Carnivorous Plants of New South Wales, Australia

Robert Gibson • P.O. Box 1330 • Dubbo • New South Wales 2830 • Australia

Keywords: ecology: *Aldrovanda*, *Drosera*, *Ibicella*, *Utricularia*, New South Wales (Australia) — observations: *Drosera peltata*

Introduction

The state of New South Wales (hereafter NSW), in eastern Australia (Figure 1A), is home to twenty-one native species of carnivorous plants. These are outlined in the following article. The distribution maps presented are based primarily on the study of specimens at the herbarium of the Royal Botanical Gardens in Sydney. Additionally, *Ibicella lutea* has become established in parts of the state (Auld and Medd, 1987).

NSW can be conveniently divided into five physiographic and botanical regions which are, from east to west: coast, tablelands, western slopes, western plains and far-western plains (Figure 1B). In this article the Australian Capital Territory on the southern tablelands will be treated as part of NSW. This region, 28°—37.5°S and 141°—152.5°E, has an area of just over 800,000km^2.

The native carnivorous plant flora consists of ten species of the Droseraceae

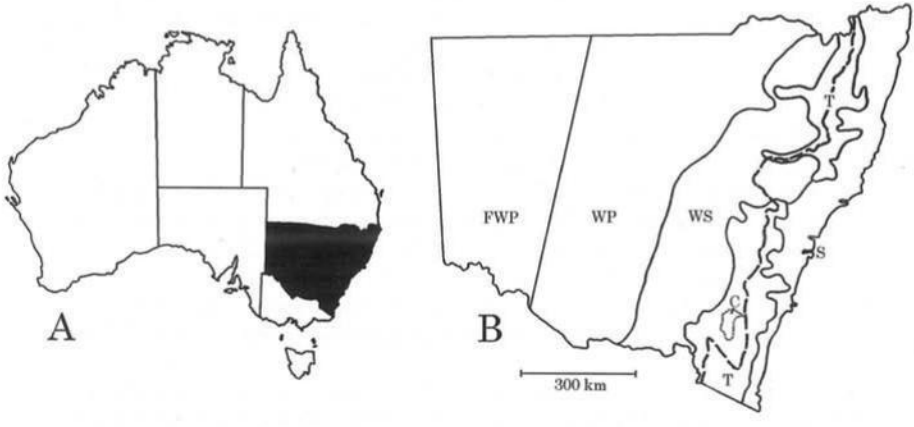

Figure 1: (A) Location map of the state of New South Wales (in black) in eastern Australia. (B) Physiographic and botanic regions of New South Wales: Coast, Tablelands (T), Western Slopes (WS). Western Plains (WP) and Far-Western Plains (FWP). The crest of the Great Dividing Range is indicated by the dashed line. The border of the Australian Capital Territory is dotted in, and the positions of Sydney (S) and Canberra (C) are indicated.

and eleven of the Lentibulariaceae: *Aldrovanda vesiculosa, Drosera arcturi, D. auriculata, D. binata, D. burmannii, D. glanduligera, D. indica, D. peltata, D. pygmaea, D. spatulata, Utricularia australis, U. aurea, U. beaugleholei, U. biloba, U. caerulea, U. dichotoma, U. gibba, U. lateriflora, U. monanthos, U. uliginosa*, and *U. uniflora. Ibicella lutea*, a non-native plant which in the past was considered carnivorous also occurs in NSW. These species will be briefly described below, with accompanying distribution maps (Figure 2).

Family Droseraceae

Aldrovanda vesiculosa has been recorded in one location in NSW (Figure 2C) and is currently considered to be a rare or threatened species. It occurs sporadically along the Queensland, Northern Territory and far northern Western Australian coastal areas of Australia (Erickson, 1968) as well as southeast Asia, from Japan to India, tropical and southern Africa and Europe. It is likely that originally it had a broader distribution within NSW which has been significantly reduced by agriculture and urbanisation.

Drosera arcturi is locally common in swamps and creek banks at or above the tree line, between 1600 and 2100 metres altitude, in the Snowy Mountains around the Mount Kosciusko massif (Figure 2A). It occurs on mountain tops in adjacent Victoria, and in Tasmania and New Zealand from sea-level to alpine elevations (Erickson, 1968). The NSW plants are typical of this summer-growing, winter-deciduous species, and form a loose rosette of three to six erect to semi-erect linear leaves between one and seven cm long. In late spring many plants produce a vertical scape which rises from the base of the third or fourth leaf of the season. The solitary white-petalled flowers are open between mid-December and mid-January. The rosette surmounts a branching, horizontal to inclined shallowly-buried rhizome. To survive the winter, the last two leaves produced in February do not grow to maturity, but form a tight, inverted cone beneath the summer leaves. They recommence growth the following October.

Drosera auriculata is a common and widespread erect tuberous species found throughout the eastern third of the state, from the coast to the western slopes (Figure 2B), and also occurs elsewhere in southeastern Australia and New Zealand (Erickson, 1968). It is an adaptable species, growing from sea-level to 1100 metres in many seasonally to permanently wet environments. Whilst most plants flower between June and November, flowering specimens have been collected throughout the year. This is not surprising since growth may continue as long as the soil remains moist. This is a variable species (Gibson, 1992) which has been considered a subspecies of *D. peltata* (Conn, 1981), however, this appears contrary to classical studies by Vickery (1933), and consistent morphological and ecological differences between both species.

Drosera binata is locally common along the entire coast and adjacent Great Dividing Range (Figure 2A) from sea-level to 1100m and occurs in permanently wet places. This robust and variable species is the largest carnivorous plant in NSW, with lamina often over 30 cm long. Most of the varieties have been informally named by Steve Clemesha (1981). Generally the plants with once-divided leaves occur along the south coast (Clemesha's "T-form"); those with the widest and usually the moderately divided leaves occur around Sydney (*D. binata* var. *dichotoma*); and those with narrow, much-divided leaves occur along the north coast (*D. binata* var. *multifida*). Some populations of the latter have pink-petalled flowers rather than the typical white-petalled flowers. The sweet-scented blooms are produced between October and April, and the plants usually undergo a short period of dormancy from late autumn to early winter. This species also occurs in Victoria, South

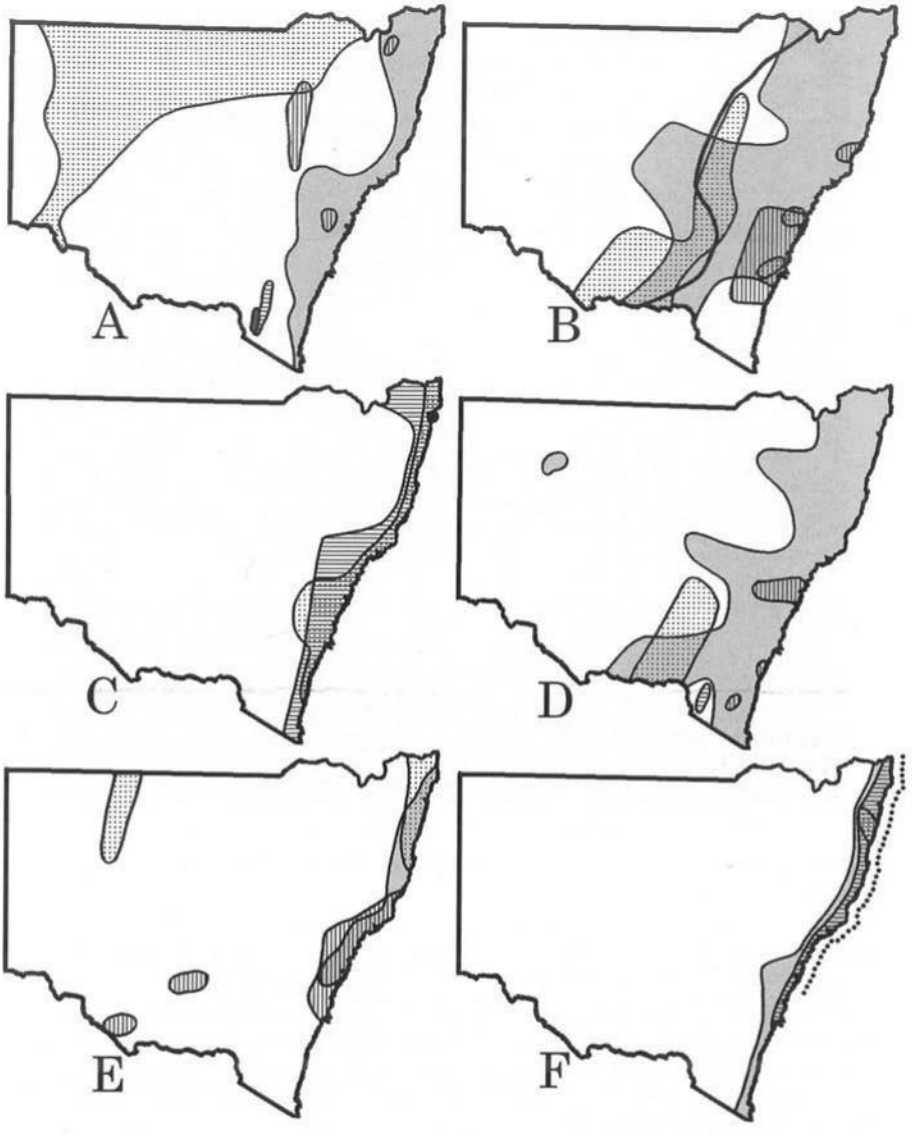

Figure 2: Distribution maps of the native carnivorous plants of New South Wales. (A) Summer-growing *Drosera*: *D. arcturi* (dark grey), *D. binata* (light grey), *D. burmannii* (vertical stripes), *D. indica* (dots), *D. peltata* var. *gracilis* (horizontal stripes). (B) Winter-growing *Drosera*: *D. auriculata* (east of heavy black line), *D. glanduligera* (dots), *D. peltata* variety with green rosettes and pink or white petals (light grey), *D. peltata* variety with red rosettes and white petals (vertical stripes). (C) Generally evergreen Droseraceae: *Aldrovanda vesiculosa* (single black dot), *D. pygmaea* (dots), *D. spatulata* (horizontal stripes). (D) The *Utricularia dichotoma* group: *U. beaugleholei* (dots), *U. dichotoma* (light grey), *U. monanthos* (horizontal lines), *U. uniflora* (vertical stripes). (E) Aquatic *Utricularia*: *U. aurea* (dots), *U. australis* (vertical stripes), *U. gibba* (light grey). (F) Other *Utricularia*: *U. biloba* (coastline range indicated by offshore dots), *U. caerulea* (dots), *U. lateriflora* (light grey), *U. uliginosa* (horizontal stripes).

Figure 3: *Drosera indica*, small plants just developing scapes.

Australia, Tasmania, a small area in southwest Western Australia, and throughout New Zealand (Erickson, 1968).

Drosera burmannii grows in scattered populations in northeastern NSW (Figure 2A), reaching its southern limit in Sydney. It also grows in Queensland and across northern Australia (Erickson, 1968; Marchant & George, 1982; Hart, 1987), and into southeast Asia and western Micronesia (Ziemer, 1987). This summer-growing annual (or short-lived perennial) has red or golden-green rosettes measuring up to 4cm in diameter (see Back Cover). The white or rarely pale pink flowers are produced on one-sided racemes from September to June—it probably flowers year-round in favourable conditions

Drosera glanduligera is a winter-growing annual which produces golden-green rosettes up to 3 cm in diameter. In August to October, multiple short (only 12 cm tall) glandular scapes are produced which bear orange flowers. *D. glanduligera* occurs in the south and central coast (including western Sydney), and across the divide along the length of the western slopes, and in the adjacent south and central western plains, from sea-level to 500 m (Figure 2B). This wide-ranging species grows across subtropical Australia (Marchant & George, 1982).

Drosera indica is an annual, erect species which occurs sporadically in the northwestern and far western plains, primarily along watercourses in the Darling River system, between 100 to 300 metres elevation (Figure 2A). The scrambling plants grow to 25 cm tall with thin, linear leaves as long as 20 cm, and numerous axillary racemes bearing white, or pink flowers (Figure 3). Seeds germinate in summer and plants grow for as long as the soils remain moist; flowers are produced

mainly during May to September. This species has been dispersed down the Darling River system, probably by summer floods—it has been recorded as far south as Euston, Victoria, just upstream of the Darling River's confluence with the Murray River (Erickson, 1968). It is likely the distribution and abundance of this species varies from year to year according to summer rainfall received in the river basin. This species also occurs throughout Queensland and northern Australia, and extends into southeast Asia to Japan and India (Erickson, 1968; Marchant & George, 1982), and also tropical Africa, including Madagascar (Obermeyer, 1970).

Drosera peltata is the most widespread and variable carnivorous plant species in the state (Gibson, 1992) and occurs from the coast to the western plains, up to elevations of 1500 metres. It occurs in all Australian states, New Zealand, and southeast Asia, from Japan to India .(Hooker, 1879; Erickson, 1968; Marchant and George, 1982). At least four distinct variants occur in NSW, each within a well-defined range (Figures 2A, 2B).

1)A *D. peltata* variant with green rosettes and pink (or white) petals occurs in the eastern third of the state, from sea level to 1200 m. (Figure 2B). It is a robust variety with a distinctive golden-green basal rosette (Figure 4) surmounted by one or more green (aging to red) stems which measure up to 50 cm tall. Plants in lower (hotter) or more northerly locations have pink flowers whilst those in cooler environments typically have white flowers. Both forms flower between July and December. It occurs throughout south eastern Australia, including Tasmania, with an isolated population in far northern New Zealand.

2)A *D. peltata* variant with red rosettes and white-petals appears to be endemic to the central eastern part of the state (Figure 2B). It often grows in wetter, sandier substrates than the previously mentioned variant, and has an altitudinal range from sea level to 1100 metres. It produces an attractive red basal rosette and a single olive-green or red erect stem which is up to 30 cm tall. One or more racemes of white flowers are borne from July to December (Figure 5).

3)*D. peltata var. gracilis* occurs only in a very restricted area in the southern tablelands between 800 and 1500 metres (Figure 2A). Found in wet peat soils, it is a slender variety with red rosettes. It grows during the warmer parts of the year, and small white flowers are borne in January and February (McIntyre, 1986).

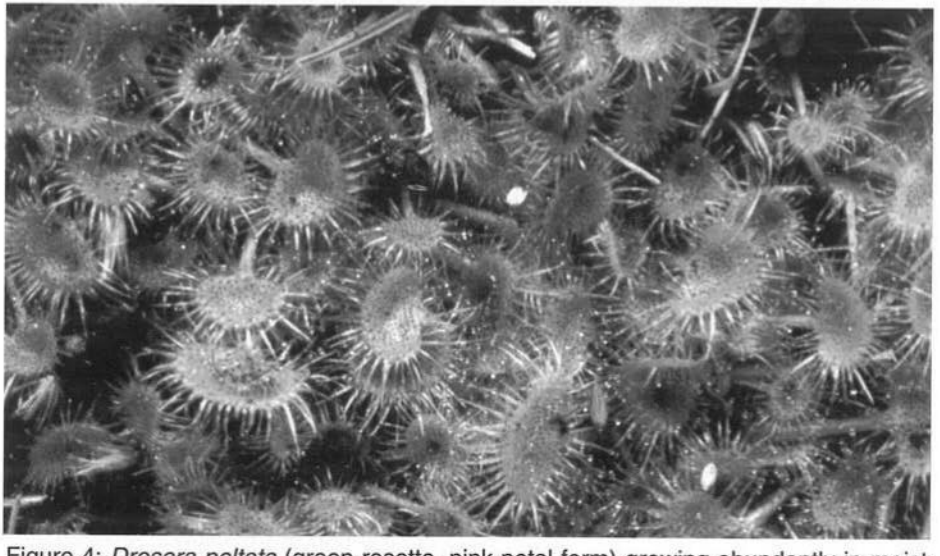

Figure 4: *Drosera peltata* (green-rosette, pink-petal form) growing abundantly in moist clay. The plants are still in the rosette phase.

4)A *D. peltata* variant appears to be restricted to remnant woodland on clay soils in the South Creek basin, 40 kilometres west of Sydney. With short scaped inflorescences, glabrous sepals, and ovoid seeds, up to 0.4mm long, this interesting variant almost appears to be intermediate between *D. peltata* and *D. auriculata*. It was more fully described in Gibson (1993) and is currently under further study.

Some of the *D. peltata* herbarium specimens examined at the Royal Botanic Gardens, Sydney during the preparation of this paper could not be assigned to any of the above variants, and may represent as yet undescribed and new variants. Further studies, including observations of live plants in these areas, are recommended.

Drosera pygmaea is the only pygmy *Drosera* to occur outside of Western Australia. It is recorded from along the coast to the central tablelands, from sea level to 1000 metres (Figure 2C). It occurs throughout southeastern Australia, and in New Zealand (Erickson, 1968). The rosettes grow to 1.8 cm diameter. Each leaf consists of a thin petiole and a round, red lamina measuring up to 2 mm in diameter. In times of drought the leaves die whilst the growing point survives, shielded by the dense, silvery-white cone of stipules. Flowering occurs predominantly from September to June. Gemmae are produced between May and July if the soil is sufficiently moist, and the plant can proliferate rapidly. This diminutive species is easily overlooked, and is probably more widespread than herbarium collections indicate.

Some variation in scape architecture and taxonomic uncertainty exists with this species. Whilst the flowers typically have 4 petals and are solitary, five-petalled flowers are not uncommon, as seen in the photo published in Kondo and Kondo (1983). Rarer still are multi-flowered scapes. Plants with two-flowered scapes have been recorded in southeast Queensland (Stanley and Ross, 1983) and cultivated plants from the New South Wales South Coast may produce scapes with up to five flowers. The taxonomic significance of these variants requires further investigation. In addition, this species has been recorded in two locations in Western Australia (Lowrie, 1989) where the very similar *D. occidentalis* complex occurs. These variants, and the isolated population in southwest Western Australia (Lowrie, 1989) may require further taxonomic investigation.

Drosera spatulata grows along the length of the coast and adjacent tablelands, from sea-level to 1100 metres (Figure 2C). The red rosettes are usually 3-4 cm in diameter, but may reach 8 cm across when they grow under a thin film of water. Pink or white flowers are borne on one-sided racemes from September to July. It is common for the tips of the sepals to spread away from the ripening fruit. Plants in exposed, upland areas undergo a short period of winter dormancy, although they remain evergreen. Some leaf shape variation occurs—the leaves may be narrowly wedge-shaped, or have a slightly flaring petiole with a rounded lamina—but in all cases the stalked retentive glands occur over the length of the leaf. Some forms have unusually large flowers. A complete study of this common and widespread species would probably yield some surprising information. This species is found throughout southeastern and eastern Australia, New Zealand, southeast Asia from Indonesia to Japan (Erickson, 1968), and western Micronesia (Ziemer, 1987).

Family Lentibulariaceae

Utricularia aurea is a robust, evergreen, perennial aquatic species found primarily on the north coast, with infrequent records in the intermittent Paroo River in the far western plains (Cunningham *et al.*, 1992), always north of 31°S and from sea level to 200 metres elevation (Figure 2E). It commonly grows in farm dams. The leaves, which are produced all year, have three primary segments which are further

Figure 5: *D. peltata* (red-rosette, white-petal form) growing with *Drosera spatulata* on the south coast.

Figure 6: *Utricularia beaugleholei* in flower. Note the whorled arrangement of the flowers, the prominent yellow-striped palate and the reflexed margins of the upper lip. Photo by Sean Spence.

Figure 7: *Utricularia biloba* flowering in cultivation.

finely divided (Taylor, 1989). Yellow flowers are produced from December to May. This species also occurs in northern Australia, and southeast Asia, to Pakistan and Japan (Taylor, 1989).

Utricularia australis is a robust aquatic species which is similar to *U. aurea* (Taylor, 1989) but it may be identified by its leaves having only having two primary segments. Yellow flowers occur infrequently from January to July. This species stops growing in autumn and produces turions: compact, dormant, hairy growing points which recommence growth in mid-spring. It is found along the coast south of 31.5°S, the adjacent southern tablelands, and sporadically in the southwest slopes and western plains, from sea-level to 600 metres (Figure 2E). This adaptable species may occur in irrigated rice fields and also amongst waterlilies on sale at Sydney nurseries. It occurs in every Australian state (except Queensland), in New Zealand, tropical and temperate Asia, tropical and South Africa and most of Europe (Taylor, 1989).

Utricularia beaugleholei is a terrestrial species closely related to *U. dichotoma*. It is known only from five collections in NSW, from the southern tablelands and southwest slopes, at elevations between 100 and 500 metres (Figure 2D). The purple flowers are borne in multiple whorls of three between September and March. The strongly reflexed upper petal and radially arranged, 4-11 narrow yellow ridges at the base of the large, semi-circular lower petal are distinctive (Figure 6). This species also grows in central and western Victoria, and far-southeast South Australia (Gassin, 1993).

Utricularia biloba is a distinctive species known from only a few locations on the north and central coast, extending just south of Sydney (Figure 2F). It typically grows as an affixed aquatic in water up to 80 cm deep, and bears leaves up to 10 cm long which are divided into many filiform segments. In shallower water or exposed wet sand, the leaves are shorter and less divided. Traps are usually only produced underground. In February to June the substantial (up to 50 cm tall), often branching scapes are produced which carry up to 30 attractive dark purple flowers. The bilobed lower petal bears two white and yellow stripes on its bulbous palate (Figure 7). The broken range of this species may be a product of the last sea level rise 18000 to 6000 years ago, which flooded and fragmented a once extensive barrier beach system with interdune lakes and swamps (Roy, 1984). More recently, urban sprawl and agriculture have ruined many other locations. This species is endemic to the east coast and extends into southeastern Queensland (Hart, 1987; Taylor, 1989).

Utricularia caerulea is found only on the north coast, north of 30°S, at altitudes of 0—200 metres (Figure 2F). There is an informal record of it occurring as far south as Sydney (Erickson, 1968, page 73). This variable terrestrial species flowers from August to April and has purple or white flowers clustered at the top of 30 cm tall scapes. The horizontal nectary spur projects beyond the apex of the lower petal, which has four parallel yellow stripes at its base. This wide ranging species also occurs in Queensland and northern Australia, southeast Asia, from India to Japan, and Madagascar (Taylor, 1989).

Utricularia dichotoma, an attractive and variable species, is the most widespread bladderwort in the state and occurs from the coast to western slopes, and less commonly in the southwest and far-western plains (Figure 2D). It grows from sea level to 1500 metres altitude. It flowers year-round, though most commonly in the warmer months, bearing dichotomously-arranged or singularly-held purple (rarely white) flowers on a scape 10—50 cm tall. The flowers have a flat upper petal and a semicircular to tear-drop shaped lower petal. The palate has two or three prominent yellow ridges with smaller, peripheral ridges. The western-most occur-

rence of this species in NSW is an interesting one in a number of moundsprings. It occurs in all states except the Northern Territory (Taylor, 1989).

Utricularia gibba is the smallest aquatic bladderwort in the state and occurs in the north and central coasts, from sea level to 300 metres altitude (Figure 2E). It is a perennial species with a conspicuously coiled growing tip and sparsely divided, filiform leaves up to 2 cm long which bear 1-4 traps. It flowers from September to June and is particularly floriferous when in drying pools and on mud banks. Whilst commonly found in most rivers and lakes, this species is equally at home in farm dams and amongst waterlilies on sale in nurseries. It is one of the most widespread of all carnivorous plants and occurs in Queensland, the Northern Territory, Western Australia, New Zealand, New Caledonia, southeast Asia, southern Europe, and throughout Africa and the Americas (Taylor, 1989).

Utricularia lateriflora grows along the coast and adjacent tablelands, from sea level to 1000 metres altitude (Figure 2F). This small terrestrial species produces remarkably tough scapes which stand up to 10 cm tall and bear 1-8 purple (rarely white) flowers. This deep-rooted, drought-tolerant species probably occurs elsewhere in the state. Its total range is from southeast Queensland to southeast South Australia, including Tasmania (Taylor, 1989).

Utricularia monanthos is an attractive but small terrestrial species restricted to the southern tablelands between 1150 and 1650 metres altitude (Figure 2D). One or two dark-purple flowers are produced on short scapes from December to March. The lower petal is tear-drop shaped, with two or three yellow ridges at its base. The leaves are up to 5 cm long, and its 3 mm × 2 mm traps may be studied easily with the naked eye. In NSW it grows separate from all other bladderworts but it may be accompanied by *D. arcturi*. This species also occurs in mountain districts in Victoria, Tasmania and New Zealand (Taylor, 1989). From my studies I am not convinced of the recent union of this species with *U. novae-zelandiae*.

Utricularia uliginosa is a small but distinctive species found along the coast north of 35.5°S, from sea level to 200 metres altitude (Figure 2F). It grows either as a terrestrial species or as an affixed aquatic; in the latter case it can produce remarkably large leaves up to 18 cm long. The erect scapes bear one to five purple flowers. The upper petal scarcely projects beyond the calyx. The horizontal, narrowly wedge-shaped lower petal is dominated by an axial dome. This widespread species also occurs in Queensland and across Northern Australia, in New Caledonia, and in southeast Asia to Japan and India (Taylor, 1989).

Utricularia uniflora is a widespread, locally common species recorded from the central coast and central and southern tablelands, from sea level to 1100 metres elevation (Figure 2D). Although similar to *U. dichotoma*, it is a distinctive species. The purple flowers are produced singularly (rarely in pairs) mainly from November to June. They have a distinctive semi-circular lower petal, paler in the center than the margins, with radially arranged, yellow, white and purple palate ridges of differing lengths. This species occurs from south eastern Queensland to Victoria and western Tasmania (Taylor, 1989).

Family Martyniaceae

Ibicella lutea is a widely established weed from South America which may be carnivorous (Juniper *et al.*, 1989). This summer-growing annual is found from the coast to the western slopes and its tough, hooked fruit cause financial losses in the wool industry (Auld and Medd, 1987). The majority of the plant is covered with short-stalked retentive glands which efficiently trap small flying insects. The related *Martynia annua, Proboscidea louisianica* and *P. fragrans* (from the Americas) are

also established in eastern Australia, including NSW, and are similarly covered in stalked retentive glands (Auld and Medd, 1987). They have been proven to be only sub-carnivorous (at most). Perhaps they depend on bugs for the digestion of their prey, comparable to other sub-carnivorous plants like *Byblis* or *Roridula*.

Conclusion

From the distribution maps it is evident that the native carnivorous species grow in five physiographic regions, in a range of intermittently to permanently wet habitats. Most are found along the coast and adjacent tablelands, with a concentration of fifteen species on the central coast around Sydney. Only seven species extend west of the Great Dividing Range. The majority of species are widespread and common and extend to other parts of eastern Australia, and often overseas. Only *Aldrovanda vesiculosa* is classed as rare or endangered within the state. The two endemic *Drosera peltata* variants are currently undergoing further study.

Acknowledgements

I wish to thank the helpful staff at the Royal Botanic Gardens herbarium in Sydney for granting me study access to the collection. I also wish to thank Robert Gassin for thought-provoking correspondence and for the exchange of data.

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Erratum

In issue 28:1, page 26, the Editor's comment was accidentally truncated. The last line should have read, "These latter have previously been attributed to *N. veitchii* or a hybrid involving this species."

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