.P. 2008. *Aponogeton fugax* (Aponogetonaceae), a new endemic species from the Cape Floral Region, South Africa. *Bothalia* 38: 156–159.
- MUCINA, L. & RUTHERFORD, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- SWOFFORD, D.L. 2002. *PAUP*: Phylogenetic Analysis Using Parsimony (*and Other Methods)* Version 4. Sinauer Associates, Sunderland, MA.
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PTERIDOPHYTA—THELYPTERIDACEAE

METATHELYPTERIS BURROWSIORUM, A NEW SPECIES FROM SWAZILAND AND A FIRST GENUS RECORD FOR SOUTHERN AFRICA

Metathelypteris (H.Itô) Ching is a genus of ± 16 species with a number of additional infraspecific taxa. It is widely distributed in the Old World, particularly Asia (Ching 1963). In recent years a collection was made in the Lebombo Mountains of northeastern Swaziland, representing not only a first record for this genus in southern Africa, but also a new species; this novelty is described here. *Metathelypteris* is poorly represented in Africa, with only one species—*M. vandervekenii* Pic. Serm.—known previously from the continental mainland, in Rwanda (Pichi Sermolli 1983). *M. fragilis* (Baker) Holttum subsp. *guineensis* Benl occurs only on two islands in the Gulf of Guinea, São Tomé and Bioko (Fernando Po) (Benl 1988; Figueiredo 1998; 2002), whereas the typical subspecies is known only from a single gathering from Madagascar (Baker 1877; Holttum 1974).

***Metathelypteris burrowsiorum* N.R.Crouch, sp. nov.**, *M. fragilis* (Baker) Holttum similis sed pinnis profunde bipinnatifidis neque ad costam anguste alatum sectis, frondibus longioribus cum 15–22 paribus pinnarum discretis, non 8–16 paribus, et venis in pinnulis discretis non furcatis, differt.

TYPE.—Swaziland: 2632 (Bela Vista): dry stream bed in riverine forest next to boulder, Carmichael Farm, Siteki, Lebombo Mtns, (–AC), 02-12-2006, J.E. Burrows & S.M. Burrows 9649 (BNRH, holo., PRE, iso.).

Plants terrestrial. *Rhizome* erect, caudex short, ± 8 mm long, up to 8 mm diam., closely set with roots and stipe bases; scales sparse, up to 9×1 mm, chartaceous, castaneous, sessile, attenuate, margins irregularly set with acicular hairs. *Fronds* tufted, arching, up to 370 mm long; stipe firm, 70–120 mm long, up to

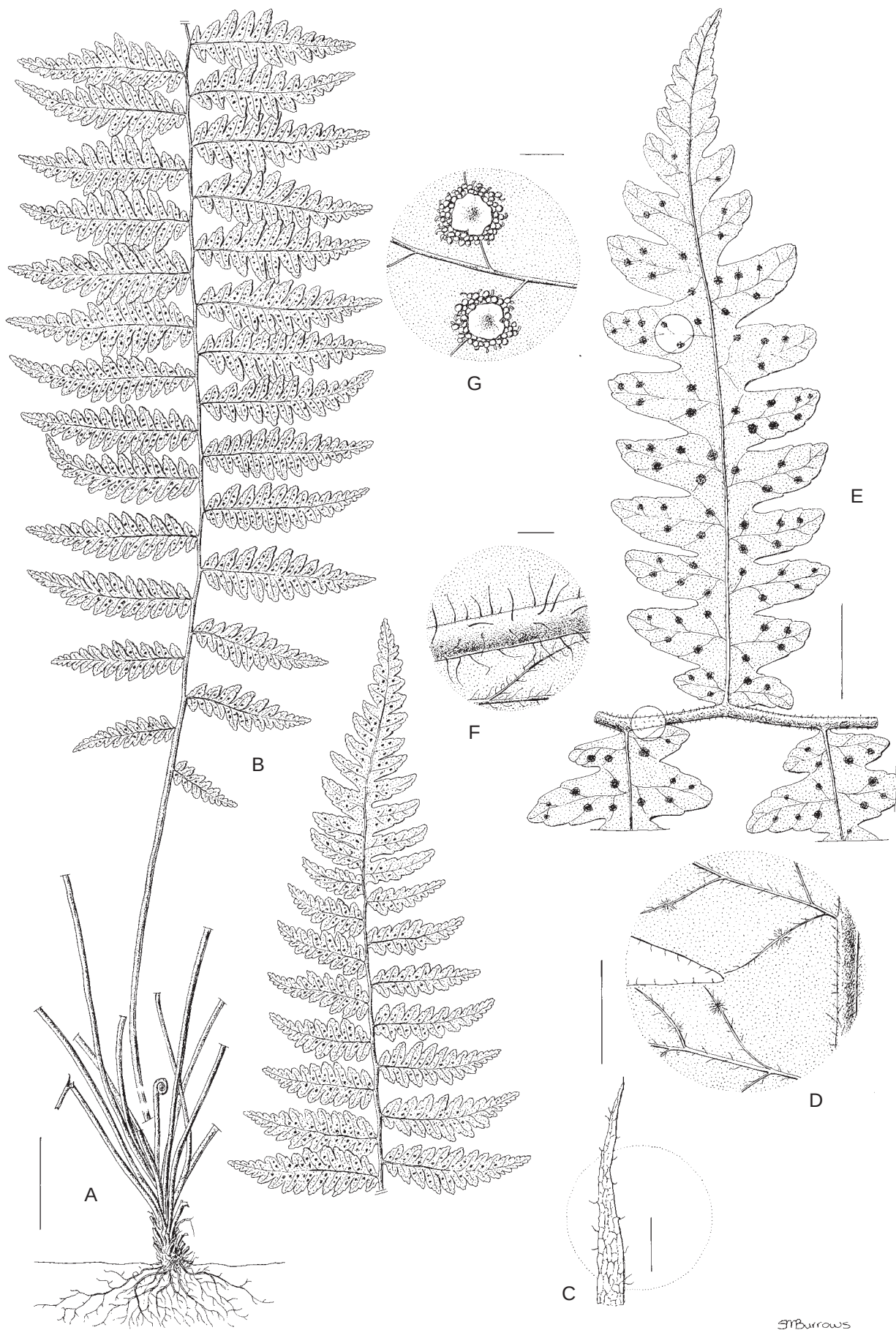


FIGURE 13.—*Metathelypteris burrowsiorum*, Burrows & Burrows 9649 (BNRH). A, rhizome with lower stipes; B, frond; C, rhizome scale; D, free, pinnate venation; E, deeply pinnatifid pinna; F, rachis section with uniseriate acicular hairs; G, indusiate round sori along veins. Scale bars: A, B, 20 mm; C, 2 mm; D, 2.5 mm; E, 5 mm; F, 1 mm; G, 0.5 mm. Artist: S. Burrows.

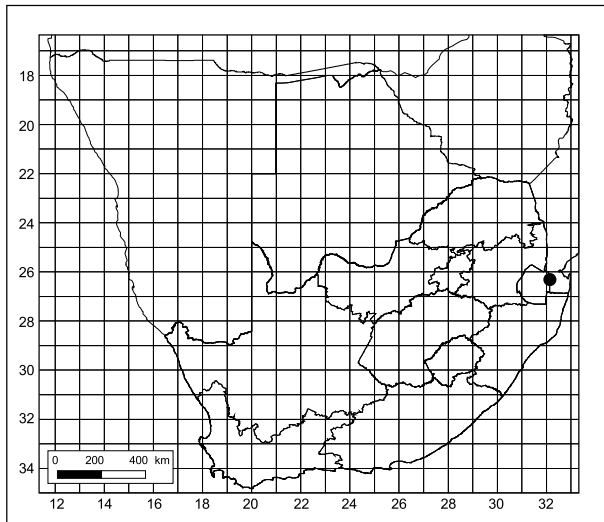


FIGURE 14.—Known distribution of *Metathelypteris burrowsiorum*.

1.5 mm diam., pale green to stramineous, scales proximally sparse, similar to those of rhizome, up to 2.6×0.3 mm, pilose with short, acicular hairs up to 0.12 mm long. *Lamina* 1-pinnate-pinnatifid, lanceolate, $220\text{--}300 \times 50\text{--}80$ mm, pale green to yellow-green, tapering apex formed by gradually shortened upper adnate pinnae, with 15–22 free pinna pairs, with 1 or 2 basal pinna pairs gradually reduced; rachis shallowly sulcate, pale green, sulca more pronounced distally, with hairs similar to those on stipe but longer, 0.5–1.0 mm long. *Pinnae* sessile, thinly herbaceous, subopposite to alternate, spaced, elliptic, decrescent at bases, largest $28\text{--}40 \times 10\text{--}12$ mm, deeply lobed to more than $\frac{2}{3}$ way to costa. *Pinnule* lobes oblong, obtuse, often somewhat falcate, up to 4.5×2.5 mm, irregularly crenate-sinuate; basal acroscopic lobe sometimes enlarged, adaxially moderately set with unicellular acicular hairs along costa, veins and along margins, and sparsely set along costa and veins with minute capitate hairs (0.08–0.13 mm long) bearing a translucent to opaque to orange gland at top, abaxially moderately set with unicellular acicular hairs along and occasionally scattered between veins, up to 0.45 mm long, and sparsely set along costa and veins with capitate hairs as for adaxial surface; costa adaxially without sulci, pronounced abaxially, set with hairs similar to those on rachis. *Venation* evident, free, pinnately branched in lobes, branches simple not forked, ending short of margin, with no vein pairs anastomosing below sinus. *Sori* circular, medial on veins, up to 7 per lobe; indusium chartaceous, green turning pale brown, persistent, reniform to subcircular, with unicellular acicular hairs above, up to 0.5 mm diam.; receptacle naked. *Sporangium* stalk 2 cells thick, simple, capsule circular in lateral view, with 12 or 13 indurated annulus cells, 5 or 6 stomial cells; spores 64 per sporangium, brown, ellipsoidal, monolete, verruculose to shortly echinate. Figure 13.

Distribution: *Metathelypteris burrowsiorum* is known only from a single Swaziland locality (Figure 14) at 520 m, at a well-shaded site within Southern Lebombo Bushveld (SVI 16). It falls within the summer rainfall region with a mean annual precipitation of 550–1 000 mm (Rutherford *et al.* 2006). It is terrestrial, and was

found on soils derived from underlying rhyolite of the Jozini Formation, in a seasonally dry stream bed protected from the erosive action of floodwater by a boulder. Other ferns in close vicinity included *Doryopteris concolor* and *Microgramma mauritiana*. Although the new species is evidently rare in Swaziland, it has possibly been located on the periphery of its range, given the close proximity of the type locality to Mozambique. Searches for further subpopulations should accordingly focus on the adjacent region in Mozambique. The rather unexpected and sparse occurrence of *M. burrowsiorum* in the region is consistent with the history of discovery of other *Metathelypteris* taxa in Africa and its surrounding islands—when present, plants are typically very rare and localized.

Etymology: the specific epithet *burrowsiorum* jointly honours John and Sandra Burrows, for their contribution to pteridology in south-central Africa that spans three decades, and as the collectors of the type specimen.

Diagnostic characters: *Metathelypteris burrowsiorum* differs from *M. fragilis* in having pinnae that are deeply bipinnatifid but not cut to a narrowly winged costa, in producing longer fronds with 15–22 free pinnae pairs rather than 8–16, having veins free in the pinnules and not forked, and possessing indusia with acicular rather than capitate hairs. The pinnule margins of *M. fragilis* are obtusely lobed a third to halfway to the rachis, not irregularly crenate-sinuate as with *M. burrowsiorum*. The new species differs from *M. vandervekenii* in lacking capitate glandular hairs on the abaxial lamina surface and on the indusia—although these are present on the costule and veins—and in having the rachis hairy throughout, not only on the upper surface. The Rwandan taxon also has a more dissected lamina (Pichi Sermolli 1983). Other African *Metathelypteris* species have fronds that are ovate-lanceolate or deltate in outline, relative to the somewhat narrow lanceolate lamina of *M. burrowsiorum*.

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Dr Hugh Glen of the South African National Biodiversity Institute (SANBI), Durban, kindly provided the Latin diagnosis, Ms Hester Steyn of SANBI (Pretoria) prepared the map and the Keeper of the Herbarium, Royal Botanic Gardens, Kew, provided permission to access specimens and library facilities.

REFERENCES

- BAKER, J.G. 1877. On a collection of ferns made by Miss Helen Gilpin in the interior of Madagascar. *Journal of the Linnean Society, Botany* 16: 197–206.
- BENL, G. 1988. The Pteridophyta of Bioko (Fernando Po). Contributions to a flora of the island. IV. *Acta Botanica Barcinonensis* 38: 1–69.
- CHING, R.C. 1963. A reclassification of the family Thelypteridaceae from the mainland of Asia. *Acta Phytotaxonomica Sinica* 8: 289–335.
- FIGUEIREDO, E. 1998. The Pteridophytes of São Tomé and Príncipe (Gulf of Guinea). *Bulletin of the Natural History Museum, London (Botany)* 28: 41–66.
- FIGUEIREDO, E. 2002. Pteridófitos de São Tomé e Príncipe. *Estudos, Ensaios e Documentos, Lisboa* 162: 1–209.

- HOLTTUM, R.E. 1974. Thelypteridaceae of Africa and adjacent islands. *Journal of South African Botany* 40: 123–168.
- PICHI SERMOLLI, R.E.G. 1983. A contribution to the knowledge of the Pteridophyta of Rwanda, Burundi, and Kivu (Zaire)—I. *Bulletin du Jardin Botanique National de Belgique* 53: 177–284.
- RUTHERFORD, M.C., MUCINA, L., LÖTTER, M.C., BREDENKAMP, G.J., SMIT, J.H.L., SCOTT-SHAW, C.R., HOARE, D.B., GOODMAN, P.S., BEZUIDENHOUT, H., SCOTT, L., ELLIS, F., POWRIE, L.W., SIEBERT, F., MOSTERT, T.H., HENNING, B.J., VENTER, C.E., CAMP, K.G.T., SIEBERT, S.J., MATTHEWS, W.S., BURROWS, J.E., DOBSON, L., VAN ROOYEN, N., SCHMIDT, E., WINTER, P.J.D., DU PREEZ,

- P.J., WARD, R.A., WILLIAMSON, S. & HURTER, P.J.H. 2006. Savanna Biome. In L. Mucina & M.C. Rutherford, The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: 438–538.

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AGAVACEAE

FURCRAEA FOETIDA: AN INVADING ALIEN IN SOUTH AFRICA

The genus *Agave* L. has long been recognized as invasive in southern Africa, and until recently was thought to be the only one of eight genera in the Agavaceae (Verhoek 1998) to have become regionally naturalized (Smith & Mössmer 1996; Smith 2003). In recent years, colonies of large plants bearing a loose resemblance to agaves in general vegetative habit (Figure 15) have been noted as widely naturalized in KwaZulu-Natal, the Western Cape and Mpumalanga (Figure 16); these have been determined as *Furcraea foetida* (L.) Haw. (syn. *F. gigantea* Vent.) of the tribe Agaveae (Agavaceae). A plate of this Meso- and South American species is reproduced in Verhoek (2002). *F. foetida* bears some resemblance to those species of *Agave* locally grown, particularly in domestic and amenity horticulture; it also has rigid, succulent leaves, rather than leathery, flaccid ones, and in this regard resembles young specimens of *Agave americana* L., but the leaves are verdant green and not glaucous. The main morphological differences between *Agave* and *Furcraea* are presented in Table 1.

Taxonomically, *Furcraea* Vent. is a poorly understood genus—see for example Ahmed Kahn (1997) on the species cultivated in India, and García-Mendoza (1999, 2000) on the tree-like furcraeas. Geographically, *Furcraea* extends from east-central Mexico through the Antilles and eastern Brazil to Peru; it is the only genus in the Agavaceae with a primary distribution centred south of Guatemala. Approximately 20 species are recognized in two subgenera: *F.* subgen. *Furcraea* and *F.* subgen. *Roetzlia* (Verhoek 1998). The subject of this report is subgen. *Furcraea*. Various orthographic variants on *Furcraea* exist in the literature: *Furcroya*, *Furcroea*, *Fourcroea* and *Fourcroya* (Drummond 1907; Verhoek 1998).

Furcraea foetida occurs naturally from Guadaloupe, southwards through northern South America to Brazil and the Caribbean (Greater Antilles) (Grisebach 1864; Howard 1979). Through the agency of humans this species is now known to have naturalized widely in the Pacific and Indian Ocean Islands, including the Seychelles, Madagascar, the Mascarene Islands (Baker 1888; Drummond 1907; Macdonald *et al.* 1991), Marquesas Islands, Cook Islands, Fiji, Guam, French Polynesia, Hawaii, Tonga, New Caledonia, Australia (Forster 1986) and New Zealand. It is also now known from Florida in the USA (Francis 2009; PIER 2009). Morris (1887)

described how the Mauritius-based hemp industry was originally initiated in about 1875 in order to utilize the large number of plants that had naturalized along the island coastline following their introduction from South America in about 1790. The extensive uses to which *fique*, the Columbian name for this plant and its fibres had historically been employed, has been documented in detail (Anonymous 1916). By 1917 the species was under cultivation for its sisal-like fibres in several countries besides Mauritius, including Malawi [Nyasaland], Sri Lanka [Ceylon] and India (Anonymous 1917). When crushed, the leaves of some cultivars give off a strong odour, hence the origin of the specific epithet and an alternative common name ‘foetid aloe’ (Morris 1887). Selections with pronounced marginal leaf spines have subsequently been planted widely as barrier plants in tropical regions (Howes 1946), and variegated cultivars, e.g. cv. ‘Mediopicta’ grown in horticulture as landscaping and large, potted accent plants (Smith 2005).

Its arrival in South Africa may be traced to its importation by the Natal Botanical Gardens (now the Durban Botanic Gardens) sometime before the early 1880s, ± 130 years ago. It (as *Fourcroya gigantea*) receives mention as a garden accession in an early visitors’ guide (Wood 1883), with archival records revealing that a further cultivar arrived in November 1894 (as *Fourcroya gigantea* var. *variegata*) from the [Lalbagh] Botanical Gardens in Bangalore, India. The Durban Garden propagated and later distributed material to meet the demands of a growing fibre industry in Natal, now KwaZulu-Natal (KZN). The Garden Director recorded how Mauritius hemp was ‘receiving much attention’, with large areas planted to this economically important species (Wood 1907)—a good source of fibre for rope and cordage (Anonymous 1887). In support of the emerging South African hemp sector, Wood (1907) reported dispatching—over 12 months—a total of 2 350 plants (as *F. gigantea*), to farming enterprises, from Umzumbe (KZN South Coast) northwards to Zululand.

The ability of *Furcraea foetida* to invade is associated with the production of copious bulbils, ± several thousand per plant, on an inflorescence (Figure 17A, B). After flowering, these viviparous plantlets eventually drop, rooting easily on contact with the soil to form dense monotypic thickets that exclude native vegetation (ISSG Database 2009); plants are accordingly transformers (Pyšek *et al.* 2004). A dense stand of > 1

TABLE 1.—Main morphological distinctions between *Agave* and *Furcraea*

Character	<i>Agave</i>	<i>Furcraea</i>
Leaf apex	Long, hard, sharp spine	Hard button or short, firm point
Flower arrangement	Paired or in umbellate clusters	In clusters of 3–5
Flower orientation	Erect or horizontal	Pendulous
Filaments	Exserted, subulate, without basal cushion-like swelling	Included, abruptly expanded below middle forming basal cushion-like swelling
Stigma	3-lobed	Capitate or shortly 3-lobed
Perianth	Tubular or campanulate	Campanulate only

acre may be observed at Lake Eland Game Reserve (KZN South Coast). By definition (Pyšek *et al.* 2004), *F. foetida* is invasive rather than simply naturalized or a casual alien, as colonies are known to have persisted for more than 10 years, and, via vegetative propagules, to have spread more than 100 m in less than 50 years. Longer distance dispersal events (of bulbils) are seemingly facilitated by man, with naturalized subpopulations currently known as far apart as Klein Brakrivier in the Western Cape, and Loskop Dam in Mpumalanga. Bulbil production follows shortly after flowering, at which time resources in the (dying) basal rosette are transferred to aerial vegetative propagules, and more rarely to developing fruit and seed. A hundred percent survival and rooting of fresh Puerto Rican bulbils ($n = 100$) placed in moist potting mix have been observed after a single week, with plantlets attaining an average height of 178 ± 4 mm after only one month (Francis 2009). Parent plants also produce new plantlets by lateral budding (offshoots). Further weedy characteristics are exhibited by *F. foetida*: its capacity to thrive in sun as well as partial shade, its non-susceptibility to fire (plants singe rather than burn), and a variable phenology. Plants appear to flower when they attain sufficient vigour and size to support the large inflorescence, at 5–20 years depending on environmental conditions (Francis 2009).

***Furcraea foetida* (L.) Haw.**, Synopsis plantarum succulentarum: 73 (1812); Howard (1979); PIER (2009); Verhoek (2009).

Agave foetida L.: 323 (1753).

F. gigantea Vent.: 65 (1793); Sims (1821) (as *Furcroea*); Bailey (1958).

Massive, robust, fibrous-rooted multi-annual, monocarpic, leaf succulent. *Stem* short, ± 1 m high, usually only 200–300 mm long within ± 2.5 –3.5 m diam. basal rosette. *Leaves* up to 50, rigid, outermost recurving, verdant green to yellow-green, linear-lanceolate to oblanceolate, up to 2400×200 (–250) mm, thick, firm, smooth or obsolescently striate, somewhat roughened beneath, fleshy with thread-like parallel fibres; margins hard and smooth, usually entire at least in distal half, sometimes basally with a few hooked marginal spines shaped like shark's teeth pointing towards the leaf apex, mature apex a firm, blunt point. *Inflorescence* fast-growing, paniculate; scape 5–12 m high; panicle $\pm$ as long as peduncle, central branches much branched; after flower senescence frequently producing large number of bulbils 10–160 mm long. *Flowers* with pedicels articulated, 6–12 mm long, in clusters of 2–5, pendulous, only a few open at a time for several weeks, white, greenish white, yellowish green, or pale blue-green, tubular, 25 – 50×10 –18 mm, scented. *Perianth* segments 6, with tepals spreading, 23–30 mm long, oblong, distinct except at base. *Stamens* 6, inserted; filaments short, abruptly expanded below middle. *Ovary* inferior, 12–15 mm long; style inserted, dilated, 3-lobed proximal to middle; stigma 3-lobed. *Fruits* capsular, loculicidally dehiscent, infrequently produced. *Seeds* many, black, flat, 2 rows



FIGURE 15.—Small colony of *Furcraea foetida*, Umzimkulu Mouth, KwaZulu-Natal. Photograph: N. Crouch.

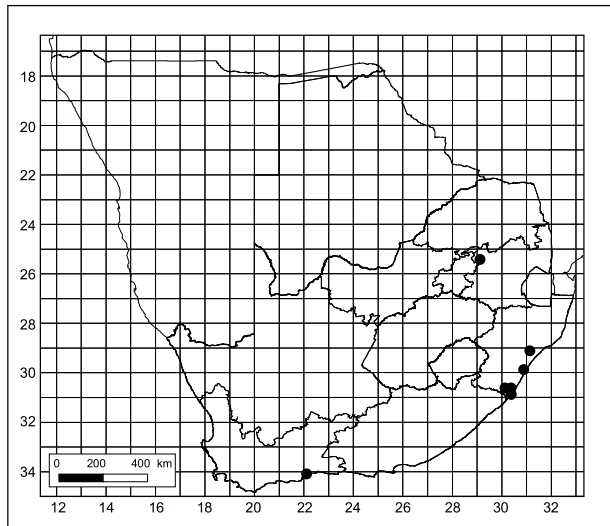


FIGURE 16.—Known naturalized distribution of *Furcraea foetida*, ●, in FSA region, based on sight records and herbarium vouchers.

per locule. *Chromosome number* $2n = 60$. *Flowering time*: mainly in the cooler months in South Africa, but often spontaneous throughout the year.

Specimens examined

KWAZULU-NATAL.—2930 (Pietermaritzburg): Pinetown, roadside cutting alongside M13 highway, about 200 m eastbound beyond onramp to N3, 293 m, (–DD), 13-01-2010, *N. Crouch 1261* (NH). 3030 (Port Shepstone): Wichman's farm, (–CD), 29-12-1968, *A.P. Wells 437* (NH).

Common names: Mauritius hemp, foetid aloe, *aloës vert* (Morris 1887), green aloe (Anonymous 1887). Wild populations in Columbia are referred to as *fique* (Anonymous 1916) or *cabuya* (Drummond 1907), as *cadère*, *chanvre de Maurice*, *choka* and *choka vert* on French Reunion (La Réunion) (ISSG Database 2009), and elsewhere as female *karata*, *maguey*, *mayuey criollo*, and *cocuisa* (Francis 2009).

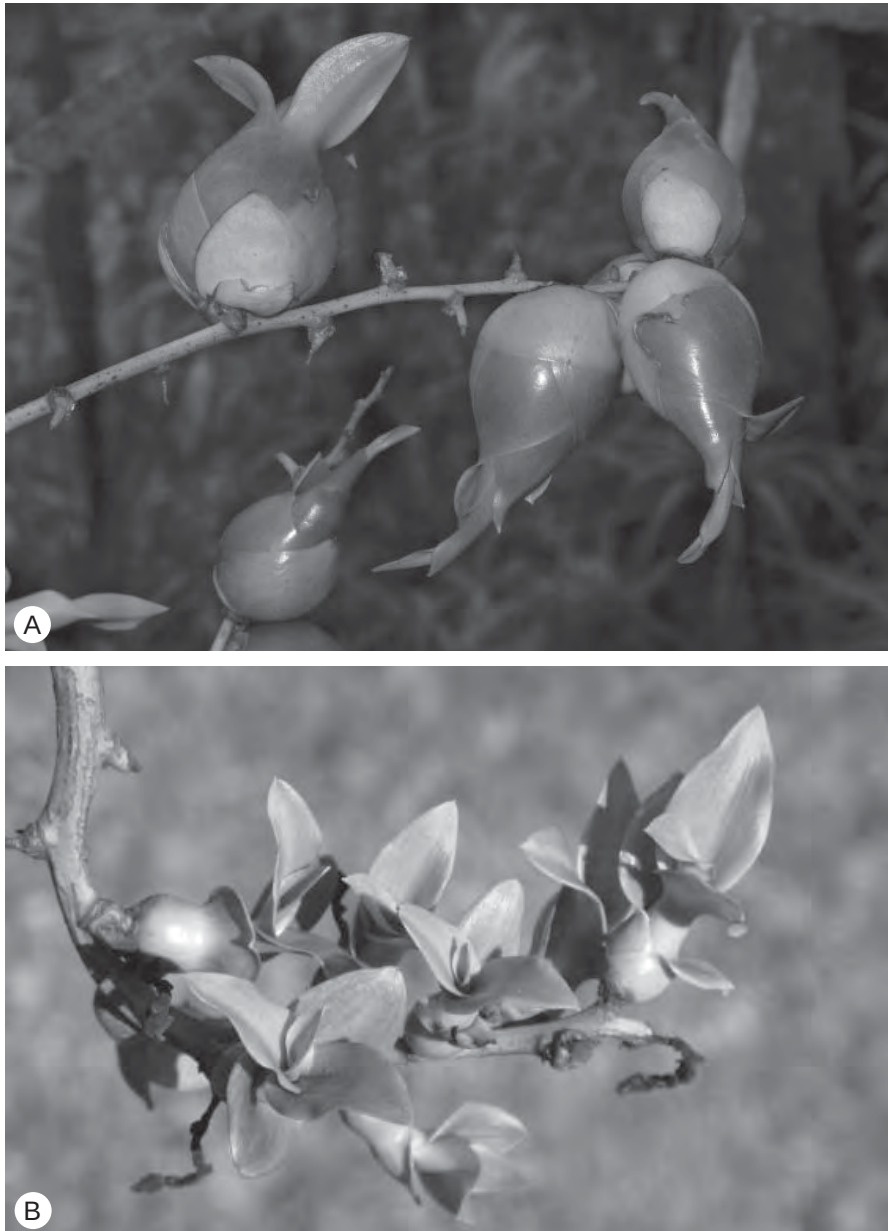


FIGURE 17.— *Furcraea foetida*: A, mature inflorescence with aerial bulbils; B, aerial bulbils proliferating on a mature inflorescence branch. Photographs: N. Crouch.

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REFERENCES

- AIHMED KAHN, H. 1997. Morphotaxonomical studies of *Furcraea* (Agavaceae) of India. *Journal of Plant Anatomy and Morphology* 7: 140–147.
- ANONYMOUS. 1887. Fibre plants. *Kew Bulletin* 1887 (3): 1, 2.
- ANONYMOUS. 1916. Figue. *Furcraea gigantea*. *Kew Bulletin* 1916 (7): 169–170 (with plate).
- ANONYMOUS. 1917. A list of economic plants native or suitable for cultivation in the British Empire. *Kew Bulletin* 1917 (7/8): 241–296.
- BAILEY, L.H. 1958. *The Standard Cyclopedia of Horticulture*, vol. 2. MacMillan, New York.
- BAKER, J.G. 1888. *Furcraea*. *Handbook of the Amaryllidaceae*. Bell, London.
- DRUMMOND, J.R. 1907. The literature of *Furcraea* with a synopsis of the known species. *Missouri Botanical Garden Annual Report* 18: 25–75.
- FORSTER, P.I. 1986. Agavaceae. 3. *Furcraea*. In A.S. George, *Flora of Australia. Iridaceae to Dioscoreaceae*, vol. 46: 77, 78. Australian Government Publishing Service, Canberra.
- FRANCIS, J.K. 2009. *Furcraea foetida*. Agavaceae. <http://www.fs.fed.us/global/iitf/pdf/shrubs/Furcraea%20foetida.pdf> (accessed 22 Dec. 2009).
- GARCÍA-MENDOZA, A. 1999. Una especie nueva de *Furcraea* (Agavaceae) de Chiapas, México. *Novon* 9: 42–45.
- GARCÍA-MENDOZA, A. 2000. Revisión taxonómica de las especies arborecentes de *Furcraea* (Agavaceae) en México y Guatemala. *Boletín de la Sociedad Botánica de México* 66: 113–129.
- GRISEBACH, A.H.R. 1864. *Flora of the British West Indian Islands*. Reeve, London.
- HAWORTH, A.H. 1812. *Synopsis plantarum succulentarum*, edn 1. Taylor, London.
- HOWARD, R.A. 1979. *Flora of the Lesser Antilles, Leeward and Windward Islands*, vol. 3. Arnold Arboretum, Harvard University, USA.
- HOWES, F.N. 1946. Fence and barrier plants in warm climates. *Kew Bulletin* 1(2): 51–87.
- ISSG DATABASE (GLOBAL INVASIVE SPECIES DATABASE). 2009. *Furcraea foetida*. <http://www.invasivespecies.net/database/species/ecology.asp?si=1257&fr=1&sts=&lang=EN> (accessed 22 Dec. 2009).
- LINNAEUS, C. 1753. *Species plantarum*, edn 1. Salvius, Stockholm.
- MACDONALD, I.A.W., THEBAUD, C., STRAHM, W.A. & STRASBERG, D. 1991. Effects of alien plant invasions on native vegetation remnants on La Reunion (Mascarene Islands, Indian Ocean). *Environmental Conservation* 18: 51–61.
- MORRIS, D. 1887. Mauritius hemp. *Kew Bulletin* 1887 (3): 8–10.
- PIER (PACIFIC ISLAND ECOSYSTEMS AT RISK). 2009. *Furcraea foetida* (L.) Haw., Agavaceae. http://www.hear.org/pier_v3.3/fufoc.htm (accessed 22 Dec. 2009).
- PYŠEK, P., RICHARDSON, D.M., REJMÁNEK, M., WEBSTER, G.J., WILLIAMSON, M. & KIRSCHNER, J. 2004. Alien plants in checklists and floras: towards a better communication between taxonomists and ecologists. *Taxon* 53: 131–143.
- SIMS, J. 1821. *Furcraea gigantea*. *Curtis's Botanical Magazine* 48: t. 2250.
- SMITH, G.F. 2003. Agavaceae. In G. Germishuisen & N.L. Meyer, *Plants of southern Africa: an annotated checklist*. *Strelitzia* 14: 955.
- SMITH, G.F. 2005. *Gardening with succulents. Horticultural gifts from extreme environments and the arid world*. Struik Publishers, Cape Town.
- SMITH, G.F. & MÖSSMER, M. 1996. *FSA contributions 4: Agavaceae*. *Bothalia* 26: 31–35.
- VENTENAT, É.P. 1793. *Bulletin de la Société Philomatique de Paris no. 28 Vendémiaire, an 2 de la Rép. i.*
- VERHOEK, S. 1998. Agavaceae. In K. Kubitzki, *The families and genera of vascular plants. III. Flowering plants. Monocotyledons. Liliaceae (except Orchidaceae)*: 60–70. Springer-Verlag, Berlin.
- VERHOEK, S. 2002. *Furcraea*, Agavaceae. In *Flora of North America Editorial Committee, Flora of North America north of Mexico* 26: 461, 462. Oxford University Press, Oxford.
- WOOD, J.M. 1883. *A guide to the Natal Botanical Gardens containing a plan of the gardens, byelaws, etc. and catalogue of plants*. Durban.
- WOOD, J.M. 1907. *Report on Natal Botanic Gardens and Colonial Herbarium for the year 1906–1907*. Bennett & Davis, Durban.

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APOCYNACEAE

DISTRIBUTION OF *CRYPTOLEPIS DELAGOENSIS* (PERIPLOCOIDEAE-CRYPTOLEPIDAE), A SUBCONTINENTAL SOUTHERN AFRICAN ENDEMIC AND SELECTION OF A NEOTYPE

During a visit to Mahamba Gorge in Swaziland in November 2009, John Burrows showed the first author a branch of a *Cryptolepis* that grew on the Mahamba mountainside. These plants were also growing along the river bank next to the campsite and one of them was in full flower. Initial investigations at the National Herbarium (PRE) revealed that it was *C. delagoensis* and a new record for Swaziland. After consultation of the collection, further material, previously incorrectly identified as *Secamone filiformis* (L.f.) J.H.Ross, extended our knowledge of *C. delagoensis*, and led to this note.

Cryptolepis delagoensis seems to be so infrequently collected that it has not even been reported in the preliminary checklist of vascular plants for Mozambique (Da Silva *et al.* 2004). It was annotated as an insufficiently known species in Kloppe *et al.* (2006). In the

most recent assessment of all South African species, Raimondo *et al.* (2009) listed the conservation status of *Cryptolepis delagoensis* as least concerned (LC).

Cryptolepis delagoensis Schltr. has not previously been reported for Swaziland (Compton 1966, 1976; Kemp 1981, 1983; Braun *et al.* 2004; Braun 2010). In the protologue, the species was described and based on a single unnumbered specimen of Schlechter (Schlechter 1905; Brown 1907). It was collected at Delagoa Bay near Lourenço Marques (today Maputo). All Schlechter's holotypes were deposited in the Berlin Herbarium (B) which was bombed during the Second World War, and most of these specimens were destroyed (Hiepko 1978; Nicholas 1992; Livshultz 2003). Although some specimens from B were out on loan at the time of the bombing, recent enquiries to the curator revealed that

the *Cryptolepis delagoensis* specimen was not one of them. It is therefore presumed that Schlechter's specimen was also destroyed. The following neotype is therefore selected here.

***Cryptolepis delagoensis* Schltr.** in Botanische Jahrbücher 38: 26 (1905). Neotype: South Africa, Natal [KwaZulu-Natal], Tembe Game Reserve, Ngobozana Trail, H.J.T. Venter 9335 (PRE, neotype here designated; BLFU, isoneotype).

The Kemp specimen (1181) of *Cryptolepis delagoensis* is the first record of this species in Swaziland, even though it was wrongly identified and listed under *Secamone filiformis* Schltr. (Braun *et al.* 2004).

The two species, *Cryptolepis delagoensis* and *Secamone filiformis*, have many common features: both are lianas with a climbing nature; both have leaves that are somewhat bicolorous with the lower surfaces much paler compared to the dark green adaxial side; and the lower epidermis is densely covered by papillae, those in *S. filiformis* being much smaller than those found in *C. delagoensis*.

The difference in flowers is very obvious. In *Cryptolepis delagoensis* the inflorescences are few-flowered with 2–6 flowers and pedicels 1–3 mm long, contrasting with the inflorescences of *S. filiformis* which have 5–12 flowers with pedicels 2–4 mm long. Furthermore, the leaves of *C. delagoensis* are elliptic to lanceolate-elliptic with the blade 10–22 × 4–7 mm and in *S. filiformis* the leaves are linear with the blade 12–44 × 1–4 mm.

Cryptolepis delagoensis grows in closed, short bushland, open woodland scrub usually on a rocky substrate, or in thickets of short sand forest. The plants grow in well-drained loamy soils and partial shade on steep, undisturbed slopes, river banks or plains. The creamy yellow flowers are borne from November to February followed by the development of follicles that are dark brown when mature. Specimens have been collected at altitudes from 30–1 000 m. In sand forests it can attain heights of ± 4 m tall. The known distribution for *C. delagoensis* is given in Figure 18.

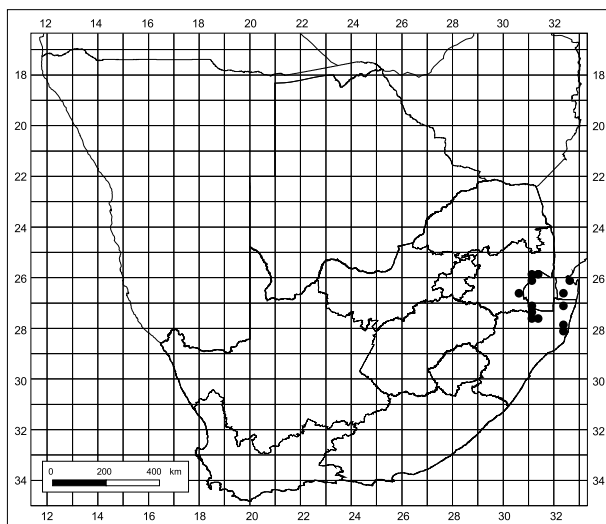


FIGURE 18.—Known distribution of *Cryptolepis delagoensis* Schltr.

Specimens examined

SWAZILAND.—2631 (Mbabane): Mololotsha Valley, 26° 06'S 31° 06' E, (–AA), Kemp 1181 (PRE!, SDNH). 2731 (Louwsburg): Mahamba Gorge, ± 4.4 km NNW of Mahamba Border Post, Mahamba Lodge, (–AA), Bester 9763 (BLFU!, LYD!, MO!, PRE!, PRU!, UDW!).

MOZAMBIQUE.—2632 (Bela Vista): Maputo, southern end of Licuati Forest Reserve, ± 30 km SW of Bela Vista, Goyder 5034 (K).

MPUMALANGA.—2531 (Komatipoort): Barberton, (–CC), Thorncroft 825 (NU, NH); Ida Doyer Reserve on Farm Schoonoord 380JU, near Swaziland border at Havelock, (–CC), Fourie 1641 (PRE!); Ugu-tugulo Gorge below Shiyalongubo Dam (Makonjwa Range), waterfall plunge-pool rim, 25°46'12"S 31°16'18"E, (–CD), Winter 6439 (PRE!). 2630 (Carolina): Amsterdam, 9 km S of town, (–DA), Bruyns 9365 (BOL).

KWAZULU-NATAL.—2731 (Louwsburg): Piensrand area, crest of Nqongwana Hill, (–AC), MacDevette 718 (NH); Vryheid Dist., road to Bhivarte (Paris) Dam, (–CA), Bruyns 9357 (BOL); Coronation, Paris Dam, 27°31'0"S 31°2'0"E, (–CA), Hankey 556 (PRE!); Vryheid Dist., Coronation, Schurwerand Farm 9640, ± 26 km north from Coronation in gorge above Bivane River, (–CA), Jacobsen 5371 (PRE!); Itala Game Reserve, slope above Square Davel, (–CB), MacDevette 2220 (NH, PRE–photocopy). 2732 (Umbombo): Ingwavuma Dist., Tembe Elephant Park, (–AB), Ward 1928 (NH, PRE!); Tembe Game Reserve, Ngobozana trail, (–AB), Venter 9335 (BLFU, PRE); False Bay, Bird Sanctuary, near Mr Redman's house, (–CD), Gerstner 4731 (PRE). 2832 (Mtubatuba): Hlabisa Dist., False Bay, bird sanctuary, Bushveld Reserve, (–AB), Gerstner 4731 (PRE!).

REFERENCES

- BRAUN, K.P. 2010. *Swaziland flora database*. <http://www.sntc.org.sz/flora/index.asp> (accessed 1 March 2010).
- BRAUN, K.P., DLAMINI, S.D., MDLADLA, D.R., METHULE, N.P., DLAMINI, P.W. & DLAMINI, M.S. (compilers) 2004. *Swaziland flora checklist*. South African Botanical Diversity Network Report No. 27. SABONET, Pretoria.
- BROWN, N.E. 1907. In W.T. Thiselton-Dyer, *Flora capensis* 4,1: 528. Reeve, London.
- COMPTON, R.H. 1966. An annotated checklist of the flora of Swaziland. *Journal of South African Botany*, Suppl. vol. 6: 62–64.
- COMPTON, R.H. 1976. The flora of Swaziland. *Journal of South African Botany*, Suppl. vol. 11: 442–472.
- DA SILVA, M.C., IZIDINE, S. & AMUDE, A.B. 2004. *A preliminary checklist of the vascular plants of Mozambique*. South African Botanical Diversity Network Report No. 30. SABONET, Pretoria.
- HIEPKO, P. 1978. Die erhaltenen Teile der Sammlungen des Botanischen Museums Berlin-Bahlem (B) aus der Zeit vor 1943. *Willdenowia* 8: 389–400.
- KEMP, E.S. 1981. *Additions and name changes to the flora of Swaziland*. Swaziland National Trust Commission, Occasional Publication No. 1.
- KEMP, E.S. 1983. *A flora checklist for Swaziland*. Swaziland National Trust Commission, Occasional Publication No. 2.
- KLOPPER, R.R., CHATELAIN, C., BÄNNINGER, V., HABASHI, C., STEYN, H.M., DE WET, B.C., ARNOLD, T.H., GAUTIER, L., SMITH, G.F. & SPICHTER, R. 2006. *Checklist of the flowering plants of sub-Saharan Africa: an index of accepted names and synonyms*. South African Botanical Diversity Network Report No. 42. SABONET, Pretoria.
- LIVSCHULTZ, T. 2003. Leptotypification of *Dolichostegia* Schlechter (Asclepiadoideae, Apocynaceae) and a new combination, *Dischidia boholensis*. *Taxon* 52: 595–600.
- NICHOLAS, A. 1992. The Asclepiadaceous works of Rudolph F. Schlechter (1872–1925). *Willdenowia* 22: 215–264.
- RAIMONDO, D., VON STADEN, L., FODEN, W., VICTOR, J.E., HELME, N.A., TURNER, R.C., KAMUNDI, D.A. & MAN-YAMA, P.A. (eds). 2009. Red List of South African plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

SCHLECHTER, R. 1905. *Asclepiadaceae africanae*. In A. Engler, Beiträge zur Flora von Afrika XXVIII. *Botanische Jahrbücher* 38: 25–56.

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PTERIDOPHYTA–MARSILEACEAE

PILULARIA DRACOMONTANA, A NEW SPECIES OF PILLWORT FROM THE KWAZULU-NATAL DRakensBERG, SOUTH AFRICA

The genus *Pilularia* L. remains relatively poorly known, although recent work on its phylogenetic position (Nagalingum *et al.* 2008) as well as the function and structure of spores in this heterosporous genus (Schneider & Pryer 2002) have improved our understanding of its diversity and relationships. The exact number of species is not certain; currently five or less are recognized (Large & Braggins 1989; Nagalingum *et al.* 2008).

The first record of the genus in southern Africa—identified tentatively as *P. americana* A.Braun on the basis of both vegetative and sexual characters—was collected from Nieuwoudtville on the Bokkeveld Escarpment in 2001, at an altitude of ± 800 m. There, *P. americana* grows immersed and emergent on the periphery of seasonal pans, in a region receiving winter/spring rainfall of 500–650 mm per annum (Roux 2002). During April 2010, a second collection of this cryptic genus, representing a novel species, was gathered from tarns in the southern Drakensberg of KwaZulu-Natal, at more than twice the Bokkeveld altitude, and over 1 000 km distant. This latest collection is of a diminutive species, significantly smaller than *P. americana* in many vegetative and sexual respects, and with an ecological requirement of perennial submersion in deep, sandstone tarns. Circinate vernation is not obvious in either taxon known from South Africa. This is in contrast to North American material of *P. americana* in which circinate vernation is reported to be a prominent character (Johnson 2010). Roux (2002) neither described nor illustrated this inward coiling feature of the frond for the Nieuwoudtville plants, unlike Cook (2004), whose illustration and text was presumably based on extra-South African material.

Fresh samples were viewed in water, using a Nikon AZ100 microscope. Longitudinal views through megaspores were obtained on a Nikon 80i microscope, using 1 μ m toluidene blue-stained sections of material embedded in epoxy resin, using standard procedures. Light microscope images and measurement data were acquired using NIS Elements D software (Nikon, Japan). For scanning electron microscopy (SEM), samples were fixed chemically, dehydrated in a graded ethanol series and dried using hexamethyldisilazane (SPI Supplies, US), mounted on stubs using double-sided carbon tape and rendered conductive by sputter coating with

gold. Samples were viewed using a LEO 1450 SEM (Carl Zeiss, Germany).

Pilularia dracomontana N.R.Crouch & J.Wesley-Smith, sp. nov., *P. americana* A.Braun similis sed sporocarpis minoribus solum 3–5 megasporas in quoque soro continentibus, acrolamella proportione valde longiori, foliis etiam brevioribus (usque ad 14 mm, non 15–100 mm longis), sine vernatione manifeste circinata, internodiis brevioribus (usque ad 4.2 mm, non 30 mm), differt. *Pilularia dracomontana* a speciebus omnibus aliis generis sporocarpia in plantis immersis, non emerisis nec emergentibus pariendo, differt.

TYPE.—KwaZulu-Natal: 2929 (Underberg): Cobham, growing submerged in a sandstone tarn above Lakes Cave, 2 160 m, (–CB), 1 April 2010, N. Crouch 1268 (PRE, holo., NH, iso.).

Plants aquatic, mat-forming. *Rhizome* filiform, creeping, irregularly branched, up to 0.24 mm diam., set with 1–5 roots at nodes, internodes (1.47–)2.70(–4.2) mm long, initially sparsely hairy, glabrous with age, mostly with a few hairs at frond base, hairs up to 5 cells long. *Fronds* borne singly at nodes, erect, simple, setiform, (8.9–)11.98(–13.66) mm long, basally with few laterally attached, 3-celled hairs, glabrous apically. *Sporocarp* subterranean, globose, (1.49–)1.58(–1.7) mm diam., laterally attached, cream-coloured and densely hairy when young, atrocastaneous and sparsely hairy when mature, hairs up to 5 cells long, appressed; sporocarps 4-locular, dehiscing into 4 valves, each locule with a single sorus containing micro- and megasporangia; sporocarp pedicel arising from node on rhizome, up to 1.43 $\times$ 0.21 mm, produced laterally. *Microsporangia* clavate, several per sorus, wall one cell layer thick, hyaline, each bearing 28–32 microspores. *Microspores* trilete, circular in polar view, elliptic in equatorial view, laesurae short, perispore hyaline, much larger than spore, epispore densely rugulate, (44.23–)49.88(–53.41) μ m diam. at equator and (36.03–)42.25(–51.95) μ m diam. at poles, pseudo-endospore (intine) evident below exine layer. *Megasporangia* ellipsoid, wall one cell layer thick, hyaline, 3–5 per sorus (12–19 per sporangium), each bearing a single megaspore. *Megaspores* spherical in polar, and broadly elliptic in lateral view, with prominently ridged acro-

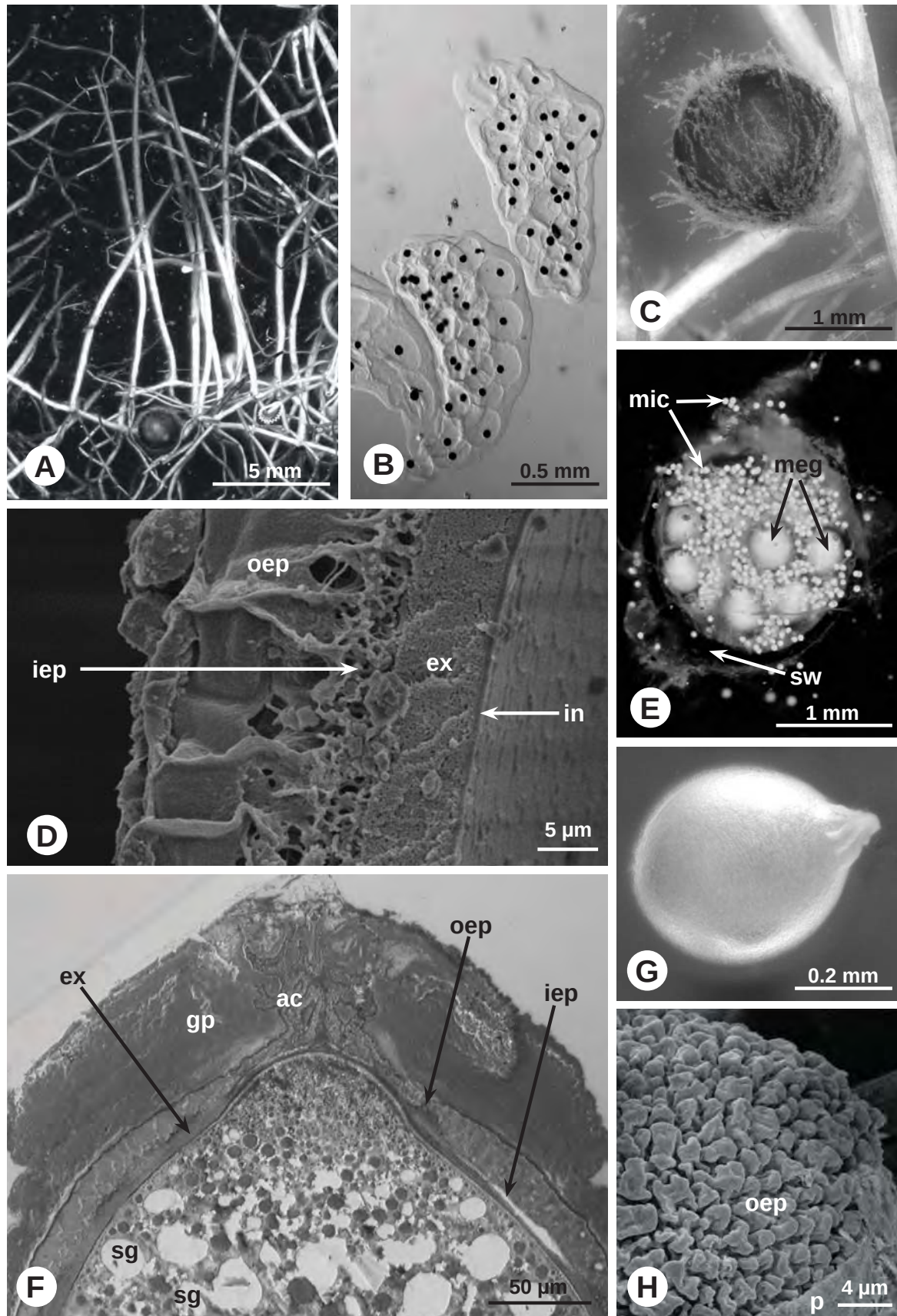


FIGURE 19.—*Pilularia dracomontana*. A, fertile mat portion, fronds borne singly at nodes; B, clavate microsporangia, intact with microspores surrounded by hyaline perispore; C, intact sporocarp unevenly covered with multicellular appressed hairs; D, t/s microspore wall; E, apical view of mechanically ruptured mature sporocarp; F, l/s distal end of mature megaspore; G, megaspore with apical papilla-like laesura (acrolamella); H, partially dissected microspore. ac, acrolamella; ex, exine layer; gp, gelatinous perine layer; iep, inner episporic sublayer; in, intine layer; meg, hyaline megasporangia; mic, microspores; oep, rugulate outer episporic sublayer; p, dehydrated perine layer; sg, starch grain; sw, sporocarp wall.

lamella (apical papilla-like laesura) (76.86–)99.54(–120.07) μm long, perispore hyaline, much larger than megaspore, both perispore and epispore thicker around distal pole than at equator, outer sublayer of epispore deeply plicate giving it a finely rugose appearance, inner sublayer of epispore much thinner than outer sublayer, pseudoendospore (intine) evident below exine layer, epispore up to 346 μm in length (excluding acrolamella) and up to 329 μm at equator. Figure 19.

Distribution: *Pilularia dracomontana* is thus far known only from three tarns in the Cobham District of the KwaZulu-Natal Drakensberg (Figure 20). The site is at the upper limit of the Southern Drakensberg Highland Grassland (Gd 4), almost on the boundary of uKhahlamba Basalt Grassland (Gd 7) (Mucina *et al.* 2006). *P. dracomontana* grows with an undescribed species of *Isoetes* (aff. *I. transvaalensis* Jermy & Schelpe) in deep sandstone tarns on a southern aspect. Plants grow in silt at the bottom of the tarns, at a depth of ± 40 cm, with fronds buried $\frac{1}{4}$ to $\frac{1}{2}$ of their length. In habitat, plants annually receive precipitation of $\pm 1\,120$ mm from summer rainfall, but also winter snow; the tarns ice over frequently between June and August. No plants have been observed to grow as emergents in soil on the perimeter of the tarns, indicating that *P. dracomontana* may be an obligate submerged hydrophyte, at least in its vegetative state. Given its diminutive size and arcane form, this species may well be more widespread in suitable habitat in the Drakensberg, but has been overlooked to date. Plants are locally abundant in the Cobham tarns, which range in diameter from 10–15 m.

Etymology: the specific epithet *dracomontana* is a geographic indicator of the distribution of this species, which is known only from the KwaZulu-Natal Drakensberg.

Diagnostic characters: *Pilularia dracomontana* differs from *P. americana* in both vegetative and sexual characters, and is smaller in several respects. Mature sporocarps of *P. americana* have a mean diameter of 2.67 mm and contain 12–20 megaspores per sorus (Large & Braggins 1989), whereas the corresponding values for *P. dracomontana* are 1.58 mm, and 3–5 megaspores respectively. The apical papilla-like laesura (acrolamella) of the megaspores of *P. dracomontana* is proportionately much longer (at $\pm 23\%$) than its equivalent in *P. americana*, which has been documented as $\pm 12.5\%$ of the total spore length (Tryon & Lugardon 1991). Leaf lengths of *P. americana* range from 15–50(–100) mm (Correll 1956; Large & Braggins 1989; Mickel & Smith 2004), whereas leaves of the new species are no longer than 14 mm, on average attaining < 12 mm. The leaves of *P. americana* from North America exhibit obvious circinate vernation (Johnson 2010), but this feature is yet to be observed in *P. dracomontana*; additionally, more than one leaf per node has been observed in *P. americana* (Correll 1956), whereas *P. dracomontana* invariably produces only one per node. Internode lengths recorded by Roux (2002) for *P. americana* are up to 11 mm and by Grounds (1974) up to 30 mm; the maximum observed in *P. dracomontana* is only 4.2 mm. Comparison of the Drakensberg species with the two other 4-locular pillworts, *P. novae-zelandiae* Kirk and *P. novae-hollandiae* A.Braun, reveals real differences

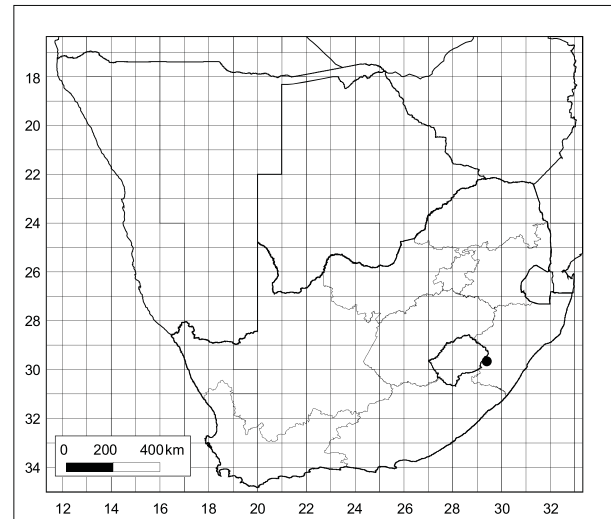


FIGURE 20.—Known distribution of *Pilularia dracomontana*, ●.

in the size of fronds, pedicels, sporocarp diameters, megaspores per sporocarp, and spore dimensions (Large & Braggins 1989). Some authors (e.g. Nagalingum *et al.* 2008) consider these two last-mentioned *Pilularia* species to be conspecific, and New World specimens previously referred to *P. americana* to likely belong to at least two taxa. The European species, *P. minuta* Durieu (known also from North Africa) and *P. globulifera* L., each possess only two locules. The non-emergent yet prolific fertile character (at a submerged depth of 40 cm) of *P. dracomontana* appears unique in the genus: *Pilularia* is otherwise consistently reported (Tryon & Tryon 1982; Mickel & Smith 2004) to produce sporocarps only on emergent plants.

Specimen examined

Pilularia americana

NORTHERN CAPE—3119 (Calvinia): Nieuwoudtville, in mud on edge of seasonal pan, (–AC), 10-10-2001, J.P.Roux 3156 (NBG).

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REFERENCES

- COOK, C.D.K. 2004. *Aquatic and wetland plants of southern Africa*. Backhuys Publishers, Leiden.
- CORRELL, D.S. 1956. *Ferns and fern allies of Texas*. Texas Research Foundation, Renner, Texas.
- GROUND, R. 1974. *Ferns*. Pelham Books, London.

- JOHNSON, D.M. 2010. Marsileaceae. 23. In Flora of North America Editorial Committee, *Flora of North America north of Mexico* (online version), vol. 2. Pteridophytes and Gymnosperms. www.efloras.org (accessed 09-2010).
- LARGE, M.F. & BRAGGINS, J.E. 1989. An assessment of characters of taxonomic significance in the genus *Pilularia* (Marsiliaceae): with particular reference to *P. americana*, *P. novae-hollandiae*, and *P. novae-zelandiae*. *New Zealand Journal of Botany* 27: 481–486.
- MICKEL, J.T. & SMITH, A.R. 2004. The pteridophytes of Mexico. *Memoirs of the New York Botanical Garden* 88. NYBG Press, Bronx, USA.
- MUCINA, L., HOARE, D.B., LÖTTER, M.C., DU PREEZ, J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDEKAMP, G.J., POWRIE, L.W., SCOTT, L., CAMP, K.G.T., CILLIERS, S.S., BEZUIDENHOUT, H., MOSTERT, T.H., SIEBERT, S.J., WINTER, P.J.D., BURROWS, J.E., DOBSON, L., WARD, R.A., STALMANS, M., OLIVER, E.G.H., SIEBERT, F., SCHMIDT, E., KOBISI, K. & KOSE, L. 2006. Grassland Biome. In L. Mucina & M.C. Rutherford, *The vegetation of South Africa, Lesotho and Swaziland. Snelitzia* 19: 349–436.
- NAGALINGUM, N.S., NOWAK, M.D. & PRYER, K.M. 2008. Assessing phylogenetic relationships in extant heterosporous ferns (Salviniales), with a focus on *Pilularia* and *Salvinia*. *Botanical Journal of the Linnean Society* 157: 673–685.
- ROUX, J.P. 2002. Marsileaceae–Pteropsida. First report of the genus *Pilularia* from continental Africa. *Bothalia* 32: 82, 83.
- SCHNEIDER, H. & PRYER, K.M. 2002. Structure and function of spores in the aquatic heterosporous fern family Marsileaceae. *International Journal of Plant Sciences* 163: 485–505.
- TRYON, A.F. & LUGARDON, B. 1991. *Spores of the Pteridophyta*. Springer-Verlag, New York.
- TRYON, R.M. & TRYON, A.F. 1982. *Ferns and allied plants with special reference to tropical America*. Springer-Verlag, New York.

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PTERIDOPHYTA–SINOPTERIDACEAE

A NEW SUBSPECIES OF *CHEILANTHES DELTOIDEA* FROM GAUTENG AND LIMPOPO, SOUTH AFRICA

Cheilanthes deltoidea Kunze is a small and easily overlooked fern endemic to southern Africa. Hitherto it has been recorded in the western and northwestern parts of the Northern Cape, the Cederberg area of the Western Cape, and in southern Namibia. To the east, there is a disjunct record from the Waterberg in Limpopo Province (Jacobsen & Jacobsen 1986; Burrows 1990), and Klopper *et al.* (2006) reported the discovery of a particularly small form of *C. deltoidea* in the Centurion area of Gauteng. Klopper *et al.* (2006) suggested that this form (perhaps including the plants from the Waterberg) may warrant description as a new infraspecific taxon, but further studies were needed to confirm the suggested status. Recently, a population of this same entity was discovered north of the Cradle of Humankind area, very close to the Gauteng/North-West border. The population in the Waterberg was located and a comparative study of the various forms and their habitat was completed.

Northern Cape populations of *Cheilanthes deltoidea* fall within the winter rainfall region and produce new fronds during this time of year; during the dry summer months the plants are desiccated and shrivelled. In this region, *C. deltoidea* grows predominantly in fissures on granite or gneiss rock formations. The northeastern populations in Centurion, the Cradle of Humankind area and the Waterberg are in the summer rainfall region and the seasonality of its growing cycle differs accordingly. Centurion and Cradle of Humankind plants were only found on outcrops of chert rock associated with dolomite representing the Malmani Subgroup, Chuniespoort Group of the Transvaal Supergroup (Obbes 2000; Eriksson *et al.* 2006). These populations were present on chert in Carletonville Dolomite Grassland (Mucina & Rutherford 2006), but apparently do not occur on the chert outcrops of the Rand Highveld Grassland in Centurion (Petro Lemmer pers. comm.).

In the Waterberg, plants of *C. deltoidea* grow in Central Sandy Bushveld (Mucina & Rutherford 2006), on phonolithic lava that forms part of the lower strata of the Waterberg Group (Barker *et al.* 2006; Prof. P. Eriksson & Dr N. Lenhardt pers. comm.). Plants were consistently smaller in Centurion, the Cradle of Humankind area and the Waterberg than in the Northern Cape. Based on the clear disjunction in the distribution range, the specific geological requirements, and the morphological and phenological differences observed, the small form from Gauteng and Limpopo is here described as a new subspecies.

***Cheilanthes deltoidea* Kunze subsp. *silicicola* Klopper & A.E. van Wyk, subsp. nov.**, a subspecies typica frondis minoribus (lamina $\pm$ 8–21 mm longa, pinnis basalibus $\pm$ 5–15 mm longis), squamis rhizomatis pallide brunnescentibus, stipa lamina sesquilogior, in silice vel lava phonolithica aestate crescente differt.

TYPE.—Gauteng, 2528 (Pretoria): Centurion, Irene, Doornkloof, Smuts House Museum, on koppie close to monument, (–CC), 30-03-2006, R.R. Klopper & A.W. Klopper 217 (PRE, holo.).

Rhizome shortly creeping, 2–3 mm diam., densely covered with roots and old stipe bases; scales lanceolate, attenuate, $\pm$ 2–3 mm long, pale light brownish, concolorous, entire. *Fronds* closely tufted, erect, herbaceous to thinly coriaceous; stipe sulcate, slender, 10–22(–45) mm long, dark reddish brown, becoming darker with age, glabrous. *Lamina* broadly deltate in outline, 8–21 (–30) $\times$ 9–26(–35) mm, 2- or 3-pinnatifid, pinnae in 3–5 $\pm$ opposite pairs, basal pinnae basiscopically developed, 5–15(–18) mm long; ultimate segments oblong acute to broadly spatulate in fertile fronds, obtuse in sterile or partially sterile fronds, margins entire, glabrous; rachis

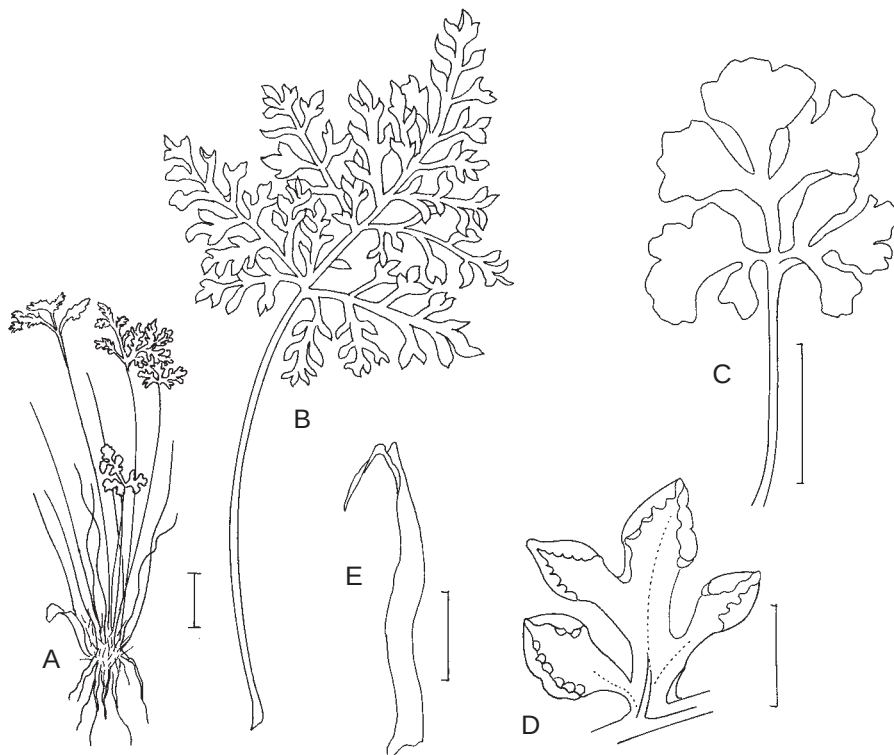


FIGURE 21.—*Cheilanthes deltoidea* subsp. *silicicola*, R.R. Klopper & A.W. Klopper 217. A, habit; B, mature leaf growing in deep shade; C, immature leaf; D, marginal sori; E, rhizome scale. Scale bars: A–C, 5 mm; D, E, 2 mm. Artist: G. Condy.

dark reddish brown, glabrous, narrowly winged for its entire length. Venation free, obscure adaxially. Sori linear; false indusium continuous, 0.3–0.4 mm broad. Figure 21.

Diagnostic characters: *Cheilanthes deltoidea* subsp. *silicicola* can be distinguished by its small, broadly deltoid fronds, continuous false indusium, and winged rachis. It is consistently smaller (frond lamina $\pm$ 8–21 mm long, basal pinnae $\pm$ 5–15 mm long) than the typical subspecies and has an average stipe:lamina ratio of $\pm$ 1.5 (compared to $\pm$ 1 in subsp. *deltoidea*). When growing in the shade of rocks, as at the type locality, plants can become larger (stipe up to 45 mm long, and lamina up to 30 $\times$ 35 mm), but they never reach the average size of *C. deltoidea* subsp. *deltoidea*, and the stipe:lamina ratio remains consistent. Rhizome scales of *C. deltoidea* subsp. *silicicola* are a pale brownish colour as opposed to more castaneous in *C. deltoidea* subsp. *deltoidea* (Table 2). Furthermore, *C. deltoidea* subsp. *deltoidea* only grows in sheltered rock crevices on south-facing aspects, where it is completely sheltered from direct sunlight. It is found mostly on granite or gneiss rock for-

mations (Jacobsen 1983; Burrows 1990). *Cheilanthes deltoidea* subsp. *silicicola* grows on north- or northwest-facing aspects, and is confined to chert and phonolithic lava outcrops (Klopper *et al.* 2006).

Distribution: only known from the Centurion area of Gauteng and north of the Cradle of Humankind (Gauteng/North-West border), with an outlier record from the Waterberg in the Limpopo Province (Figure 22). It could be more widespread where suitable geology is present.

Habitat and ecology: grows in sheltered soil pockets and rock crevices mainly on northern and northwestern aspects of chert outcrops associated with dolomite of the Malmani Subgroup, Chuniespoort Group of the Transvaal Supergroup, and on phonolithic lava of the Waterberg Group. In Centurion and the Cradle of Humankind area, this fern has only been found on chert and not on the associated dolomite.

In Centurion it is found in a relatively small area in Carletonville Dolomite Grassland near the transition with Rand Highveld Grassland (Mucina & Rutherford 2006), but is not present in the latter (Petro Lemmer pers. comm.). The population north of the Cradle of Humankind also occurs in Carletonville Dolomite Grassland, whereas the Waterberg population is associated with Central Sandy Bushveld (Mucina & Rutherford 2006). During the dry season it shrivels up completely and revives when sufficient moisture is available.

Etymology: from Latin, *silicis* (silica), and *-cola* (inhabiting), alluding to the narrow geological preference of this subspecies that only grows on chert and phonolithic lava, both having a very high silica content.

TABLE 2.—Differences between *Cheilanthes deltoidea* subsp. *silicicola* and *C. deltoidea* subsp. *deltoidea*

	subsp. <i>silicicola</i>	subsp. <i>deltoidea</i>
Rhizome scales	2–3 mm long, pale light brownish	$\pm$ 3 mm long, castaneous
Stipe length	10–22 mm	16–34 mm
Lamina length	8–21(–30) mm	18–50(–100) mm
Basal pinnae length	5–15(–18) mm	11–34(–55) mm
Stipe:lamina ratio	$\pm$ 1.5	$\pm$ 1
Geology (substrate)	chert or phonolithic lava	granite or gneiss

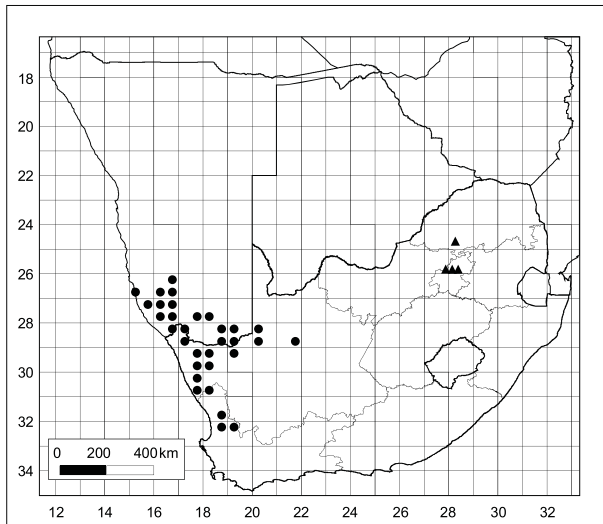


FIGURE 22.—Known distribution of *Cheilanthes deltoidea*, adapted from Burrows (1990), with his permission, by adding localities based on specimens kept at PRE and NBG that have been collected since publication of map; *Cheilanthes deltoidea* subsp. *deltoidea*, ●; *C. deltoidea* subsp. *silicicola*, ▲.

Conservation status: owing to its very small size and the fact that this fern shrivels up during dry periods, it is easily overlooked. Much of the suitable habitat for this plant has already been destroyed through massive urban expansion in Centurion. For this reason *Cheilanthes deltoidea* subsp. *silicicola* was assessed as Vulnerable [VU B1ab(ii,iii,iv,v) + 2ab(ii,iii,iv,v); C2a(i); D1+2] by the Threatened Species Programme (Victor & Pfab 2009, as *C. deltoidea* subsp. nov.). It is exposed to several threats, the most prominent being habitat loss from urbanization, but also alien vegetation, unnatural fire regimes, and trampling.

Other specimens examined

GAUTENG.—2527 (Rustenburg): Kalkheuwel-wes, Lewenskloof, (–DD), 24-01-2008, L. Mills s.n. (PRE). 2528 (Pretoria): Centurion, Doornkloof, Portion 107 on Farm Doornkloof 391-JR, (–CC), 18-02-2006, P. Lemmer 623 (PRE), Portion 198 (part of remainder of Portion 335), 25-03-2006, R.R. Kloppe, J. Nel & A. Nel 216 (PRE); Irene, Farm Doornkloof 391-JR, rocky ridges between Smutsoppie and M57, (–CC), 29-03-2005, A.E. van Wyk 13630 (PRU), 07-10-2005, A.E. van Wyk 13653 (PRU); Doornkloof 391-JR, (–CC), 31-01-2008, L. Mills s.n. (PRE); Erasmus, (–CC), 24-01-2008, L. Mills s.n. (PRE); Centurion, Irene, Century Hill, (–CC), 03-02-2009, J.J. Meyer 5168 (PRE); Centurion, Farm Rietvallei 377-JR, adjacent to Rietvlei Nature Reserve, close to where Olifantsfontein road crosses Sesmylspruit, (–CD), 26-02-2006, R.R. Kloppe & A.W. Kloppe 215 (PRE).

LIMPOPO.—2428 (Modimolle/Nylstroom): Waterberg Dist., Farm Leeuwpoot 573 KR, (–CB), 21-03-1980, N. Jacobsen 5209 (PRE), 08-04-1984, W.B. Jacobsen 5500 (PRE); Waterberg Dist., Farm Leeuwpoot 573 KR, (–CB), ± 20 km northwest of Modimolle (Nylstroom) on Lephale (Vaalwater) road, on ridge next to dam wall, 05-12-2009, R.R. Kloppe & A.W. Kloppe 255, 256 & 257 (PRE).

***Cheilanthes deltoidea* Kunze** in Linnaea 10: 535, 536 (1836) subsp. *deltoidea*. *Pellaea deltoidea* (Kunze) Baker: 146 (1867). *Allosorus deltoideus* (Kunze) Kuntze: 806 (1891). *Doryopteris deltoidea* (Kunze) Diels: 269 (1899). Type: Northern Cape, Namaqualand, Zilverfontein, J.F. Drège s.n. (LZ†, holo.; K, lecto.; B, BM, K!, islecto.), designated by Anthony (1984: 109).

Doryopteris deltoidea (Kunze) Diels var. *laxa* Sim: 217 (1915). Type: Northern Cape, Namaqualand, between O'Kiep and Nababeep, 1883, H. Bolus 9463 (PRE, holo.!, BOL!, K, iso.).

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REFERENCES

- ANTHONY, N.C. 1984. A revision of the southern African species of *Cheilanthes* Swartz and *Pellaea* Link. *Contributions from the Bolus Herbarium* 11: 1–293.
- BAKER, J.G. 1867. Tribe 6. Pterideae. In W.J. Hooker & J.G. Baker, *Synopsis Filicum* 4: 113–160. Hardwicke, London.
- BARKER, O.B., BRANDL, G., CALLAGHAN, C.C., ERIKSSON, P.G. & VAN DER NEUT, M. 2006. The Soutpansberg and Waterberg Groups and the Blouberg Formation. In M.R. Johnson, M.R. Anhaeusser & C.R. Thomas, *The geology of South Africa*: 301–318. Geological Society of South Africa / Council for Geoscience, Pretoria.
- BURROWS, J.E. 1990. *Southern African ferns and fern allies*. Frandsen Publishers, Sandton.
- DIELS, F.L.E. 1899. Polypodiaceae. In H.G.A. Engler & K.A.E. Prantl, *Die natürlichen Pflanzenfamilien* 1,4: 139–339. Engelmann, Leipzig.
- ERIKSSON, P.G., ALTERMANN, W. & HARTZER, F.J. 2006. The Transvaal Supergroup and its precursors. In M.R. Johnson, M.R. Anhaeusser & C.R. Thomas, *The geology of South Africa*: 237–260. Geological Society of South Africa / Council for Geoscience, Pretoria.
- JACOBSEN, W.B.G. 1983. *The ferns and fern allies of southern Africa*. Butterworths, Durban.
- JACOBSEN, W.B.G. & JACOBSEN, N.H.G. 1986. Adiantaceae: *Cheilanthes deltoidea* Kunze in the Waterberg, Transvaal. *Bothalia* 16: 41, 42.
- KLOPPER, R.R., LEMMER, P. & NEL, J. 2006. *Cheilanthes deltoidea*, a new locality in Gauteng, South Africa (Pteridophyta). *Bothalia* 36: 173, 174.
- KUNTZE, C.E.O. 1891. *Revisio generum plantarum* 2. Felix, Leipzig.
- KUNZE, G. 1836. *Plantarum acotyledonearum Africae australis recensio nova*. *Linnaea* 10: 480–570.

- MUCINA, L. & RUTHERFORD, M.C. (eds). 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- OBBES, A.M. 2000. *The structure, stratigraphy and sedimentology of the Black Reef–Malmani–Rooihogte succession of the Transvaal Supergroup southwest of Pretoria*. Bulletin 127. Council for Geoscience, Pretoria.
- SIM, T.R. 1915. *The ferns of South Africa*, edn 2. Cambridge University Press, Cambridge.
- VICTOR, J.E. & PFAB, M.F. 2009. *Cheilanthes deltoidea* subsp. nov. In D. Raimondo, L. von Staden, W. Foden, J.E. Victor, N.A. Helme, R.C. Turner, D.A. Kamundi & P.A. Manyama, Red List of South

African plants 2009. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

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The medical ethnobotany of Lesotho: a review

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Keywords: ethnobotany, Lesotho, magic, *materia medica*, medicine, traditional healers

ABSTRACT

Traditional healing in Lesotho is reviewed, focusing on four aspects: 1, cultural practices; 2, traditional health care practitioners; 3, dosage forms; 4, the *materia medica*. Cultural practices are strongly associated with the belief that intangible forces are responsible for human happiness and misery. A total of 303 plant species are used medicinally (including 25 alien species), representing eight pteridophyte and 75 angiosperm families, of which the most important are Asteraceae, Fabaceae, Hyacinthaceae, Apocynaceae, Scrophulariaceae, Lamiaceae and Poaceae. *Dicoma anomala* (used mainly for digestive ailments) and *Artemisia afra* (used mainly for respiratory ailments) appear to be the best known and most widely used medicinal plants amongst a total of 37 species that have been cited four or more times in the literature. About 50 species are variously employed for magic and sorcery. There are no new species records but 36 new uses are reported. Our conclusion is that the medicinal plants of Lesotho are relatively well recorded and that this review will allow detailed comparisons with other African healing cultures.

INTRODUCTION

Traditional healing has always been practised in Lesotho from time immemorial, but the concepts, practices and *materia medica* are not well known beyond the borders of the country and have not yet been systematically recorded. This paper is therefore aimed at providing a broad review of traditional medicine in Lesotho, focusing on cultural practices, traditional health care practitioners and especially the botanical identity, vernacular names, uses and dosage forms of the plants that are used.

There are three reasons why we are hesitant to call this a review of Sotho traditional medicine. Firstly, it is difficult to delimit the geographical boundaries of the Sotho culture, e.g. should North Sotho (Pedi)—excluded here—be included? Secondly, there are subtle linguistic differences, in terminology and plant names, for example between the Sesotho spoken in Lesotho and that which is spoken in other parts of southern Africa. Thirdly, the plant species used in Lesotho sometimes differ from the species found in other regions. However, even though this review is focused on Lesotho, the information probably has a much wider relevance and application than the boundaries of a single, small country.

Sources of information

The review is based on the experience and recollections of the first author and on the available literature. These experiences and recollections stem from early life (until 20 years ago) of the first author; many of these plants were used in her home and village in the rural areas of the Qacha's Nek District and later in the Maseru District in Lesotho. Further information regarding plant use was gathered through discussions and interviews with informants using Sesotho names of plants and in some cases with voucher specimens. The most comprehensive reference material is that of Phillips (1917)

but the list of plants is incomplete and many of the names are outdated. Jacot Guillarmod (1971) also gives an account of plant use but her main source was Phillips (1917). Other useful sources of information include Watt & Breyer-Brandwijk (1962), Motlamelle (1938), Schmitz (1982) and Maliehe (1997), of which the last three are out of print. The last-mentioned is limited to 60 species of useful plants in Lesotho. Some valuable information has also been published in early volumes of *Bantu studies* (Watt & Brandwijk 1927) and in lesser known publications such as Casalis (1861) and Ashton (1967). A comprehensive list of medicinal plants which includes the scientific names, author citations, vernacular names and main uses, is presented in the Appendix. Authorities for scientific names are not repeated in the text.

Cultural practices

Three important aspects, medicine (*moriana*, *litlhare*), magic (*lithlare*), and sorcery (*boloi*) play an important role in the Basotho culture.

Medicine (*moriana*, *litlhare*)

Many people in Lesotho, particularly those in rural areas with no clinics or health facilities, are able to diagnose and treat minor common ailments such as colds, coughs, headaches and constipation. This self-medication relies almost exclusively on medicinal plants. Headaches, for example, can simply be cured by inhaling smoke from a burning stick of *monkhoane* (*Heteromorpha aborescens*), stomach aches by chewing roots of a grass known as *hloko* (*Elionurus muticus*) (Motlamelle 1938). If there is no cure, a traditional healer is consulted. Women are traditionally experts in home remedies because they collect vegetables (*moroho*), many of which are also used for medicinal purposes. Historically however, most traditional healers are men. There are two main reasons for this: 1, there is a strong traditional belief that women should perform their duties at home, taking care of their families, including children and the elderly; 2, there are taboos around women handling strong medicines.

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If there was an epidemic in a village, the village doctor or chief's doctor (at the chief's expense), usually a diviner (*selaoli*) or herbalist (*ngaka-chitja*), would prepare a mixture (known as *leliba*) that would have to be taken by all the villagers.

Magic (*lithlare*)

Medicines are not only used to cure illnesses but are used for almost any situation, including those that occur when a need for help in controlling natural or social phenomena is perceived. This category includes plants that are used as Category 1, good luck charms, such as *molomo-monate* (*Lotononis eriantha* var. *obovata*) which is a very well-known plant used to 'make sure you are heard wherever you go' (e.g. litigants use it to strengthen their case.); Category 2 includes plants that are used as love philtres such as *Cymbopogon marginatus* which may be added to a man's bathing water while he calls out the name of the desired woman; Category 3 includes plants that are used as charms against lightning, thunderstorms and hailstorms such as *Phygelius aequalis* (*metsemi-matšo*) which is a renowned charm to protect crops from hail damage. The Basotho believe that good health is not only physical but also spiritual; therefore ancestral spirits (*balimo*) form an integral part of their lives. If a person experiences bad luck and misfortune, then this is most likely ascribed to the fact that they have neglected their ancestors and are therefore being punished.

Sorcery (*boloi*)

There is a strong belief in sorcery among the people of Lesotho, so much so that misfortune, accident, unusual illness, or even death may be attributed to it. Sorcerers are believed to use special or ordinary medicines maliciously. It was previously believed that they were even capable of and responsible for harming whole communities through disasters and epidemics (Ashton 1967). Therefore, it was (and still is) a socially unacceptable practice. Although killing alleged sorcerers was proclaimed illegal by King Moshoeshoe I in 1855 (Ashton 1967), people suspected of sorcery were often severely punished, sometimes even brutally tortured to death (Casalis 1861). This practice, however, appears to have discontinued in the last 50 years. Sorcery is believed to be driven either by jealousy (mostly) or by revenge. The effects of sorcery range from a minor injury or illness (such as diarrhoea or stomach ache believed to be due to worms, beetles or small snakes introduced into the patient's body, often from eating bewitched food), or more serious conditions such as convulsions (due to strangling by a familiar (a supernatural being), i.e. a *thokolosi*), or death by lightning. When sorcery is suspected, a diviner is consulted, who will then, as the first step, counteract the witchcraft by renewing all protective medicines. Sometimes the patient is taken and hidden away in another village. If nothing works, then people who believe themselves to be victims of sorcery have sometimes been driven to murdering the suspected sorcerer (Ashton 1967).

Traditional healthcare practitioners

Several types of traditional healthcare practitioners exist in Lesotho. These include: the diviner or bone

thrower (*ngaka, selaoli*), the herbalist (*ngaka chitja*), the seer (*senohe*), the veterinarian (*ngaka-ea-liphoofolo*), the sangoma (*lethuela, mokoma, leqekha*), the apprentice (*lehlahana*) and the charlatan (*ngakana-ka-hetla*). The Sesotho word *ngaka* is a generic term applied to any kind of healer or doctor, but some authors (e.g. Motlamele 1938) apply it exclusively to the diviner. Although traditional healers do not have any special status in society, the chief formerly had a doctor who occupied a socially high-ranking position next to him or her. These doctors associated with the chiefs were rainmakers (*seepa-meru*), diviners (*ngaka, selaoli*) and keepers of war medicine.

When consulting a healer, one is expected to pay an initial consultation fee (usually a sheep or goat) to 'open the bag of medicines'. In the case of a diviner, the fee is known as *pula-molomo*, which literally translated means 'one that opens (*bula*) the mouth (*molomo*)' [*pula* is the noun form of *bula*, not to be confused with *pula* (rain), which is written in the same way but pronounced differently]. *Pula-molomo* therefore has to be paid before the diviner will even speak. It is not customary to say 'thank you' when given medicine because this will weaken its strength. Final payment is done only if the treatment has worked.

Diviner (*Ngaka, Selaoli*)

The diviner uses bones (*litaola*) to help him make a diagnosis and discern the appropriate treatment. The diagnosis is based on the way in which the various bones land or fall on the ground, having been thrown by the person consulting. Diviners are expected to solve problems of any kind; they prescribe remedies for minor ailments, protection against sorcery, misfortune and accidents, and also for good luck and prosperity. 'There is, in fact, no manner of question which the diviners do not undertake to answer' (Casalis 1861). Traditionally, he is a striking figure and may be recognised by his headdress (*kuoane*), made from monkey skin and decorated with feathers, gall bladders and eagle's claws, a shoulder strap of horns (*lenaka*) from various beasts containing all kinds of powders and ointments (known as *mohlabelo*) and, a bag of divining bones (*khetsi*) consisting of varying pairs of bones from different animals (Ashton 1967).

Herbalist (*Ngaka-chitja*)

Traditional healers who rely only on plants are known in Sesotho as *ngaka-chitja* which means a hornless doctor, because they do not keep medicines in horns. They diagnose and treat minor ailments and, traditionally, if they are unable to cure the disease, they refer patients to a diviner. In recent times they are known also to refer patients to a clinic.

Seer (*Senohe*)

The seer is a person with the power of second sight, meaning that they divine supernaturally. This power is a skill that cannot be acquired but is believed to be a gift from the ancestors. A seer can diagnose illnesses and foretell the future. A special type of seer can locate (see) people who have drowned or have been swallowed by the water serpent, *khanyapa* or *noha-ea-metsi* (Ash-

ton 1967). Chief Mohlomi, a very well-known leader in Lesotho's history, who was an advisor, mentor, and doctor to the founder of the Basotho nation, King Moshoe-shoe I, was a seer by profession.

Veterinarian (*Ngaka-ea-liphoofolo*)

Historically, there were no doctors devoted entirely to animal illnesses; this was the job of diviners, herbalists or seers. However, the existence of veterinarians is now recognised. Animals such as cattle, Basotho ponies, sheep and goats play an important role in the Basotho culture. Cattle are symbolic in Lesotho, being used for *lobola* (*bohali*) and may also be slaughtered during burial rituals to accompany (*ho felehetsa*) deceased persons so they can rest in peace. In addition, cattle represent wealth. Many areas in Lesotho are still only accessible by horses and they therefore serve as a useful mode of transport. Sheep and goats are kept mainly for meat and wool. It is therefore imperative that all these animals are kept healthy. Veterinarians work in a similar manner as herbalists; they are able to diagnose and treat a wide range of animal diseases including gall sickness, 'black leg' and lung sickness.

Sangoma (*Lethuela, Mokoma, Leqekha*)

The concept of a sangoma is foreign to the Lesotho culture and it was introduced by the Thembus who originated from what was then known as the Cape Colony (Motlamentele 1938; Ashton 1967), perhaps currently the Eastern Cape Province. The language in which sangomas practise their craft points to the foreign origins of this tradition. Furthermore, sangomas are mostly women, whereas in Lesotho, healers were traditionally male only. When consulted, they diagnose problems using the divining method (in a similar manner as diviners, except that their bag of bones also includes sea shells and lately a set of dice) and prescribe medicines.

Apprentice (*Lehlahana*)

Diviners and herbalists learn their profession by becoming an apprentice (*lehlahana*) to a reputable healer. Among other duties, the *lehlahana* carries the teacher's bag, cooks the food, collects the fees, collects and prepares the medicines and performs techniques such as making incisions (*ho phatsa*) (Motlamentele 1938). Once qualified, the apprentice may establish his or her own practice, or on rare occasions he or she may inherit the master's horn. Other healers inherit prescriptions from their family members who are doctors.

Charlatan (*Ngakana-ka-hetla*)

While we disagree with Casalis' (1861) assertion that traditional healers are 'a crowd of clever and cunning men, who, under the generic name of *engakas*, or learned men, perform functions of priests, prophets, diviners, and doctors, and enrich themselves at the public expense', there are traditional healers who are charlatans. These are termed *ngakana-ka-hetla* (the verb *hetla* means to look over your shoulder) in Sesotho, a mocking word applied to people who claim to be healers but have not undergone proper training. As a result they have to keep looking over their shoulders to make sure they are not being followed by the patients whom they have cheated.

Dosage forms and methods of administering medicine

Medicinal plants are used in many different forms. They are taken as decoctions (mostly with water, rarely with milk) or infusions either orally (*ho noa*) or as an enema (*ho tšela*) for various internal ailments. Plants are also incinerated, powdered and used as a snuff (*ho tsuba*), often to induce sneezing to get rid of head and chest colds. Another form is inhalation of either smoke from a burning plant (another form of *ho tsuba*) or vapour from a freshly crushed plant or fresh leaves of *lengana* (*Artemisia afra*) or *koena* (*Mentha longifolia*) stuffed in the nostrils, as a cure for headaches and colds. Smoke can also be introduced into the body through fumigation (*ho futhela*). Boiling decoctions (generally of some *Helichrysum* species, *Artemisia afra* or *Mentha longifolia*) are used for steaming (*ho arubela*) to treat colds. Sometimes plants are also taken as mastics, although only a few plants are chewed raw (e.g. *Alepidea cordifolia* and *Elionurus muticus*). Other medicines are applied or rubbed into incisions/scarifications (*ho phatsa*) made on the body. These incisions are done for two reasons: 1, to protect people against sorcery or to counteract its effects, in which case several parts of the body (including forehead, cheeks, chin, neck, throat, breasts, and joints) are scarified and the medicine is rubbed in; or 2, as a cure for ailments such as headaches, whereby only the affected part is scarified. Other plants are used externally as lotions, mixed with fat to make ointments or applied as poultices (*ho thoba* or *ho tapisa*).

Materia medica

A checklist of medicinal plants used in Lesotho is presented in the Appendix. The list is arranged alphabetically according to family and genus. Several plant species used for magical purposes and during the divining process (e.g. for washing the divining bones) have also been included in the list. The botanical nomenclature in older publications has been updated to reflect currently accepted names, following Germishuizen & Meyer (2003).

The appendix reveals that 355 plant species (including 23 exotics), from eight pteridophyte and 76 angiosperm families, are used for various medicinal purposes in Lesotho. In terms of the number of medicinal species, the most important families are Asteraceae (76), Fabaceae (33), Hyacinthaceae (15), Apocynaceae (12), Scrophulariaceae (12), Lamiaceae (11) and Poaceae (11). It is also interesting to note that seven species of ferns are used medicinally—mostly used to treat headaches, either through smoking the leaves or inhaling smoke from smouldering leaves.

Some plants are age and gender specific, others are strictly for livestock, whereas others are used for both humans and animals. Several plants are used to treat children's ailments. From the Appendix, the following pattern of exclusive uses emerges: human (287 species), livestock (8 species), women (20 species), men (three species) and children (29 species). The medicinal plant uses can also be grouped on the basis of the ailment treated, such as problems relating to digestion (84 species), respiration (67 species), fertility and reproduc-

tion (31 species), circulation (26 species) and skin and wounds (24 species). Another important category is that of magic and sorcery; at least 50 species are used for this purpose. For the sake of brevity, a more detailed analysis is not given here, but the necessary data for more comprehensive analyses are available in the Appendix.

Interesting examples of specific uses include the following. Plants used exclusively for children include *Brachystelma foetidum* (colds), *Helichrysum ecklonis* (diarrhoea) and *Euphorbia clavarioides* (skin rashes). Numerous plants are used specifically by women for infertility (e.g. *Ajuga ophrydis*, *Equisetum ramosissimum* and *Haplocarpha scaposa*); menstrual pains (e.g. *Gunnera perpensa*, *Scabiosa columbaria*) or for ailments associated with pregnancy such as heartburn, flatulence and colic (e.g. *Anthospermum rigidum*, *Gazania linearis*, and *Convolvulus bidentatus*). Plants used to treat animals only include *Watsonia densiflora* (for diarrhoea in calves) and *Acrotome inflata* (for 'black leg' in cattle).

Based on the frequency of published and unpublished records (Appendix), it is possible to rank the species and in this way determine which ones are the best known and/or most frequently used. A total of 37 species in the Appendix have at least four citations for medicinal uses—and almost invariably the same number of citations for vernacular name(s). These 37 species may be considered as the most important and best known medicinal plants in Lesotho and are therefore shown in bold type in the Appendix. The number of citations for vernacular names and for uses were both considered and are given in Table 1.

It is interesting to note that the two most important medicinal plants in the *materia medica* of Lesotho are used also for the two most common everyday ailments, namely respiratory and digestive problems (*Artemisia afra* and *Dicoma anomala*). *Artemisia afra* (*lengana*) is most commonly used as a nasal plug but the leaves are also used as a decoction or for steaming. The plant is used as a traditional medicine in many parts of Africa, to treat various illnesses including colds, sore throat, headaches and intestinal worms, but should not be used

in high doses as it usually contains thujone, which is a central nervous system toxin (Van Wyk & Wink 2004). *Dicoma anomala* (*hloenya*: to grimace, because of the extremely bitter taste) is used for a wide range of illnesses including diarrhoea, toothache, hypertension, diabetes, period pains, pneumonia, backache, wounds and sores, and for gall sickness in cattle. In South Africa and Zimbabwe, it is used for similar digestive and respiratory ailments (Van Wyk & Gericke 2000).

Another plant ranking amongst the top in importance is *Pentania prunelloides*, appropriately named *setima-mollo* (fire extinguisher) in Sesotho for its use to relieve the burning pain of boils and reducing fevers. *Urtica urens* (*bobatsi*: something that is rough) is interestingly not indigenous to Lesotho but is also amongst the list of commonly used plants. Other important plants include *Gerbera pilloseloides* (*tsebe-ea-pela*: ear of the rock-rabbit), *Helichrysum caespitium* (*phate-ea-ngaka*: mat of the healer, because of the prostrate habit), *Mentha longifolium* (*koena*: crocodile, because of its association with aquatic environments), *Rhamnus prinoides* (*mofifi*: very dark, because of the dark green foliage), *Alepidea cordifolia* (*lesoko*), *Heteromorpha arborescens* (*monkhoane*), *Felicia muricata* (*'ma-mileng*: along the road), *Gerbera viridiflora* (*moarubetso*: the one used to fumigate), *Helichrysum odoratissimum* (*phefo*: breeze, allegedly because when burnt during harvesting it brings about a breeze that helps with winnowing), *Cotyledon orbiculata* (*serelile*: slippery), *Trifolium burchellianum* (*'musa-pelo*: the one who turns the heart around), *Gunnera perpensa* (*qobo*), *Olea europaea* (*mohloare*), *Hermannia depressa* (*seletjane*: a small axe), *Eucomis undulata* (*khapumpu*), *Bulbine narcissifolia* (*khomo-ea-balisana*: a cow of the shepherds), *Dianthus basuticus* (*hlokoana-la-tsel*: the grass of the road), *Mentha aquatica* (*koena-e-nyenyane*: the small crocodile), *Cussonia paniculata* (*motšetse*), *Gazania krebsiana* (*tsikitlane*), *Xysmalobium undulatum* (*poho-tšehla*: yellow bull) and *Tulbaghia acutiloba* (*sefottha-fottha*). The traditional use of *Mentha aquatica* and *M. longifolia* for respiratory problems can be ascribed to the presence of a volatile oil with possible decongestant effects (Van Wyk & Gericke 2000). *Xysmalobium undulatum* is used all over south-

TABLE 1.—No. times vernacular names cited and no. times uses cited for taxa

7, 7	6, 6	5, 5	5, 4	4, 4
<i>Artemisia afra</i>	<i>Gerbera pilloseloides</i>	<i>Alepidea cordifolia</i>	<i>Bulbine narcissifolia</i>	<i>Ajuga ophrydis</i>
<i>Dicoma anomala</i>	<i>Helichrysum caespitium</i>	<i>Cotyledon orbiculata</i>	<i>Dianthus basuticus</i>	<i>Albuca setose</i>
	<i>Mentha longifolium</i>	<i>Eucomis undulata</i>		<i>Aloe striatula</i>
	<i>Olea europaea</i>	<i>Gerbera viridiflora</i>		<i>Crassula peploides</i>
	<i>Rhamnus prinoides</i>	<i>Gunnera perpensa</i>		<i>Cussonia paniculata</i>
		<i>Helichrysum odoratissimum</i>		<i>Euclea crispa</i>
		<i>Hermannia depressa</i>		<i>Gazania krebsiana</i>
		<i>Heteromorpha arborescens</i>		<i>Gladiolus crassifolius</i>
		<i>Pentania prunelloides</i>		<i>Hibiscus microcarpus</i>
		<i>Trifolium burchellianum</i>		<i>Hypoxis argentea</i>
				<i>Mentha aquatica</i>
				<i>Scabiosa columbaria</i>
				<i>Stachys aethiopica</i>
				<i>Urtica urens</i>
				<i>Vernonia hirsuta</i>
				<i>Withania somnifera</i>

ern Africa for stomach problems and for a similar purpose in modern phytotherapy—it contains uzarin which has proven anti-diarrhoeal properties (Van Wyk & Wink 2004).

Although the meaning of some Sesotho plant names is not obvious, many of them are descriptive and indicate either the habit or the usage of the plant (Moteetee & Van Wyk 2006). For example, *Stapelia grandiflora* (*bohatsu*: numbness) is used to cure numbness of the limbs, *Asclepias aurea* (*mohlatsisa*; emetic) is used as an emetic to treat constipation, *Senecio erubescens* (*letapiso*; poultice) is used as a hot poultice, *Scabiosa columbaria* (*selomi*: one that causes pain or bites) is used to relieve period pains and *Gomphocarpus fruticosus* (*moithimolo*: one who causes sneezing) is used to cure headaches and colds by sneezing. Several plants known as '*musa-pelo*' are used as sedatives and adaptogens, for dropsy of the heart or heart palpitations. This concept has been dealt with in detail elsewhere (Moteetee & Van Wyk 2007).

Animal products are also used for medicinal purposes. Examples include cow dung (used to cure chickenpox), dog fur (placed on a dog-bite wound to speed up the healing process), a mixture of powdered mare's afterbirth and crocodile skin (to assist difficult childbirth; fumigation with smoke from crocodile skin is an alternative). Snake flesh mixed with *Linum thunbergii* (*bohloko*) is used to treat snakebite.

CONCLUSIONS

The most important plants that are used in Basotho traditional medicine and the main health care practitioners and their practices have been described and conceptualized for the first time. A total of 355 plant species are used, representing eight pteridophyte and 76 angiosperm families of which the Asteraceae, Fabaceae, Hyacinthaceae, Apocynaceae, Scrophulariaceae, Lamiaceae and Poaceae are the most important. The traditional system appears to be dynamic and adaptive, because at least 25 alien species have been incorporated into the *materia medica*.

Plants are used for a wide range of ailments, the most frequent indications being digestive ailments and respiratory conditions. *Dicoma anomala* (used mainly for digestive ailments) and *Artemisia afra* (used mainly for respiratory ailments) appear to be the best known and most widely used medicinal plants. Fifty-two species are variously employed for magic and sorcery. Other important medicinal species include *Gerbera pilloseloides*, *Helichrysum caespititium*, *Mentha longifolium*, *Rhamnus prinoides*, *Alepidea cordifolia*, *Heteromorpha arborescens*, *Felicia muricata*, *Gerbera viridiflora*, *Helichrysum odoratissimum*, *Cotyledon orbiculata*, *Trifolium burchellianum*, *Gunnera perpensa*, *Olea europaea*, *Pentanisia prunelloides*, *Hermannia depressa*, *Eucomis autumnalis*, *Bulbine narcissifolia* and *Dianthus basuticus*.

Although hitherto scattered in the literature, the medicinal plants of Lesotho seem to be relatively well recorded, as this review did not reveal any new species records. Detailed comparisons with other African heal-

ing cultures are now possible. The data suggest that the uses of the plants were not comprehensively recorded, as 36 new uses are reported. Field surveys in remote parts of Lesotho may reveal additional species and use records, but we believe that we have presented a reasonably comprehensive insight into the diversity of Lesotho medicinal plants and practice.

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REFERENCES

- ASHTON, H. 1967. *The Basuto, a social study of traditional and modern Lesotho*: 283–318. Oxford University Press, London.
- BRENDLER, T. & VAN WYK, B-E. 2008. A historical, scientific and commercial perspective on the medicinal use of *Pelargonium sidoides* (Geraniaceae). *Journal of Ethnopharmacology* 119: 420–433.
- CASALIS, E. 1861. *The Basutos; twenty-three years in South Africa*: 1–355. Nosbert, London.
- GERMISHUIZEN, G. & MEYER, N.L. 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. 2006. *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41. SABONET, Pretoria.
- HUTCHINGS, A. & VAN STADEN, J. 1994. Plants used for stress-related ailments in traditional Zulu, Xhosa and Sotho medicine. Part 1: plants used for headaches. *Journal of Ethnopharmacology* 43: 89–124.
- JACOT GUILLARMOD, A. 1971. *Flora of Lesotho*. Cramer, Lehre.
- MALIEHE, E.B. 1997. *Medicinal plants and herbs of Lesotho*. Mafeteng Development Project, Lesotho.
- MOTEETEE, A. & VAN WYK, B-E. 2006. Sesotho names for exotic and indigenous edible plants in southern Africa. *Bothalia* 36: 25–32.
- MOTEETEE, A. & VAN WYK, B-E. 2007. The concept of '*musa-pelo*' and the medicinal use of shrubby legumes (Fabaceae) in Lesotho. *Bothalia* 37: 75–77.
- MOTLAMELLE, M.P. 1938. *Ngaka ea Mosotho*. Morija Printing Works, Lesotho.
- PHILLIPS, E.P. 1917. A contribution to the flora of the Leribe Plateau and environs. *Annals of the South African Museum* 16: 1–379.
- SCHMITZ, M.O. 1982. *Wild flowers of Lesotho*. ESSA, Roma, Lesotho.
- SHALE, T.L., STIRK, W.A. & VAN STADEN, J. 1999. Screening of medicinal plants used in Lesotho for anti-bacterial and anti-inflammatory activity. *Journal of Ethnopharmacology* 67: 347–354.
- VAN WYK, B-E. & GERICKE, N. 2000. *People's plants: a guide to useful plants of southern Africa*. Briza Publications, Pretoria.
- VAN WYK, B-E. & WINK, M. 2004. *Medicinal plants of the world*. Briza Publications, Pretoria.
- WATT, J.M. & BRANDWIJK, M.G. 1927. Suto (Basuto) medicines. *Bantu Studies* 3: 73–100, 154–178, 296–319.
- WATT, J.M. & BREYER-BRANDWIJK, M.G. 1962. *The medicinal and poisonous plants of southern and eastern Africa*. Livingstone, Edinburgh.

APPENDIX.—List of Lesotho medicinal plants; their vernacular names in Sesotho; parts used; main uses and references. Most important species are in bold type

Species (naturalized alien species are marked with an asterisk*; best-known species are given in bold)	Common names and references	Main uses and references (uses given in bold are newly recorded; where known, plant parts used have been included)
PTERIDOPHYTES		
Aspleniaceae		
<i>Asplenium monanthes</i> L.	<i>lehōrōmetso</i> [JG; O; P]	leaves smoked for head and chest colds [H & V; W & B2]
<i>trichomanes</i> L. subsp. <i>quadrivalens</i> D.E.Mey. emended <i>Lovis</i>	<i>lehōrōmetso</i> [H & V; JG; O]	same as above [H & V; W & B2]
Dryopteridaceae		
<i>Polystichum pungens</i> (Kaulf.) C.Presl	<i>lehōrōmetso</i> [JG; O; P]	decoction from rhizomes used as a vermifuge in humans and for 'bots' in horses; given as an enema [JG; P]
Equisetaceae		
<i>Equisetum ramosissimum</i> Desf.	<i>mohlaka-photoane</i> [JG; P]	decoction of cooked rhizomes drunk for infertility in women; colds and colic in infants [JG; P]; charm to drive away worms from fields [JG]
Lycopodiaceae		
<i>Lycopodium clavatum</i> L.	<i>boriba-bo-boholo/ moriri-oa-matlapa</i> [JG; O]	leaves dried and smoked for colds in the head and chest [JG]
Ophioglossaceae		
<i>Ophioglossum vulgatum</i> L.	<i>tsejananyana</i> [JG; O; P]	warm decoction of rhizomes to bathe boils [JG; P]
Pteridaceae		
<i>Adiantum capillus-venenis</i> L.	<i>lehōrōmetso/ lepata-maao</i> [JG; O; P]	dried leaves burnt and smoked for head and chest colds [H & V; JG]
<i>Cheilanthes eckloniana</i> (Kuntze) Mett.	<i>lehōrōmetso</i> [H & V; JG; O]	leaves smoked for head and chest colds [H & V; W & B2]
<i>hirta</i> Sw.	<i>mahuoeneng</i> [JG; O; P]	decoction of plant drunk for colds and sore throat [JG; P; W & B]
<i>involuta</i> (Sw.) Schelpe & N.C.Anthony var. <i>obscura</i> (N.C.Anthony) N.C.Anthony	<i>lehōrōmetso / mahuoeneng</i> [JG; O]	burnt leaves smoked for head and chest colds [H & V; O; W & B2]
<i>quadrinipinnata</i> (Forssk.) Kuhn	<i>lehōrōmetso</i> [JG; O]	crushed rhizome is mixed with milk and drunk for diarrhoea and cure for spider bites [JG]
<i>Pellaea calomelanos</i> (Sw.) Link. var. <i>calomelanos</i>	same as above [JG; O; P]	decoction from cooked, crushed rhizomes used to get rid of afterbirth in cows; colds [JG]
<i>Pteris cretica</i> L.	<i>lehōrōmetso / lesira</i> [JG; P]	whole plant crushed as protective charm for warriors [JG; P]
Selaginellaceae		
<i>Selaginella cafferonum</i> (Milde.) Hieron.	<i>moriri-oa-mafika</i> [JG; O]	whole plant dried and smoked with <i>Lycopodium clavatum</i> to cure head and chest colds [H & V; JG; O]
Woodsieaceae		
<i>Cystopteris fragilis</i> Bernh.	<i>lehōrōmetso</i> [JG; O; P]	decoction from rhizomes given as an enema for de-worming (mixed with other plants); constipation [JG; P]
DICOTYLEDONS		
Acanthaceae		
<i>Blepharis espinosa</i> E.Phillips	<i>mohlalalane</i> [JG; P]	infusion made from whole plant to cure colds [JG; P]
<i>Crabbea hirsuta</i> Harv.	<i>letsoejana</i> [P]	in conjunction with divining bones [P]
Achariaceae		
<i>Kiggelaria africana</i> L.	<i>lekharisi</i> [P]	as protective charm [O; P]

B & V. Brendler & Van Wyk (2008); H & V. Hutchings & Van Staden (1994); JG, Jacot Guillaumod (1971); M1, Maliehe (1997); M & V. Moteete & Van Wyk (2007); M2, Motlamele (1938); O, own experience of first author; P, Phillips (1917); S, Schmitz (1982); S *et al.*, Shale, Stirk & Van Staaden (1999); W & B1, Watt & Brandwijk (1927); W & B2, Watt & Breyer-Brandwijk (1962).

APPENDIX.—List of Lesotho medicinal plants; their vernacular names in Sesotho; parts used; main uses and references. Most important species are in bold type (cont.)

Species (naturalized alien species are marked with an asterisk*; best-known species are given in bold)	Common names and references	Main uses and references (uses given in bold are newly recorded; where known, plant parts used have been included)
Amaranthaceae <i>Amaranthus thunbergii</i> Moq. <i>Cyathula uncinulata</i> (Schrad.) Schinz	<i>thepe</i> [JG; M1; O] / <i>thepe-ea-Lesotho</i> [JG] <i>bohomo-bo-bohola</i> / <i>bohomo-ba-lipoli</i> [JG; O]	leaf infusion drunk to cleanse blood [M1; O]; vermifuge [O] decoction from boiling roots drunk for treatment of stricture of the urethra; emetic for excess bile; unguent [JG; W & B2]
Anacardiaceae <i>Searsia</i> <i>divaricata</i> (Eckl. & Zeyh.) Moffett <i>erosa</i> (Thunb.) Moffett <i>lancea</i> (L.f.) F.A.Barkley	<i>kolitsane</i> [JG; M1; O] <i>tšilabele</i> [JG; O; P] <i>tšilabele</i> [JG; M1; O]	cooked roots used for excessive bile; kidney and bladder problems; backache; mixed with <i>Aloe striatula</i> for constipation [M1]; dried leaves smoked to cure coughs and colds [JG; O]; pegs from stems for rainmaking [O; P] diarrhoea in humans and cattle [JG; P]; pegs from stems for rainmaking [O; P] cures dizziness due to anaemia; diabetes; heart problems [M1]; leaf infusion for asthma [O]
Apiaceae <i>Alepiea</i> <i>cordifolia</i> B.-E. van Wyk (previously included in <i>amatymbica</i> Eckl. & Zeyh.) <i>pilifera</i> Weim. <i>setifera</i> N.E.Br. <i>Berula erecta</i> (Huds.) Coville subsp. <i>thunbergii</i> (DC.) B.L.Burtt <i>Conium chaerophylloides</i> Thunb. Heteromorpha arborescens Cham. & Schltdl. var. <i>abyssinica</i> (A.Rich.) H. Wolff var. <i>arborescens</i> <i>Pimpinella caffra</i> (Eckl. & Zeyh.) D.Dietr.	<i>lesoko</i> [JG; M1; O; P; S] <i>lesokoana</i> [JG; O; P] <i>lesokoana</i> [JG; O; P] <i>lehlatso</i> [JG; O; P] <i>lefokololi</i> [JG; O; P] <i>monkhoane</i> [JG; O] <i>monkhoane</i> [H & V; JG; M2; O; P] <i>sehoetjana</i> [JG; P]	raw roots chewed or decoction drunk for chest pains; coughs and fever [JG; M1; O; P; S]; painful joints [M1]; lotion used to wash divining bones [JG] roots chewed or decoction drunk for chest pains; coughs and fever [JG; O; P]; smoke from incinerated root inhaled for headaches [W & B1] small pieces of plant boiled to wash a person suffering from headache [JG; P] prepared lotion from plant to wash feverish patients [JG; P] medicine from leaves given to children for intestinal worms [JG]; charm for lightning [JG] and loyalty to the chief [JG; P] asthma [JG; P]; smoke inhaled from burning plant for headaches [H & V; JG; M2; O] charm against illness or mischievous spirit [JG; P]
Apocynaceae <i>Asclepias</i> <i>aurea</i> (Schltr.) Schltr. <i>humilis</i> (E.Mey.) Schltr. <i>stellifera</i> Schltr. <i>Brachystelma foetidum</i> Schltr. <i>Gomphocarpus fruticosus</i> (L.) Aiton f. subsp. <i>decipiens</i> (N.E.Br.) Goyder & Nicholas subsp. <i>fruticosus</i> <i>Pachycarpus rigidus</i> E.Mey. <i>Parapodium costatum</i> E.Mey. <i>Raphionacme hirsuta</i> (E.Mey.) R.A.Dyer ex E. Phillips <i>Stapelia grandiflora</i> Masson <i>Xysmalobium</i> <i>parviflorum</i> Harv. ex Scott-Elliott <i>undulatum</i> (L.) Aiton f. var. <i>undulatum</i>	<i>mohlatsisa</i> [JG; O; P] <i>lehlomane</i> [M1; O] <i>mohlatsisa/ montsokoane</i> [O; W & B1]/ <i>mohola-ntja</i> [JG] <i>seru</i> [JG; P] <i>moithimolo-aa-thaba</i> [JG; O; P] <i>moithimolo/ lebejane</i> [JG; M1; O] <i>phōma-metsu/ leshokhoana / poho-tšehla</i> [JG; O; P] <i>sehamela-poli</i> [JG; O; P] <i>kherenchane</i> [JG; P] <i>bohatsu</i> [JG; O; P] <i>leoto-la-khofo</i> [JG; O; P] <i>poho-tšehla/ leshokhoa</i> [JG; M1; O; P]	leaves chewed raw or infused as emetic for constipation [JG; O; P] in weak concentrations leaf infusion for diarrhoea in children and in animals [M1; O] emetic [O]; snake-bite; non-fatal lightning stroke [W & B1] for colds in children [JG; P] for sore breasts [JG; P]; snuff from burnt crushed whole plant smoked for head and chest colds [H & V; JG; O; P] crushed, burned plant sniffed for head colds [H & V; JG]; sap from leaves inserted into nostrils as decongestant; headaches [JG; M1; O]; in small doses for excess bile; asthma [JG] for stomach cramps [JG; P; S <i>et al.</i>]; powdered roots for headaches; decoction taken for colds [S <i>et al.</i>] dried roots as protective charm against bad omens [O] for internal tumours [JG; P] hot infusion of whole plant used for numbness of limbs [JG; O; P] drunk for colic [JG; O; P] heartburn; vermifuge in children; decongestant; powdered roots for headaches [M1; O]

B & V. Brendler & Van Wyk (2008); H & V. Hutchings & Van Staden (1994); JG, Jacot Guillard (1971); M1, Maliehe (1997); M & V. Moteete & Van Wyk (2007); M2, Motlamele (1938); O, own experience of first author; P, Phillips (1917); S, Schmitz (1982); S *et al.*, Shale, Stirk & Van Staaden (1999); W & B1, Watt & Brandwijk (1927); W & B2, Watt & Breyer-Brandwijk (1962).

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Aquifoliaceae <i>Ilex mitis</i> (L.) Radlk. var. <i>mitis</i>	<i>mollo-oa-phofu</i> [JG; P]	enema for colic in children; when working divining bones [P]
Araliaceae <i>Cussonia paniculata</i> Eckl. & Zeyh. subsp. <i>sinuata</i> (Reyneke & Kok) De Winter	<i>motšatse</i> [JG; M1; O; P]	emetic; kidneys and bladder; boils; intestinal ulcers; indigestion; heartburn [JG; M1; O; P]
Asteraceae <i>Artemisia afra</i> Jacq. ex Willd	<i>lengana</i> [H & V; JG; M1; O; P; S; W & B1] <i>phōa</i> [JG] <i>moroko-hloko</i> <i>pheshoana-e-nyenyane</i> [JG; P] <i>pheshoana-aa-basieal tee</i> [JG; O] <i>sephomolo</i> [JG; O; P]	leaf decoction for flu; colds; fever; coughs; decongestant [H & V; JG; M1; O; P; S]; stomach ailments; enema given to children with constipation [JG; O; P; S]; leaf infusion inserted into ears for earache [W & B1]; leaf infusion for toothache [O] boiled roots mixed with <i>Helichrysum callicomum</i> and <i>H. rugulosum</i> are given as enema for colic; mixed with <i>Scabiosa columbaria</i> for scab in humans; mixed with <i>Lotononis lanceolata</i> to treat fevers; contagious diseases and anthrax [JG]; for syphilis [JG; S <i>et al.</i>]; headaches [S <i>et al.</i>] infusion of whole plant used for wounds and sores [S <i>et al.</i>]
<i>Aster bakerianus</i> Burt Davy ex C.A.Sm.		decoction of whole plant inserted in incisions made on sore feet [JG; P] same as above [JG; P]; charm against any illness [JG] decoction from leaves as purgative; sometimes as enema [W & B1]
<i>Aster</i> sp. <i>Athrixia</i> <i>angustissima</i> DC. <i>elata</i> Sond. <i>phylicoides</i> DC. <i>Berkheya</i> <i>cirsifolia</i> (DC.) Roessler <i>montana</i> Wood & Evans <i>onopordifolia</i> (DC.) O.Hoffm. ex Burt Davy var. <i>onopordifolia</i> DC. <i>setifera</i> DC. <i>Cineraria</i> <i>aspera</i> Thunb. <i>lyratiformis</i> Cron * <i>Conyza</i> * <i>bonariensis</i> (L.) Cronquist * <i>canadensis</i> (L.) Cronquist <i>obscura</i> DC. <i>podocephala</i> DC. <i>Cotula anthemoides</i> L. <i>Dicoma anomala</i> Sond. subsp. <i>anomala</i>	<i>mohatollo</i> [M1] <i>mohatollo</i> [JG; P] <i>mohato</i> [JG; P] <i>leleme-la-khomo</i> [JG; M1; O] <i>moholu-aa-pela</i> [JG; O; P] <i>moholu-aa-pela khotolia</i> [JG; O; P] <i>mokoteli lehamonyane</i> [JG; O; P] <i>mokoteli</i> [JG; O; P] / <i>lehamo</i> [JG; P] <i>phefo-aa-meru</i> [JG; P] <i>manku-e-moholo</i> [JG; O; P] <i>hlapi-e-nyenyane</i> [JG; P] <i>hloenya</i> [H & V; JG; M1; O; P; S] <i>sehalathala-sa-matlaka</i> [JG; O; P] <i>sehlakoana</i> [H & V; JG; P] <i>'ma-mileng/ mohantsokane</i> [H & V; JG; O; P; W & B1] <i>tsikitlane</i> [JG; M1; O; P]	cleanses liver and bladder [M1] lotion made from roots for bruises [JG; P] for fever; and in the past, mixed with <i>Euphorbia clavarioides</i> , was used for leprosy [JG; P] root decoction for kidney problems; circulatory problems; arthritis [M1]; abdominal pains [O; S] leaves smoked for asthma and tuberculosis [H & V; JG; P] leaves burnt and smoked for colds [H & V; W & B1; W & B2] decoction of leaves for sore throat; lotion to wash sick children; ringworm [JG; P] same as above [JG; P] decoction of roots for fever; fumigant [JG; P] decoction of roots given to feverish people [JG; O; P] decoction of leaves and roots for colic [JG; P] infusion of roots taken for colic [JG; P]; diarrhoea [JG; M1; O; S <i>et al.</i>]; constipation and flatulency [JG; M1; O]; heartburn [M1; O]; mixed with <i>Berkheya setifera</i> for bilious attacks [W & B1]; powdered flowers as ointment for wounds and sores [JG; M1; O; S; S <i>et al.</i> ; W & B1]; toothache [JG; P]; mixed with <i>Scabiosa columbaria</i> for period pains [JG; O]; backache; diabetes [M1]; as a snuff for nasal congestion [S]; mixed with <i>Helichrysum caespitium</i> ; <i>Scabiosa columbaria</i> and <i>Zantedeschia albomaculata</i> to treat venereal diseases [M1; O; W & B1]; mixed with <i>Cymbopogon</i> spp. for gall sickness [JG; S]; vermifuge [M1; O; S] whole plant to fumigate the hut of person suffering with a cold or diarrhoea [JG; P]; leaf decoction as aperient ; diabetes and high blood pressure [O] stems burnt and smoked for headaches [H & V; JG; P; W & B2] plant is crushed and inhaled for headaches [H & V; JG; P; W & B1; W & B2]; given to ill cows after calving [P]
<i>Eriocephalus punctulatus</i> DC. <i>Euryops evansii</i> Schltr. <i>Felicia muricata</i> Nees, subsp. <i>muricata</i> Gazania <i>krebsiana</i> Less, subsp. <i>serrulata</i> (DC.) Roessler		crushed root as anti-emetic in children; flatulency [M1; O]; heartburn; crushed plant mixed with water for earache [JG; O]; hot decoction for toothache [JG; P]

B & V, Brendler & Van Wyk (2008); H & V, Hutchings & Van Staden (1994); JG, Jacot Guillaumod (1971); M1, Maliehe (1997); M & V, Moreeete & Van Wyk (2007); M2, Motlamele (1938); O, own experience of first author; P, Phillips (1917); S, Schmitz (1982); S *et al.*, Shale, Stirk & Van Staaden (1999); W & B1, Watt & Brandwijk (1927); W & B2, Watt & Breyer-Brandwijk (1962).

APPENDIX.—List of Lesotho medicinal plants; their vernacular names in Sesotho; parts used; main uses and references. Most important species are in bold type (cont.)

Species (naturalized alien species are marked with an asterisk*; best-known species are given in bold)	Common names and references	Main uses and references (uses given in bold are newly recorded; where known, plant parts used have been included)
Asteraceae (cont.)		
Gazania (cont.)		
linearis (<i>Thunb.</i>) <i>Druce</i> var. linearis	<i>tsikilitane</i> [JG; M1; O; P]	root as a purgative for pregnant women; infertility in women; diarrhoea; general abdominal problems [JG; W & B1]; crushed whole plant mixed with water to treat earache [JG]
Gerbera		
ambigua (<i>Cass.</i>) <i>Sch.Bip.</i>	<i>seboka</i> [M1; O; S]	crushed whole plant as vermifuge; anti-emetic; heartburn in children [M1; O; S]; aperient in children [M1]; root infusion given to pregnant women [O]
piloselloides (<i>L.</i>) <i>Cass.</i>	<i>isebe-ea-pela</i> [H & V; JG; O; P; W & B2]	decoction of roots for earache [W & B2]; as fumigant to clear head colds [H & V; JG; P]; decongestant for colds [S]; tuberculosis; purgative [JG]; root decoction as emetic for excess bile [O]
viridifolia (<i>DC.</i>) <i>Sch.Bip.</i>	<i>moarribetso</i> [H & V; JG; O; P; W & B2]	smoke from burning whole plant inhaled as a decongestant; burnt as fumigant to clear head colds [H & V; JG; P; O; W & B2]; gall sickness [JG; P]
Haplocarpha scaposa <i>Harv.</i>	<i>khutsana</i> [JG; P; S]/ <i>papetloana</i> [JG; O; P; S]	cold in the chest; period pains; infertility in women [S]; decoction to treat internal sores and sore eyes [S <i>et al.</i>]; when working divining bones [JG; P]
Helichrysum		
adenocarpum <i>DC.</i> subsp. adenocarpum	<i>toane-balingoana</i> [JG; O; P]	decoction of roots for diarrhoea; anti-emetic in children [JG; O; P]
athrixifolium (<i>Kuntze</i>) <i>Moeser</i>	<i>motoangoang-o-monyane</i> [JG; P]	leaves smoked for chest pains [JG; P]
aureum (<i>Houtt.</i>) <i>Merr.</i> var. monocephalum <i>Hilliard</i>	<i>leabane</i> [JG; P; S]	lotion from leaves for sore eyes [JG; P; S]
caespitium (<i>DC.</i>) <i>Harv.</i>	<i>phate-ea-ngaka</i> [M1; O; S]/ <i>selelu-sa-phooko</i> [JG; P]/ <i>moriti-aa-naha</i> [H & V; JG; P]	smoke from crushed, burnt plant inhaled for chest and head colds [H & V; JG; M1; O; P; S]; increases iron in the blood [M1]; vermifuge; leaf infusion for coughs [M1; O]; anti-emetic [JG; P; S]; improves virility in men [JG; M1; S]
cooperi <i>Harv.</i>	<i>phefo-ea-thaba</i> / <i>toane-balimo</i> [S]	powdered roots for snakebite [S]
dregeanum <i>Sond.</i> & <i>Harv.</i>	<i>toane-ea-thaba</i> [H & V; JG; O; P]	smoke from leaves inhaled for head colds [H & V; JG; O; P]
ecklonis <i>Sond.</i>	<i>tōane-balingoana-e-kholo</i> [JG; O; P]	root decoction for diarrhoea in children [JG; O; P]
mundtii <i>Harv.</i>	<i>phefo-ea-litiba</i> [O; P]	decoction of whole plant for chest complaints [JG; O; P]
nudifolium (<i>L.</i>) <i>Less</i> var. nudifolium	<i>phefshoana-ea-basiea</i> [JG; O; P]	leaves as poultice for swelling; enema from leaves for colic in children; hot decoction for fevers; 'black leg' in cattle [JG; P; W & B1]
odoratissimum (<i>L.</i>) <i>Sweet</i>	<i>phefo</i> [JG; M1; O; P; S]	whole plant burnt as fumigant for flu; coughs and colds [JG; M1; O; P; S]; mixed with <i>Olea europaea</i> and <i>Zantedeschia albomaculata</i> for backache [M1]; unguent; burnt in the fields to call upon a light breeze to assist in winnowing of grain [JG]; emetic for excess bile [O]
pallidum <i>DC.</i>	<i>boleba</i> [JG; P]	charm to make person invisible or forgotten by enemies [JG; P]
platypterum <i>DC.</i>	<i>papetloana-ea-mafika</i> [JG; P]	decoction of roots for virility in men [JG; P]
psilolepis <i>Harv.</i>	<i>toane-khomo</i> [JG; P]	decoction of roots for period pains [JG; P]
rugulosum <i>Less.</i>	<i>motoangoanyane-o-moholo</i> [JG; P]	whole plant burnt to fumigate sick room of children with colds [JG; P]
setosum <i>Harv.</i>	<i>phefo-ea-thaba</i> [JG; O; P]	fumigant for colds [JG; O; P]; snakebite [JG; P]
sutherlandii <i>Harv.</i>	<i>phefo-ea-maloti</i> [JG; O; P]	root decoction drunk to treat rheumatism [JG; O; P]
tenax <i>M.D.Hend.</i> var. <i>tenax</i>	<i>molepeli</i> [JG; P]	powder of incinerated plant is placed in incisions made on the body of sick person [JG; P]
<i>Metalsia densa</i> (<i>Lam.</i>) <i>P.O.Karis</i>	<i>leabane</i> [P]	a decoction of whole plant to wash sore eyes [P]
Nidorella resedifolia <i>DC.</i> subsp. resedifolia	<i>sehalahala-se-seputsoa/ tee</i> [JG; O; P; S]	infusion of leaves and young branches drunk as herbal tea; as fumigant during illness [JG; S]
Nolletia ciliaris (<i>DC.</i>) <i>Stietz</i>	<i>mokoteli-o-mosehla</i> [JG; P]	fumigant for feverish children [JG; P]
Othona natalensis <i>Sch.Bip.</i>	<i>molola/ sekitlela</i> [JG; O; P]	leaves smoked for chest and head colds [JG; O; P]
Pentzia cooperi <i>Harv.</i>	<i>naka/ phela</i> [JG; P]	root decoction as vermifuge in calves [JG; P]
Printzia pyrifolia <i>Less.</i>	<i>lebaila</i> [S]	infusion of all parts for chest complaints [S]
Pseudognaphalium	<i>sephomōlo</i> [JG; P]	enema for internal tumours; in small quantities as a purgative [JG; P]
luteo-album (<i>L.</i>) <i>Hilliard & B.L.Burt</i>	<i>phefo</i> [JG; O; P]	whole plant burnt in a sick room of feverish child [JG; P]
undulatum (<i>L.</i>) <i>Hilliard & B.L.Burt</i>	<i>mosuane/ manka</i> [JG; O; P]	same as above [JG; P]
Schistostephium crataegifolium (<i>DC.</i>) <i>Fenzl. ex Harv.</i>	<i>leqipi/ lehakanya</i> [JG; P]	leaves smoked for chest complaints; lotion from roots for sore eyes; emetic in cases of excess bile [JG; P]
*Schkuhria pinnata (<i>Lam.</i>) <i>Cabrera</i>	<i>letapiso/sehalikane</i> [JG]	infusion drunk for stomach aches [S <i>et al.</i>]

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Asteraceae (cont.) Senecio <i>albanensis</i> DC. var. <i>doroniciflorus</i> (DC.) Harv. <i>asperulus</i> DC. <i>brachypodus</i> DC. <i>coronatus</i> (Thunb.) Harv. <i>discodegeanus</i> Hilliard & B.L.Burtt <i>erubescens</i> Aiton var. <i>crepidifolius</i> DC. <i>macrocephalus</i> DC. <i>macrosperrus</i> DC. <i>othonniflorus</i> DC. <i>rhynchoalaenus</i> DC. sp. <i>tanacetopsis</i> Hilliard <i>Sonchus dregaeus</i> DC. <i>Tarzonanthus camphoratus</i> L. <i>Troglodyton capillaceum</i> (Thunb.) Hilliard & B.L.Burtt subsp. <i>diffusum</i> (DC.) Hilliard <i>Ursinia nana</i> DC. subsp. <i>nana</i> <i>Vernonia</i> <i>capensis</i> (Houtt.) Druce <i>hirsuta</i> (DC.) Sch.Bip. ex Walp. * <i>oligocephala</i> (DC.) Sch.Bip. ex Walp. * <i>Xanthium spinosum</i> L.	<i>lehlomanyane</i> [JG; P] <i>moferefe</i> [M1; O; P] / <i>letapisoana</i> [JG; P] <i>lephōkō</i> [JG; P] <i>motabo/lehlomanyane</i> [JG; P] <i>lehlomanyane-le-lenenyane</i> [JG; P] <i>letapiso</i> [JG; O; P] <i>sebea-mollo</i> [JG; P] <i>poli-tšohana</i> [JG; P] <i>lehlomanyane</i> [JG; P] <i>mahuoaneng</i> [JG; O; P] <i>moholu-oo-pela</i> [JG] <i>mosuoane-oo-matlapa</i> [JG; P] <i>teharasoana</i> [M1; O] <i>mofahlana</i> [H & V; JG; P] <i>mosuoane-oo-lehaha</i> [JG; P] <i>mokubetso</i> [JG; O; P; S] <i>mofefa-bana</i> [S] <i>mofefa-bana/ phefo-e-kholo</i> [JG; O; P; S] <i>mofefa-bana</i> [M1; O; S] <i>hlaba-hlabane</i> [JG; P] / <i>mokoala</i> [JG; P]	prepared roots taken for colic [JG; P] steam from boiling decoction of whole plant for colds and flu [O; S]; sore throat; mouth ulcers; improves blood circulation; mixed with <i>Mentha</i> spp. and <i>Helichrysum odoratissimum</i> to treat sore joints [M; O] leaf infusion taken for colds and chest complaints [JG; P] in strong doses as an emetic; for treatment of difficult childbirth; intestinal complaints [JG; P] as an emetic to cure colds [JG; P] decoction of roots as cure for nausea and rheumatic fever [JG; P] to cure colic [JG; P] charm to make warriors invisible to enemies [JG; P] as an emetic [JG; P] smoke from burned plant inhaled or leaves smoked for colds [H & V; JG; O; P]; decoction of roots drunk for colic; ash from burned plant inserted in incisions made on sore hands and feet [JG; P] infusion of whole plant for sore throats and mouth ulcers; hot decoction for rheumatism of joints [S <i>et al.</i>] leaves smoked to stop bleeding [JG; P] lotion from leaves for rash in children [M1; O] smoke from crushed branches inhaled for headaches [H & V; JG; P] chest pains in children [JG; P] mixed with fat; burnt plant used as ointment for wounds [JG; O; P; S] infusion of roots for stomach disorders [S] same as above [JG; O; P; S]; to divert a hailstorm [P] same as above [M1; O; S] decoction of whole plants for syphilis [P; S <i>et al.</i>] and gonorrhoea [S <i>et al.</i>] decoction of whole plant for colic in children [JG; O; P] decoction of whole plant for colic in children [JG; O; P] decoction of whole plant for colic in children; hysteria and neurasthenia; unguent for newly married couples; good luck charm; love charm; during initiation of apprentices to improve their memory [JG; O; P] auscultation for chest complaints [P]
Brassicaceae <i>Heliophila carnos</i> (Thunb.) Steud.	<i>semameloana/ tlakofiloane-e-kholo</i> [P]	leaves for constipation; anti-emetic; improves digestion [O; P]; nausea [S]; leaf infusion for excess bile in animals [O]
Buddlejaceae <i>Buddleja salviifolia</i> (L.) Lam.	<i>lelothoane</i> [O; P; S]	whole plant for intestinal ulcers [JG] roots to treat bad syphilitic sores [W & B1; P] love charm; especially for wives of polygamists [JG; P] love charm for young courting men [P]
Campanulaceae <i>Wahlenbergia</i> <i>androsacea</i> DC. <i>banksiana</i> DC. <i>denticulata</i> (Burch.) A.DC. <i>depressa</i> J.M.Wood & M.S.Evans	<i>tenane</i> [JG; O] <i>moopetsane</i> [W & B1; P] <i>bolao</i> [JG; P] <i>bolaoane</i> [P]	leaves for constipation; anti-emetic; improves digestion [O; P]; nausea [S]; leaf infusion for excess bile in animals [O]

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Cannabaceae <i>*Cannabis sativa</i> L. var. <i>sativa</i>	<i>matekoane</i> [JG; M1; O; P]	asthma; anti-emetic in TB and AIDS patients; heart problems; cancer [M1; O]
Caryophyllaceae Dianthus basuticus Burtt Davy	<i>hlokoana-la-isa</i> / <i>tlokofoano</i> [JG; M1; O; S; P] <i>tlokofoano-ea-lekoaba</i> [JG; P] <i>letsaoi monokotsaoi-aa-makhoaba</i> [JG; O; P] <i>lepatla kopane</i> / <i>lithotoana</i> [JG; P; S]	root decoction for cleansing of blood [M1]; flatulency [JG; M1; O]; fertility in bulls [JG]; root chewed as love charm [S] decoction of plant as cure for sore throat [JG; P] cooked roots to treat bronchitis and heavy coughs [JG; P] to treat fever in delirious patients [S]; for compounding of various medicines [JG; P]
Celastraceae <i>Gymnosporia buxifolia</i> (L.) Szyszyl.	<i>sefe-a-maeba</i> [P]	for snakebite [P]
Chenopodiaceae <i>Chenopodium</i> <i>*album</i> L. <i>*ambrosioides</i> L.	<i>serue</i> [JG; M1; O; P] <i>setla-bocha</i> [P; O]	decoction of whole plant drunk as vermifuge [JG; O] an infusion of plant for colds and stomach ache [O; P; W & B2]
Convolvulaceae <i>Convolvulus</i> <i>bidentatus</i> Bernh. ex C. Krauss <i>sagittatus</i> Thunb. <i>Ipomoea</i> <i>crassipes</i> Hook. <i>oblongata</i> (E. Mey.) ex Choisy	<i>moroto-aa-phooko</i> [JG; O; P; W & B1] / <i>morarana-o-monyane</i> [JG; P; W & B1] <i>moroto-aa-phooko</i> [O; P] <i>maime</i> [JG; O; P] <i>mothoko</i> [O; P]	medicine to ease pregnant women [JG; P]; root chewed for toothache [O; P; W & B1] same as above [P] root as charm to protect villages [JG; O; P] root as charm against lightning [O; P]
Crassulaceae Cotyledon orbiculata L. var. oblonga (Haw.) DC.	<i>serilele</i> [JG; M; O; P; S]	earache; sore throat [M1; S]; mixed with <i>Senecio asperulus</i> for sore throat and mouth ulcers; to foment boils on skin [JG; M1]; leaves as hot poultice for toothache [O]; insect bite [M1]; root decoction mixed with <i>Commelina africana</i> for female infertility [P]
<i>Crassula</i> <i>capitella</i> Thunb. subsp. <i>thyrsiflora</i> Toelken <i>lanceolata</i> (Eckl. & Zeyh.) Endl. ex Walp. subsp. <i>transvaalensis</i> (Kuntze) Toelken <i>natans</i> Thunb. <i>natalensis</i> Schönland peplodes Harv. <i>Kalanchoe thyrsiflora</i> Harv.	<i>serilelanyane</i> [O; P] <i>serilelanyane</i> [H & V; JG; O] <i>moriri-aa-mokhoabo</i> [JG; P; S] <i>bohobe-ba-seisomi</i> [JG; O; P] <i>mo-ora-metsi</i> [JG; O; P; S] <i>serilele/ serileli</i> [JG; O; P; S]	decoction from plant for chest complaints [P] whole plants dried; crushed and smoked for colds [JG; W & B1] as a charm in illness; placed in incisions made on body of patient and patient's mother or nurse [JG; P]; charm to counter another person's spells [S] decoction of plant for sore throat and sore eyes [JG; O; P] lotion of bruised roots to bathe feverish patients [JG; O; P; S] well-cooked roots given to pregnant women for nausea [S]; vermifuge [JG; P]; leaves as hot poultice for toothache [O]; in small quantities as enema for intestinal worms [S]
Cucurbitaceae <i>Cucumis myriocarpus</i> Naudin subsp. <i>myriocarpus</i> <i>Kedrostis capensis</i> (Sond.) A. Meeuse	<i>monyaku</i> [JG; O; W & B1] <i>sesepa-sa-linotha</i> [JG; P]	boiled fruits drunk as purgative [JG; P; W & B1] cure for colic [JG; P]

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APPENDIX.—List of Lesotho medicinal plants; their vernacular names in Sesotho; parts used; main uses and references. Most important species are in bold type (cont.)

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Dipsacaceae Scabiosa columbaria L.	<i>selomi</i> [JG; O; P; S]	roots mixed with <i>Searsia divaricata</i> and <i>Cussonia paniculata</i> for colic in pregnant women and period pains [JG; P]; for difficult childbirth [JG; S]; cleanses womb; female infertility [O; S]; mixed with <i>Aster bakerianus</i> for skin rashes [S]
Ebenaceae Euclea corticea A.DC.	<i>mohlakola</i> [JG; O] same as above [JG; O; P; S]	 decoction of bark as a purgative for constipation [JG; O]; mixed with <i>Rumex lanceolatus</i> for gall sickness in livestock [JG]; used alone or mixed with <i>E. crispa</i> for washing divining bones [JG; P] decoction of bark drunk as purgative [S]; leaf decoction for painful menstruation [JG; O; P]; charm to ward off bad omens [S]; to divert hailstorm [JG; O]
crispa (<i>Thunb.</i>) Gürke subsp. crispa		
Euphorbiaceae Euphorbia inaequilatera Sond. var. inaequilatera clavarioides Boiss. var. clavarioides	<i>seloe</i> [P] <i>sehlooko</i> [JG; M1; O; P; S]	lotion prepared from plant to relieve sore breasts in suckling mothers [P] for skin rash in children; sap from plant for cracked heels [M1; O]; mixed with milk for treatment of acne [M1]; in the old days used to treat leprosy [S]; sores and wounds [S <i>et al.</i>]
Fabaceae Acacia karroo Hayne Argyrolobium collinum Eckl. & Zeyh. lotooides Harv. Crotalaria distans Benth. subsp. distans Dichilus strictus E.Mey. Dolichos pratenis (E.Mey.) Taub. Elephantorrhiza elephanina (Burch.) Skeels Eriosema salignum E.Mey. Indigostrum fastigiatum (E.Mey.) Schrire Indigofera dimidiata Vogel ex Walp. hedyantha Eckl. & Zeyh. nigromontana Eckl. & Zeyh. tristis E.Mey. tristoides N.E.Br zeyheri Spreng. ex Eckl. & Zeyh. Lessertia depressa Harv. perennans (Jacq.) DC. Lotononis decumbens (Thunb.) B.-E.van Wyk subsp. decumbens Benth. subsp. rehmannii (Dummer) B.-E.van Wyk eriantha Benth. lanceolata (E.Mey.) Benth. mucronata Corrath	<i>leōka</i> [JG; O; P] ' <i>musa-pelo-aa-matlapa</i> [O; P] ' <i>musa-pelo-a-monyenyane</i> [O; P] ' <i>musa-pelo-a-mosehlanyana</i> [O; P] <i>lesita-tlali</i> [P] <i>letōmōkō</i> [P] <i>mosisane</i> [JG; P] <i>tesapo</i> [JG; O; P] <i>phelheleane</i> [H & V; JG; P] ' <i>musa-pelo-aa-thaba</i> [M & V] ' <i>musa-pelo-aa-mafika</i> [M & V] <i>tehlahla-baroana</i> [JG; P]/ <i>se/lea-maeba</i> [JG] ' <i>musa-pelo</i> [M & V] ' <i>musa-pelo</i> [H & V; W & B1; W & B2] ' <i>musa-pelo-a-monyenyane</i> [M & V] ' <i>musa-pelo</i> [M & V] ' <i>musa-pelo-aa-litlaba</i> [M & V] <i>semanamana-se-seholo</i> [P] <i>nomele</i> [P] <i>molomo-monate</i> [JG; O; P] <i>khonathi</i> [JG; P] <i>semanamana</i> [O; P]	crushed for colic in infants [JG; O; P] as sedative [M & V] as sedative [M & V] as sedative [M & V] charm against lightning [P] charm to drive away hailstorm [P] rhizome used for hypertension; syphilis and intestinal disorders [JG] as stimulant for bulls [JG; P] burned root smoked for headaches [H & V; JG; P] roots as sedative; neuralgia; fever [M & V] roots as sedative; neuralgia; fever [M & V] decoction for colic [JG; P] roots as sedative [M & V] whole plant chewed for neuralgia and snake-bite [H & V; W & B1; W & B2] roots chewed as a sedative [M & V] for heart palpitations and as sedative [M & V] for dropsy of heart [M & V] for dropsy of heart [P]; root decoction as emetic for excess bile [O] for dropsy of heart [P] good luck charm [JG; P] anthrax treatment (mixed with <i>Aster bakerianus</i>); fever; contagious diseases; diarrhoea [JG; P] bronchitis in children [P]

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Fabaceae (cont.) * <i>Medicago lacinata</i> (L.) Mill. var. <i>lacinata</i> Melolobium alpinum <i>Eckl. & Zeyh.</i> microphyllum (L.f.) <i>Eckl. & Zeyh.</i> Otholobium polystictum (<i>Benth. ex Harv.</i>) C.H.Stirt. Rhynchosia adenodes <i>Eckl. & Zeyh.</i> caribaea (<i>Jacq.</i>) DC. Sutherlandia montana <i>E. Phillips & R.A.Dyer</i> Tephrosia capensis (<i>Jacq.</i>) <i>Pers.</i> var. <i>capensis</i> Trifolium africanum <i>Ser.</i> var. <i>africanum</i> burchellianum <i>Ser.</i> subsp. burchellianum	<i>bohomenyana</i> [O; P] <i>'musa-pelo-o-moholo-oo-thaba</i> [M & V] <i>mofahla-toeba</i> [JG; O; P] <i>mohlonechoa</i> [JG; P] <i>mony-a-mali</i> [JG; O; P] <i>mony-a-mali</i> [JG; O; P] <i>'musa-pelo-o-moholo-oo-noka</i> [M & V] <i>'musa-pelo-oo-noka</i> [M & V; W & B2] <i>moqopolla-thula</i> [JG; P; S]/ <i>'musa-pelo</i> [JG; M & V] <i>moqopolla-thula</i> [JG; P; S]/ <i>moroko/</i> <i>'musa-pelo</i> [JG; M1; M & V]	love charm [O; P] infusion of leaves for dropsy of heart and as sedative [M & V] whole plant as fumigant in sick room [JG; P] burnt root smoked for headaches [JG; P] crushed roots and stems given to calves for dysentery [JG; P]; decoction for rheumatism; menstrual pains and dysentery [S <i>et al.</i>] powdered root as snuff for headaches [H & V]; lotion from cooked roots for rheumatic pain [JG] infusion of leaves for dropsy of heart and as sedative [M & V] root decoction for heart palpitations [M & V]; dried roots snuffed for headaches [W & B2] whole plant chewed raw or infused for heart trouble [M & V]; sore throat; diuretic and sweating agent [JG] infused roots for sore throats [JG; S; P]; heart problems [M & V]; heartburn; blood cleansing [M1]; sweating agent [JG; S]; diuretic [JG]; as charm to obtain a gift of eloquence [JG] colic and diarrhoea in children [JG; P] colic and diarrhoea in children [JG; P] for treatment of inflammations and lacerations [JG] decoction of plant as a tonic after snake-bite [W & B1] cooked plant for dysentery [O; W & B1] decoction of plant as vermifuge; dysentery [O; P]; during the divining process [P] roots for dysentery [JG; M1; O; P]; flatulency [M1]; sore eyes [JG; P]; powdered plant applied to syphilitic sores [S <i>et al.</i>] same as above [JG; P] dysentery [JG; O; P]; heartburn; lotion from boiled roots to wash feverish patients [JG; P]; ointment for sore ears [S <i>et al.</i>] colic; diarrhoea [JG; O; P] colic; diarrhoea; dysentery [JG; P] mixed with <i>Asclepias humilis</i> and <i>Scabiosa columbaria</i> used to regulate menstrual cycle; leaves as hot poultice for wounds and boils [M1; O]; decoction of roots for period pains [JG; O] and colic in pregnant women [JG; O; P]; expulsion of placenta in both women and animals [S]; vermifuge in humans and animals [M1]; leaves burnt and crushed and smoked for headaches [O]
Gentianaceae Chironia krebssii <i>Griseb.</i> palustris <i>Burch.</i> subsp. <i>palustris</i> Sebaea exigua (<i>Oliv.</i>) <i>Schinz</i> leitostyla <i>Gilg.</i> Geraniaceae * <i>Erodium cicutarium</i> L'Hér. Geranium multisetum N.E.Br. Monsonia brevirostrata <i>R.Kunth</i> burkeana <i>Planch ex Harv.</i> Pelargonium alchemilloides (L.) L'Hér. bowkeri <i>Harv.</i> sidooides DC. (listed as <i>P. reniforme</i>) Gunneraceae Gunnera perpensa L.	<i>leptjetlane-la-liliba</i> [JG; P] <i>leptjetlane</i> [JG; O; P] <i>moroeroe</i> [JG] <i>marama-a-baroatsana</i> [W & B1] <i>makorotsokane</i> [O; W & B1] <i>hlapi-e-kholo</i> [O; P] <i>khoara</i> [JG; M1; O] <i>makorotsokane</i> [JG; P] <i>bolila-ba-thaba</i> [JG; O; P] <i>khoara</i> [JG; O; P] <i>khoara-e-nyenyane</i> [B & V; JG; P] <i>qobo</i> [JG; M1; O; P]	

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Lamiaceae <i>Acrotome inflata</i> Benth. <i>Aeollanthus buchnerianus</i> Briq. Ajuga ophrydis Burch. ex Benth. <i>Leonotis dubia</i> E.Mey. Mentha aquatica L.	<i>mohlajoane</i> [JG; P] <i>thōkōloane</i> [JG; P] <i>senyarela</i> [JG; M1; O; P] <i>joala-ba-linonyana</i> [JG; P] <i>koena-e-nyenyane</i> [JG; M1; O; P] <i>koena</i> [JG; M1; O; P; S; W & B1] <i>mokata</i> [P] <i>mosisili</i> [JG; P]/ <i>mosisili-oa-loti</i> [P] <i>mosisili</i> [JG; O; S] <i>bolao-ba-litaola/ bokhata</i> [JG; O; P; W & B1] <i>motlapa-itsunyane</i> [M1]	mixed with other plants for cattle with 'black leg' [JG; P] decoction of plant as cure for colds in children [JG; P] root decoction for regulation of menstrual cycle [M1; O]; period pains; female infertility [JG; M1; O; P] as a purgative [JG; P] leaf infusion or decoction as cure for colds [JG; O; P]; excessive bile; constipation; liver problems; vermifuge in children; mixed with <i>Trifolium burchellianum</i> to treat hypertension and for virility in men; blood cleansing [M1]; mixed with <i>Senecio asperulus</i> to wash sore joints [M1] leaf infusion or decoction for fever and colds; chest pains; coughs [JG; M1; O; P; W & B1]; decongestant [M1; O]; indigestion; vermifuge in children; improves digestion; mixed with <i>Senecio asperulus</i> and <i>Helichrysum odoratissimum</i> to wash sore joints [M1] decoction of roots as enema for kidney problems [P] whole plant burnt in a hut for fumigation [JG]; drunk for stomach problems and appendicitis [S <i>et al.</i>] medicine for coughs [JG; O]; as an aperient for children; blood cleansing [S] fumigant for feverish delirium: to protect cattle against 'black water' [JG; P; W & B1]; as charm to improve memory of apprentices [O] coughs; colds; diabetes; dizziness [M1]
Linaceae <i>Linum thunbergii</i> Eckl. & Zeyh.	<i>bohlokoana</i> [JG; P]	to relieve pain and snakebite [JG; P]; protective charm [P]
Lobeliaceae <i>Lobelia dregeana</i> (C.Presl) A.DC.	<i>naptjane-ea-phiiri</i> [P]	for washing divining bones to make them more accurate [P]
Malvaceae <i>Abutilon sonneratianum</i> (Cav.) Sweet <i>Hibiscus</i> microcarpus Garcke <i>pusillus</i> Thunb. * <i>Malva parviflora</i> L. var. <i>parviflora</i>	<i>lecheane</i> [P] <i>sefala-bohoho</i> [JG; O; P] <i>bohjana</i> [H & V; JG; O; P] <i>senameloana-se-scholo</i> [JG; P] <i>tika-moise</i> [JG; O; P]	stimulant for bulls in spring [P] colic [JG; P] to cure headaches [H & V; JG; O; P]; charm against harm and lightning [P] in auscultation for chest complaints [JG; P] lotion from whole plant for bruised or broken limbs [JG; O; P; S <i>et al.</i>] and for burns [O]; emetic for excess bile [O]
Mesembryanthemaceae <i>Carpobrotus edulis</i> L. <i>Bolus</i> <i>Chasmatophyllum musculinum</i> (Haw.) Dinter & Schwantes <i>Ruschia putterilii</i> (L.Bolus) L. <i>Bolus</i>	<i>mabobe/sebabsane</i> [JG; P] <i>mabobe/sebabsane</i> [JG; P] <i>mabone/sebabsane</i> [JG; P]	cure for swollen feet [P] cure for swollen feet [P] cure for swollen feet [JG; P]
Molluginaceae <i>Psammotropha mucronata</i> (Thunb.) Fenzl var. <i>mucronata</i>	<i>senama</i> [JG; P]	constipation [JG; P]
Myricaceae <i>Morella serrata</i> (Lam.) Killick	<i>malokela</i> [JG; O; P]	period pains [JG; P]; dysmenorrhoea [H & V]; powdered roots sniffed to cause sneezing to get rid of head colds [O]

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Myrtaceae *Eucalyptus spp.	<i>boloukomo</i> [O]	stuffed in nostrils or chewed for colds [JG]; leaf decoction for steaming to treat flu and colds [O]
Oleaceae Olea europaea L. subsp. africana (Mill) P.S.Green	<i>mohloare</i> [H & V; JG; M1; O; P]	leaf infusion to cleanse kidneys and bladder; backache; male infertility [M1]; headaches [H & V; JG; P]; hypertension [JG; P]; branches burnt to drive away bad omens [M1]; pegs from stems as charm against lightning [O]
Onagraceae *Epilobium hirsutum L. *Oenothera villosa Thunb.	<i>letsoai-la-balisana</i> [JG; O; P] <i>mōōpeli</i> [P]	treatment for warts; for bathing sick infants [JG; P] smoke from burning leaves inhaled for fever in children [P]
Orobanchaceae Harveya speciosa Bernh. Sopubia cana Harv. var. cana	<i>lekholela-la-Basotho</i> [P] <i>putumo-tšoeu</i> [P]	cure for madness [P] decoction of this plant mixed with <i>Salvia runcinata</i> for period pains [P]
Oxalidaceae Oxalis corniculata L.	<i>bolila-ba-thaba</i> [JG; O; P]	for snake bite [JG; P]
Papaveraceae *Argemone ochroleuca Sweet subsp. ochroleuca	<i>hlaba-hlabane-e-putsoa</i> [M1; O]	sap from stem for sore eyes; mixed with <i>Urtica urens</i> for pulmonary tuberculosis; period pains; steam from boiling decoction of whole plant for fever; aperients [M1]
Phytolaccaceae Phytolacca heptandra Retz.	<i>monatja</i> [JG; O; P]	roots as poison used to get rid of an enemy [O]
Pittosporaceae Pittosporum viridiflorum Sims	<i>mosellallo/ mohatalle</i> [P]	protective charm for sick people [P]
Polygalaceae Polygala amatymbica Eckl. & Zeyh. gymnoclada MacOwan hottentotta C.Presl.	<i>mohloliello</i> [P] <i>mohloli</i> [P] <i>lehano</i> [JG; W & B1]	medicine for cattle [P] love charm; when working divining bones [P] decoction of root drunk for mumps; abdominal pains; treatment of anthrax [JG; W & B1]
Polygonaceae Rumex acetosella L. subsp. angiocarpus (Murb.) Murb. lanceolatus Thunb.	<i>khamane</i> [M1; O; P] <i>khamane</i> [JG; O; P]	leaf decoction to cure flatulence in livestock; toothache [M1; P]; crushed roots for skin rash [O]; decoction to treat wounds and bruises [S <i>et al.</i>] hot lotion to bathe wounds and bruises; root decoction for menstrual pains [JG; O; P]; treatment of gall sickness [JG; P]
Ranunculaceae Clematis brachiata Thunb. Ranunculus multifidus Forssk. Thalictrum minus L.	<i>bolila-ba-likhomo</i> [JG; O] <i>bolila-ba-likhomo</i> [JG; P] <i>morara-oa-thaba</i> [O; S; W & B] <i>tlhapi</i> [H & V; JG; O] <i>lefokatsane</i> [O; W & B1]	constipation; fever; tuberculosis [JG]; snuff for headaches [H & V; JG; O] for treatment of diarrhoea in calves [JG; P] vermifuge [O; S]; charm to drive away bad omens [S]; mixed with <i>Berkheya setifera</i> for syphilis [W & B1] smoke inhaled for head and chest colds [H & V; JG; O; but reported to be poisonous by W & B1] decoction of roots taken for fever [W & B1]

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Resedaceae <i>Oligomeris dregeana</i> (Müll.Arg.) Müll.Arg.	<i>pheta</i> [P]	when working with divining bones [P]
Rhamnaceae Rhamnus prinoides L'Her.	<i>moffi</i> [M1; O; P; W & B1]	decoction of roots to treat pulmonary tuberculosis [M1; W & B1]; pneumonia; bladder and kidney problems [M1; O]; charm to ward off thunder and lightning and also to protect people and crops [JG; O; P; S]
Rosaceae <i>Agrimonia bracteata</i> E.Mey. & C.A.Mey. <i>Alchemilla woodii</i> Kuntze <i>Geum capense</i> Thunb. <i>Leucosidea sericea</i> Eckl. & Zeyh. * <i>Prunus persica</i> (L.) Batsch var. <i>persica</i> <i>Rubus rigidus</i> Sm.	<i>mosinoana</i> [JG; O; P] <i>molala-phoka</i> [H & V; JG; P] <i>hlapi-ea-loti</i> [JG; O; P; S] <i>cheche</i> [JG; O; P] <i>perekisi</i> [H & V; JG; O] <i>monokašoa-aa-bama</i> [JG; P]	leaf decoction mixed with <i>Leucosidea sericea</i> as a vermifuge [JG; O; P] plant roasted on hot ashes and smoke inhaled for headaches [H & V; JG; P] roots used for diarrhoea [JG; O; S] leaf decoction for vermifuge [JG; O; P]; coughs; for excess bile in animals [O] smoke from burning roots inhaled for headaches [H & V; JG; O] root decoction taken for acute pain [JG; P]
Rubiaceae <i>Anthospermum rigidum</i> Eckl. & Zeyh. subsp. <i>pumilum</i> (Sond.) Puff. subsp. <i>rigidum</i> <i>Galium undulatum</i> Puff. <i>Kohautia amatymbica</i> Eckl. & Zeyh. Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp.	<i>phakisane</i> [P; W & B1] <i>phakisane</i> [P] <i>morara-o-mofubelu</i> [W & B1] <i>rete-la-ntja</i> [S; O] <i>setima-mollo</i> [JG; M1; O; P; S]	root decoction given for menstrual pains and as purgative to pregnant women [P; W & B1]; charm to hasten convalescence [P]; good luck charm [P] infusion of dried, pounded stems and roots for lung sickness in horses [P] taken by women in the latter part of their pregnancy; said to have purgative effects [W & B1] given to children as an aperient [S] dysentery; indigestion; relieves burning pain from boils [JG; M1; O; P]; heartburn; diarrhoea; internal tumours; ulcers; colds; fevers; venereal diseases [JG; O; P]; root decoction as emetic [O]; charm to protect babies against witchcraft [JG; P; S]; charm to keep husband or wife faithful; charm against lightning and hail [JG]; root as protective charm to get rid of bad luck [O] decoction of roots used for colic; sore throat and chest pains [JG; P]
<i>Rubia cordifolia</i> L.	<i>sharane</i> [JG; P]	
Salicaceae <i>Salix mucronata</i> Thunb. subsp. <i>mucronata</i>	<i>moluoane</i> [JG; O; P]	preparation of plant to treat burns [JG; O; P]
Santalaceae <i>Thesium</i> sp. (cf. <i>T. angulosum</i> DC.)	<i>marakalle</i> [JG; P]	for heartburn [JG; P]
Scrophulariaceae <i>Halleria lucida</i> L. <i>Hebenstretia comosa</i> Hochst. <i>Jamesbrittenia filicaulis</i> (Benth.) Hilliard <i>Limosella</i> <i>grandiflora</i> Benth. <i>longiflora</i> Kuntze maior <i>Diels</i> <i>Manulea</i> <i>crassifolia</i> Benth. <i>paniculata</i> Benth.	<i>lebetsa</i> [JG; O; P] <i>lebohlotlo/tšitoane</i> [O; W & B1] <i>mopota-mafika</i> [P] <i>bolibana/ joang-ba-metsi/ tšika-metsi</i> [JG; P] same as above [S] same as above [JG; P] <i>fukuthoane</i> [JG; P] <i>bolao</i> [JG; O; P]	pegs from stems as protective charm [JG; P] decoction prepared from roots is used for indigestion and other stomach problems [W & B1] medicine for chest pains [P] when working with divining bones [JG; P; S] when working with divining bones [S] when working with divining bones [JG; S] lotion from the plant is applied to swollen navels of babies [JG; P] infusion of branches to wash a head to cure headache; as an emetic [JG; P]; charm to provoke quarrels among people [S]

B & V. Brendler & Van Wyk (2008); H & V. Hutchings & Van Staden (1994); JG, Jacot Guillaumod (1971); M1, Maliehe (1997); M & V. Moteete & Van Wyk (2007); M2, Motlamele (1938); O, own experience of first author; P, Phillips (1917); S, Schmitz (1982); S *et al.*, Shale, Stirk & Van Staaden (1999); W & B1, Watt & Breyer-Brandwijk (1927); W & B2, Watt & Breyer-Brandwijk (1962).

APPENDIX.—List of Lesotho medicinal plants; their vernacular names in Sesotho; parts used; main uses and references. Most important species are in bold type (cont.)

Species (naturalized alien species are marked with an asterisk*; best-known species are given in bold)	Common names and references	Main uses and references (uses given in bold are newly recorded; where known, plant parts used have been included)
Scrophulariaceae (cont.) <i>Mimulus gracilis</i> R.Br. <i>Phygelius capensis</i> E.Mey.	<i>sehlapetso</i> [JG; P] <i>meti-mašo</i> [JG; P]	lotion prepared from plant to bathe feverish patients; also for irregular menstruation [JG; P] ash from burnt roots placed in incisions made on the limbs to cure numbness [JG; P]; charm against hail damaging crops [JG; P]
Sutera <i>floribunda</i> (Benth.) Kuntze <i>hispida</i> (Thunb.) Druce	<i>mopota-mafika</i> [P] <i>boluma</i> [JG; P]	mixed with <i>Senecio rhyncholeomus</i> for chest complaints [P] decoction of roots; stems and leaves given to children with chest colds [JG; P]
Solanaceae * <i>Datura stramonium</i> L. <i>Lycium horridum</i> Thunb. * <i>Nicotiana glauca</i> Graham * <i>Solanum aculeatissimum</i> Jacq. <i>nigrum</i> L. <i>panduriforme</i> E.Mey. <i>supinum</i> Dunal var. <i>supinum</i> <i>tomentosum</i> L. var. <i>tomentosum</i> <i>Withania somnifera</i> (L.) Dunal	<i>letjoi</i> [JG; M1; O; P] <i>mosukutsokane</i> [JG; P] <i>koae</i> [O; P] <i>thola</i> [JG]/ <i>thola-e-meutloa</i> [P] <i>sešhoa-bohlolo</i> [JG; O; P] <i>thōlana</i> [JG; P] <i>moghinyatsane</i> [JG; P] <i>thōla-e-nyenyane</i> [JG; P] <i>mofera-ngope</i> [JG; O; P; W & B2]	hot leaves for bruises and boils [M1; O; P] powder from burnt, crushed branches rubbed into incisions made on limbs for rheumatism [JG; P]; smoked for headaches [H & V; JG; P] snuff given to children with cold in the head to make them sneeze [JG; O; P] decoction of whole plant to cleanse uterus after miscarriage; powder used for wounds and toothache [S <i>et al.</i>] powdered roots inserted into incisions made on lower back for lumbago [JG; O; P]; decoction taken for body aches; heart problems and skin rash [S <i>et al.</i>] for toothache [JG; P] protective charm for newlweds [JG; P] protective charm for newlweds [JG; P] root decoction for colds and chills [JG; W & B1]; intestinal ailments and for wounds [JG]; to tone up the uterus [W & B1]; enema to get rid of 'small snake' in the stomach [JG; O; P]
Sterculiaceae Hermannia <i>coccocarpa</i> (Eckl. & Zeyh.) Kuntze <i>depressa</i> N.E.Br. <i>geniculata</i> Eckl. & Zeyh.	<i>leilane</i> [JG; W & B1] <i>seletjane</i> [JG; S; O; P; W & B1] <i>selepe</i> [JG; O; P]	leaves crushed and applied to wounds as plaster [W & B1]; salve for burns [JG; P]; medicine for coughs in horses [W & B1] roots chewed for heartburn [O; S]; colic and diarrhoea in children [JG; S; P]; stomach ache [W & B1]; on divining bones and as charm against witchcraft [S; P]; decoction of whole plant drunk as emetic [O] for flatulency in pregnant women; heartburn; mixed with <i>Dicoma anomala</i> for diarrhoea in children; as stimulant for bulls [JG; O; P]
Thymelaeaceae Gnidia <i>anthylloides</i> (L.f.) Gilg. <i>capitata</i> L.f. <i>gymnostachya</i> (C.A.Mey.) Gilg. <i>kraussiana</i> Meisn. var. <i>kraussiana</i>	<i>moomang</i> [JG; O; W & B1] <i>thōpananyana</i> [H & V; P; W & B2] <i>thōpa</i> [JG; P] <i>thobehe</i> [JG; O]/ <i>thōpa-e-nyenyane</i> [P]	whole fumigant for feverish patient [O; W & B1]; vermifuge [JG] snuff from leaves smoked to relieve headaches [H & V; P; W & B2]; poultice for toothache [W & B2] decoction of plant to wash wounds and bruises [P]; leaves smoked for headaches [H & V; JG; P] snuff to cure headaches [P]; medicine for fractured limbs in people and animals [JG; O; P]
Urticaceae * <i>Urtica urens</i> L.	<i>bobatsi</i> [JG; M1; O; P]	decoction of leaves to treat asthma; pulmonary tuberculosis; to cleanse the bladder; heart problems; intestinal ulcers; heartburn [M1; O]; wounds; increases iron in blood; prevents balding [M1]; snakebite [JG; P]
Verbenaceae * <i>Verbena rigida</i> Spreng.	<i>morōli</i> [JG; P]	decoction from roots as a cure for heartburn; colic [JG; P]; charm to protect new villages [P]
Vitaceae <i>Rhoicissus tridentata</i> (L.f.) Wild & R.B. Drumm.	<i>morara</i> [JG; O; P]	to treat colds; sterility in women [JG; P]

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Zygophyllaceae <i>Tribulus terrestris</i> L.	<i>tšehlo</i> [JG; O; P]	mixed with <i>Heteropogon contortus</i> to prepare medicine for rheumatism [JG; P]
MONOCOTYLEDONS		
Agapanthaceae <i>Agapanthus campanulatus</i> F.M.Leight. subsp. <i>patens</i> (F.M.Leight.) F.M.Leight.	<i>leta-la-phofu</i> [M1; O; S]	sap from leaves for skin rash in children [JG; M1; O; S]; 'crust' on infant heads [JG]; mixed with other plants for period pains [M1]
*Agavaceae * <i>Agave americana</i> L. subsp. <i>americana</i>	<i>lekhalā</i> [JG; O]/ <i>lekhalā-le-leputsoa</i> [O]	leaves for skin problems; leaf decoction containing the spines to wash sore feet [O]
Alliaceae <i>Tulbaghia acutiloba</i> Harv.	<i>sefotha-fotha</i> [JG; M1; O]	diarrhoea in children; stomach ache; high blood pressure; infusion of flowers to clear the lungs and chest; for treatment of asthma [M1; O]; lotion to wash infant with depressed fontanelle [JG]
Amaryllidaceae <i>Boophone disticha</i> (L.f.) Herb. <i>Brunsvigia cooperi</i> Baker <i>Crinum</i> <i>bulbispermum</i> (Burm.f.) Milne-Redh. & Schweick. <i>longifolium</i> Thunb. <i>Haemanthus humilis</i> Jacq. subsp. <i>hirsutus</i> (Baker) Snijman <i>Nerine angustifolia</i> (Baker) Baker	<i>leshoma</i> [JG; O; P] <i>lematla</i> [JG; O; P; S] <i>lelutla motose</i> [JG; O; P; S] <i>lelutla</i> [JG; M; O; P; S] <i>tsebe-ea-phofu</i> [JG; P] <i>lematlana</i> [JG; O; P]	leaves placed on circumcision wounds [JG; P]; infusion of bulbs for wounds and rheumatic pain [S <i>et al.</i>] alone or mixed with other plants for infertility in women [JG; O; P]; to wash divining bones to make them more accurate [JG; P] decoction of bulbs as a cure for colds [JG; O; P] medicine prepared from bulbs for colds [P] crushed bulbs used to drive away bad omens [JG; P] crushed bulbs mixed with other plants as charm against lightning [JG; P]
Araceae <i>Zantedeschia albomaculata</i> (Hook.) Baill. subsp. <i>albomaculata</i>	<i>mohalalito</i> [JG; M1; O; S]	cooked rhizomes for kidney and bladder problems; mouth ulcers [JG; M1; O]; sore throat [M1; S]; mixed with <i>Eucomis autumnalis</i> to cure cysts in the uterus [M1]; rhizomes as protective charm against witchcraft [O]
Asparagaceae <i>Asparagus</i> <i>asparagoides</i> (L.) Druce <i>microcephalis</i> (Kunth) Baker <i>ramosissimus</i> Baker	<i>khōpananyana</i> [JG; P] <i>lerara-tau/lehonyeli</i> [JG; O] <i>khōpa</i> [JG; P]	lotion made from roots to bathe sore eyes [JG; O; P] to treat eruptions and gonorrhoea [JG]; rheumatism and period pains [S <i>et al.</i>] decoction of burnt, crushed roots to cure colic [JG; P]
Asphodelaceae <i>Aloe</i> <i>aristata</i> Haw. <i>ecklonis</i> Salm-Dyck <i>ferox</i> Mill.	<i>lekhalana</i> [JG; O; P] <i>lekhalana</i> JG; O; P; S] <i>lekhalā-le-leholo</i> [M1, O]/ <i>lekhalā-la-thaba</i> [O] <i>lekhalā</i> [M1; O] <i>mohalakane/seholobe</i> [JG; M; O; S]	root decoction to induce pregnancy [JG] pulmonary tuberculosis [JG; P]; decoction of roots for infertility in women [S]; infusion of leaves as a purgative [JG; O; P; S]; boiled leaves and roots as charm to get rid of bad luck [O] leaf decoction for constipation [M1; O]; high blood pressure; enema for animals [M1]; one of ingredients for the horn [JG; O; P]; leaf and root decoction for diabetes [O] leaves mixed with roots of <i>Scarsia divaricata</i> for diabetes [M1]; wound healing [M1; O] lea infusion for constipation; stomach cramps; indigestion [JG; M1; O; S]; heartburn in humans and animals; burn wounds [JG; M1]; cleanses blood [M1]
<i>maculata</i> All. <i>striatula</i> Haw. var. <i>striatula</i>		

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Asphodelaceae (cont.)		
Bulbine		
asphodeloides (<i>L.</i>) <i>Spreng.</i>	<i>sethare-sa-pekane</i> [JG; O; P]	leaves to heal cracked lips and burns [JG; O; P]
narcissifolia <i>Salim-Dyck</i>	<i>khomo-ea-balisa</i> [JG; M1; O; S; P]	to improve blood circulation; decoction of bulbs drunk for infertility in women [M1; O]; purgative [JG; O; S]; aperient [O]
Kniphofia		
caulescens <i>Baker ex Hook.f.</i>	<i>leloe</i> [M; O]	decoction from bulbs for infertility in women; mixed with <i>Gunnera perpensa</i> to cleanse blood and uterus; regulates menstrual cycle [M1]
sarmentosa (<i>Andrews</i>) <i>Kunth.</i>	<i>leloe</i> [P]	decoction of bulbs drunk for shoulder pain [P]
Colchicaceae		
<i>Androcymbium longipes</i> <i>Baker</i>	<i>khukhoana</i> [JG]	crushed, dried roots are mixed with fat and used as ointment for sore ears [JG]
Commelinaceae		
<i>Commelina africana</i> <i>L.</i>	<i>khotsoana</i> [JG; O; P]	plant is boiled together with <i>Tephrosia capensis</i> and decoction drunk for heart problems and nervousness [JG; P]
Cyperaceae		
<i>Pycreus nitidus</i> (<i>Lam.</i>) <i>J.Raynal</i>	<i>motaataoane-oa-litlaba</i> [JG; P]	medicine for chest colds [JG; P]
<i>Schoenoplectus paludicola</i> (<i>Kunth.</i>) <i>J.Raynal</i>	<i>rororoana</i> [JG; P]	for treatment of colic [JG; P]
Eriosepmaeae		
<i>Eriospermum ornithogalooides</i> <i>Baker</i>	<i>khongoana-tšingoana</i> [JG] / <i>tsebe-ea-pela</i> [M1; O]	mixed with <i>Gunnera perpensa</i> and <i>Scabiosa columbaria</i> to cleanse the uterus and improve fertility [M1; O]; anaemia; earache [JG]
Hyacinthaceae		
<i>Drimys</i>		
<i>calcarata</i> (<i>Baker</i>) <i>Stedje</i>	<i>khoho-ea-thaba</i> [JG; P]	decoction from bulbs drunk as a cure for colic [JG; P]
<i>depressa</i> (<i>Baker</i>) <i>Jessop</i>	<i>moretele</i> [JG; O; P]	a powerful good luck and protective charm [JG; O; P]
<i>sphaerocephala</i> <i>Baker</i>	<i>tlhare-sa-nōkō</i> [JG; P]	powdered burnt roots rubbed into external tumours [JG; P]
<i>uniflora</i> <i>J.C.Manning & Goldblatt</i>	<i>khoho-ea-lefika</i> [P]	burnt powdered plant inserted into incisions made on the forehead to cure headaches [P]
<i>Eucomis</i>		
<i>autumnalis</i> (<i>Mill.</i>) <i>Chitt.</i> subsp. <i>clavata</i> (<i>Baker</i>) <i>Reyneke</i>	<i>khapumpu</i> [H & V; JG; O; M1; P; S]	bark from stem powdered and applied to head for colds in the head [H & V]; for difficult childbirth; venereal diseases [JG; M1; O; S]; powerful good luck, protective and love charm [JG; P]; piles [M1]
<i>bicolor</i> <i>Baker</i>	<i>khapumpu-ea-thaba</i> [JG; P]	treatment for colic [JG]
<i>Ornithogalum</i>		
<i>dipcaidioides</i> <i>Baker</i>	<i>morōtoan'a phokoana</i> [JG; O; P]	decoction of plant drunk to regulate the bladder; also to treat venereal diseases [JG; O; P]
setosa (<i>Jacq.</i>) <i>J.C.Manning & Goldblatt</i>	<i>nikonko-phiri</i> [JG; P] / <i>mototse</i> [JG; O; P; S]	for treatment of wounds in animals [JG; P]; charm against lightning or any harm [JG; O; P; S] and to pacify enemies [JG; S]
<i>shawii</i> (<i>Baker</i>) <i>J.C.Manning & Goldblatt</i>	<i>khapumpu</i> [JG] / <i>sesepa-sa-linotha</i> [O; JG]	enema for constipation in infants [JG]
<i>Ledebouria</i>		
<i>cooperi</i> (<i>Hook.f.</i>) <i>Jessop</i>	<i>leptjetlane</i> [M1; O; S]	in small quantities bulbs for diarrhoea in children [M1; S]; indigestion [M1]
<i>revoluta</i> (<i>L.</i>) <i>Jessop</i>	<i>boakhoē</i> [JG; P]	for treatment of lumbago (except in pregnant women [JG; P])
<i>Massonia jasminiflora</i> <i>Burch. ex Baker</i>		charm against lightning or to find lost objects [S]
<i>Merwillia plumbea</i> (<i>Lindl.</i>) <i>Speta</i>	<i>khèrèrè</i> [JG; P]	cooked bulbs mixed with food as an aperient; decoction from cooked bulbs used for treatment of internal tumours; lung sickness in cattle [JG; P]

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Hyacinthaceae (cont.) <i>Schizocarphus nervosus</i> (Burch.) Van der Merwe	<i>lenaka-la-khomo</i> [JG; P]	crushed bulb mixed with food for a child suffering from constipation [JG; O]; mixed with other plants for gall sickness [JG; P]
Hypoxidaceae Hypoxis argentea Harv. ex Baker var. sericea Baker	<i>leihlo-la-khomo</i> [JG; O; P; S] <i>moli-motsane</i> [JG; P] <i>moli-tiane</i> ; <i>tiane</i> [JG]	corms crushed and mixed with fat for sores on horses and cracked teats of cows [JG; P; S]; corms as purgative [O] mixed with <i>Ipomoea oblongata</i> as a charm against lightning [JG; P] decoction drunk for asthma and arthritis; infusion used to treat wounds and skin rash [S <i>et al.</i>]
Iridaceae <i>Crocsmia paniculata</i> (Klatt) Goldblatt Dierama <i>pendulum</i> (L.f.) Baker <i>robustum</i> N.E.Br.	<i>khahla-ea-bokone</i> [P] <i>lethepu</i> [JG; O; P; W & B1] <i>lethepu</i> [JG; O; S]	cure for diarrhoea in people and cattle [P] enema as a purgative [JG; P; W & B1] enema for constipation [JG; S]
Gladiolus crassifolius Baker	<i>khahla-e-nyenyane</i> [H & V; JG; P; W & B2] <i>khahla-e-kholo</i> [O; W & B1] <i>khahla</i> [JG; O; P] <i>khahla-ea-foi</i> [JG; O; P] <i>khahla</i> [JG; O; P]	remedy for headaches and lumbago [H & V; JG; P; W & B2] decoction of corms drunk for diarrhoea and dysentery [O; W & B1]; also for colds [W & B1] decoction of cooked crushed corms taken for rheumatism [JG; P; W & B1] cooked corms mixed with food to cure diarrhoea [JG; O; P] decoction of crushed corms given to calves with diarrhoea [JG; O; P]
Juncaceae <i>Juncus</i> spp.	<i>roroana/ rororo</i> [JG]	rhizome used to treat intestinal ailments [JG]
Orchidaceae <i>Eulophia</i> <i>hians</i> Spreng. var. <i>nutans</i> (Sond.) S.Thomas <i>tenella</i> Rchb.f. <i>welwitschii</i> (Rchb.f.) Rolfe	<i>lekhōlela</i> [JG] <i>lekhōlela</i> [P] <i>makhōlela</i> [M1]	tuber infusion for infertility in women [JG] tubers burnt and crushed and the powder rubbed into incisions made on sore limbs [P] earache; vermifuge in children; excessive sweating in menopausal women [M1]
Poaceae <i>Arundinella nepalensis</i> Trin. <i>Cymbopogon</i> <i>dieterleniae</i> Stapf. ex E.Phillips <i>marginatus</i> (Steud.) Stapf. ex Burtt Davy <i>nardus</i> (L.) Rendle <i>Elionurus muticus</i> (Spreng.) Kuntze <i>Festuca caprina</i> Nees <i>Fingerhuthia africana</i> Lehm. <i>Heteropogon contortus</i> (L.) Roem. & Schult. <i>Imperata cylindrica</i> (L.) Raeusch. <i>Pennisetum glaucum</i> (L.) R.Br. <i>Tetrachne dregei</i> Nees	<i>mahlakamane</i> [JG; P] <i>lebatjana</i> [JG; P] <i>lebata</i> [JG; P; W & B1] <i>lebata</i> [P] <i>hlōkō</i> [M2; O; P] <i>letsiri</i> [JG; O; P] <i>thita-poho</i> [JG; O] <i>selōkana</i> [P] <i>mohlaba-lerumo</i> [JG] <i>nyalothi</i> [O; P] <i>thita-poho-e-nyenyane</i> [P]	lotion prepared from the plant for washing wounds [JG; P] as medicine for eruptions and wounds; mixed with other plants for gall sickness [JG; P] love charm [W & B1] as above; also for chest pains [P] roots chewed for treatment of colic [M2; O; P] and toothache [P] root infusion drunk for stomach pains [S <i>et al.</i>] as stimulant for bulls [JG; O] medicine for rheumatism of the hands [P] decoction of roots given to children with chest colds [JG] given to cows to get rid of the afterbirth [P] charm to protect villages at wartime [P]

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Miscellaneous notes

TRIBUTE TO GERRIT GERMISHUIZEN, EDITOR OF *BOTHALIA*

For the past 14 years, Mr Gerrit Germishuizen edited *Bothalia*, the house journal of the South African National Biodiversity Institute (SANBI). On 30 September 2010 Gerrit retired from full-time employment at the Institute, and his tenure as the editor of this journal has come to an end.

Gerrit was born in Pretoria on 25 February 1950, and completed his under- and junior postgraduate studies at the University of Pretoria from 1960 to 1973. Later, in 1982, he was awarded a Masters degree by the same institution. Until 1997 Gerrit was what could perhaps best be described as a career taxonomist, moving to scientific editing only after having spent 21 years as Professional Officer in the National Herbarium of the Botanical Research Institute, later to become the National Botanical Institute (NBI), and currently SANBI. Gerrit took over the editorship of the NBI's scientific publications from Dr Otto Leistner (Smith 1998). While with the Institute's Scientific Publications section, Gerrit not only edited *Bothalia* but as scientific editor he also played a significant role, with his colleagues in the section, in editing several volumes in the NBI's and SANBI's *Flowering Plants of Africa*, *Flora of southern Africa*, *Strelitzia* and *SANBI Biodiversity Series*.

During his tenure as scientific editor, Gerrit worked on numerous benchmark botanical publications for southern Africa, some of the best known and most widely used and cited being the vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford 2006) and the region's species list (Germishuizen *et al.* 2006) and, more recently, he co-authored with H.F. Glen, an update of Gunn & Codd's volume on the botanical exploration of the subcontinent (Glen & Germishuizen 2010).

When a decision is required on whether a submitted manuscript is worthy of publication in a scientific journal, an editor is inevitably guided by opinions

expressed by referees as part of the peer-review process. Admirably, Gerrit religiously followed this golden rule sometimes to the chagrin of his colleagues and friends. But to his credit, he always looked for reasons why a paper should be published, rather than why it should be rejected. In this way Gerrit played an important role in shaping the science reporting skills of several young and established scientists. But more than that, even while editor, he was always ready to assist young taxonomists in the National and other herbaria when they needed assistance with becoming acquainted with the plant groups they have to study and curate. As scientific editor of SANBI's publications, Gerrit became acquainted with a broad cross-section of the southern African botanical fraternity and beyond, all of whom will miss his input into improving their written effusions.

REFERENCES

- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. (eds). 2006. *A checklist of South African plants*. Southern African Botanical Diversity Network Report No. 41: 1–1126. SABONET, Pretoria.
- GLEN, H.F. & GERMISHUIZEN, G. (Compilers) 2010. Botanical exploration, edn 2. *Strelitzia* 26: 1–489. South African National Biodiversity Institute, Pretoria.
- MUCINA, L. & RUTHERFORD, M.C. (eds). 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: 1–807. South African National Biodiversity Institute, Pretoria.
- SMITH, G.F. 1998. New editor for *Bothalia*. *Bothalia* 28: 113–115.

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