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Dypsis gronophyllum with its attractive praemorse leaflets. See article by M. Rakotoarinivo et al., p. 5.

BACK COVER

Masoala kona, a subcanopy palm. See article by M. Rakotoarinivo et al., p. 5.



Livistona australis, Cabbage Tree Creek Flora Reserve, Victoria, Australia. Photo by J.L. Dowe (December 2018). See article by J.L. Dowe, p. 25.

PALM NEWS

In August of this year, **Rio de Janeiro, Brazil, will host the VII World Palm Symposium** (www.palms2020.com). This conference will bring together palm researchers from all over the world to present their work in areas ranging from ecology and conservation to evolution and ethnobotany. With support from the IPS, the conference is offering travel grants to students and researchers in the early stages of their careers and/or from developing countries. The IPS is proud to sponsor in part this important gathering of palm specialists, and the IPS is grateful to the financial contributions of its membership that make this sponsorship possible.



2000-year old seeds. These ancient dates show a blend of genes from the Middle East (eastern) and North Africa (western) date palm gene pools, with older seeds possessing genomes with more eastern influence. The authors also reported that two of the six seedlings are female and four are male, meaning that when these plants mature, growers will be able to cross them and reconstitute (approximately) the dates for which the ancient region of Judea was famous.

Sarah Sallon and colleagues reported on **the germination, morphology and genetic analysis of 2000-year old seeds of the date palm, *Phoenix dactylifera*** (Science Advances 6: eaax0384; DOI: 10.1126/sciadv.aax0384). The authors compared the morphology of ancient seeds recovered from archeological sites in Israel with that of modern date palm seeds. The ancient seeds were longer and wider than modern seeds. They also performed a molecular genetic analysis of six seedlings that grew from

Chloé Guerin and colleagues have analyzed **the lipid content of palm fruits and seed across the family** (*Annals of Botany* 125: 157–172. 2020). In the context of the vital importance of lipids to worldwide human nutrition the authors characterized the oil and fatty acid composition of 174 and 144 palm species, respectively. A considerable diversity of lipid traits was revealed. Species with the most lipid-rich seeds belonged to the tribe Cocoseae, while species accumulating oil in the mesocarp occurred in all subfamilies and two-thirds of the tribes studied. Seed and fruit lipid contents were not correlated. Fatty acid composition of mesocarp oil was highly variable within tribes. Medium-chain fatty acids predominated in seeds of most palm species, but they were also accumulated in the mesocarp in some cases. Seed unsaturated fatty acid content correlated with temperature at the coldest latitude of natural occurrence. Several previously uncharacterized palms were identified as potential new sources of vegetable oils for comestible or non-food use.



Palm Diversity at Vondrozo, Madagascar

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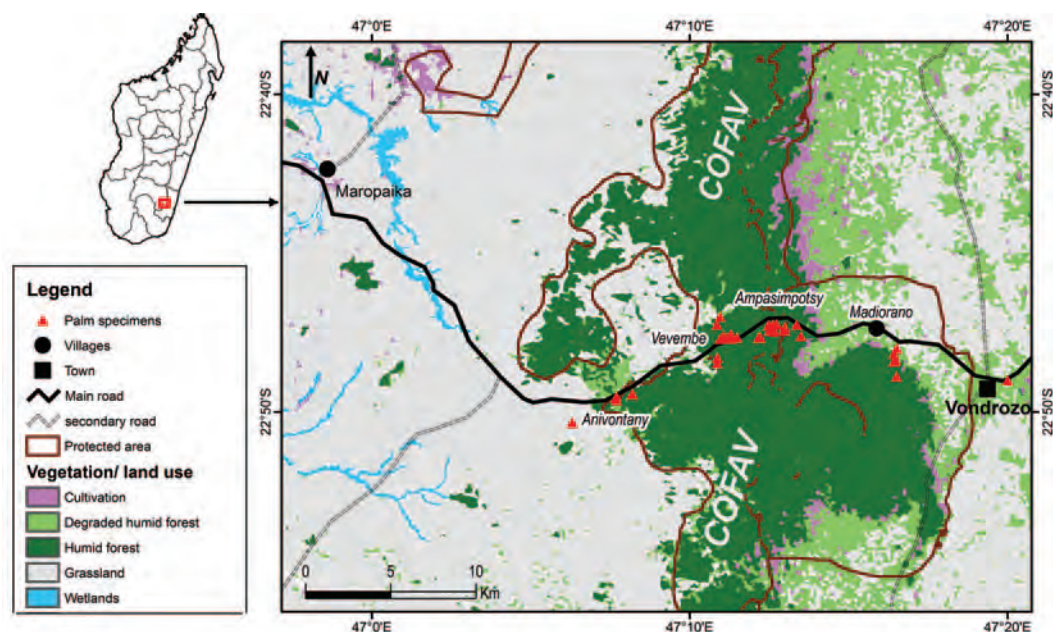
Madagascar is one of our favorite places for palms; it has such an amazing diversity, plus getting to that diversity can be so exciting! The so-called Vondrozo forest is a prime example of both a thrilling journey and rich destination.

Vondrozo is a busy little market town in the southeast of Madagascar, located 45 km (30 miles) from the town of Farafangana, on the east coast, on the Route Nationale 27, connecting Vondrozo town westwards to Ihosy in the highlands. Vondrozo is part of the lowland ecoregion in the eastern part of Madagascar (Burgess et al. 2004); the geomorphology is characterized by steep mountains and hills forming an escarpment with a relatively flat plateau stretching westwards from the escarpment summit. Altitudinal range of the escarpment is between 500 and 700 m. Geologically, the region is dominated by crystalline basement metamorphic series with gneiss and migmatites, and series-quartz schist (MEF 2010). According to the FAO soils classification (Fischer et al. 2008), the dominant types of soil are ferrasols with up to 60% sand in some areas. The climate is humid with a precipitation of about 1800–2400 mm/year (Cornet 1974); the lower part of the escarpment, in the east, is wetter than its summit. The primary vegetation is lowland

humid forest and forms part of the recently created protected area, the COFAV or Corridor Fandriana Vondrozo (Fig. 1). This forest is of vital importance to the people of the region, as it protects water supplies, and as they use it for collecting timber and non-timber forest products, grazing their cattle and in cultural and spiritual ceremonies (WWF 2018). Their main livelihood pursuits include rice cultivation, cattle herding and growing cash crops such as coffee and bananas.

Despite the previous knowledge that a large primary forest occurs in the mountains beyond Vondrozo, botanists only became aware of the richness and abundance of palms in the area in 2006. The first palm specimen from Vondrozo was made in 1963 by Bosser, the specimen (Bosser 18599) remained unidentified for a long time but has been tentatively identified as *Dypsis macdonaldiana* by Dransfield and Beentje (1995) in their monograph *The Palms of Madagascar*.

First intimations of the interest of Vondrozo for palms came from Dr. Franck Rakotonasolo,



1. Map showing the location of Vondrozo forests

from the Kew Madagascar Conservation Centre, who returned from a trip in 2006 surveying wild species of *Coffea* (Rubiaceae) with tales of large populations of palms, including *Beccariophoenix madagascariensis*, and with photographs to prove his point (Fig. 2). As soon as he got back to Antananarivo, Franck alerted the palm researchers at the Royal Botanic Gardens Kew (RBG Kew) to the exceptional diversity of the palm flora in Vondrozo, in particular the large population of *Beccariophoenix madagascariensis*, a palm species at that time considered to be on the verge of extinction as its populations in the Mantadia and Fort Dauphin areas are composed of only few mature individuals. From that time, fieldwork was planned for surveying the palm diversity in Vondrozo. Between 2006 and 2016 researchers from RBG Kew were involved in four expeditions, from which our current knowledge of the palms of Vondrozo is based.

In this time frame, much has changed as far as access conditions to Vondrozo are concerned. In 2006/07, it took only a few hours to travel the 65 km (40 miles) from Farafangana to Vondrozo; in 2016 the road had deteriorated so much it took us six hours. Furthermore, these are not the most exciting six hours, either – all we saw was grassland with little bits of scrub, small clumps of traveller's tree and more rarely the odd tree of *Dyopsis mananjarensis*. Villages are sited on

raised ground, while in the valley bottoms rice is cultivated. In the dry season the landscape is burned thoroughly.

Beyond Vondrozo the road became even worse! Only trucks and 4-wheel drive vehicles can get to Madiorano, 15 km (9 miles) West of Vondrozo, and this is where all traffic comes to an end – what was once a bridge is now a scaffolding of rusting steel. The riverbanks were steep, or covered in rice-fields, and the ex-bridge was the only possible crossing point. Most of the planks forming the bridge-bed have been recycled for other uses, and those that are left are arranged so that foot traffic and bicycles can pass. We were stuck, 5 kilometers from the escarpment and the forest we wanted to reach. Luckily the Kew driver, Roger, is a living Madagascar treasure, and came up with the solution. The few remaining planks could be spread out to support one of our two vehicles partway across the bridge; we then took up some planks from behind the car, put them in front, and so the car inched its way across (Figs. 3 & 4). Then the whole process had to be repeated for the second vehicle!

It was obvious we were the first to use this ingenious system; the road after Madiorano was even worse than before, eroded, muddy, steep and with holes half the size of a car (Fig. 5). Slowly we wound our way up the escarpment that begins here, and slowly we rose to the level of the first forest, our target

area. This is some of the most wonderful forest in Madagascar (at least for palms), stretching along the road for some 10 km before the grasslands start again, with some gallery forest in the valley bottoms. The narrow band of forest in the mountains at Vondrozo probably owes its existence to local rainfall patterns, the forest petering out to the west as the rainfall decreases. Rapid biological survey carried out by MICET (2005) resulted in the conclusion that the flora is diverse; up to 535 species of Angiosperms and 186 species of Pteridophytes. At the species level, 71% of plant species encountered in Vondrozo are endemic to Madagascar. Why this area of forest should be so exceptionally diverse and interesting for palms is not at all clear. At present, the parlous state of the road must be playing a significant role in forest protection, but even in 2007 when road access was much better, the forest seemed unusually well preserved.

At present, control of extraction and forest management comes under the umbrella of the local COBA (Communauté de base, local managers of natural resources) of Madiorano. Ultimately the forest should be protected by

the office of the Département des Eaux et Forêts located in the town of Vondrozo. We know little of the importance of these forests for wildlife, but if the plant life is so exceptionally interesting then surely the animal life will also be diverse.

Four expeditions have been undertaken in Vondrozo so far:

1) MR in 2006, making the first modern palm collections from the area; among the collections made were a significant number of specimens that could not be matched with any known taxon.

2) JD and MR in 2007 together with Soejatmi Dransfield and Jacky Andriatiana from Parc Botanique et Zoologique de Tsimbazaza, Antananarivo. The trip aimed to visit more unexplored forests fragments and to recollect additional material for completing the description of *Dypsis gronophyllum*.

3) MR accompanied Wolf Eiserhardt from RBG Kew in 2014 to collect material for DNA analysis as part of the Madclades project, a phylogenetic study of all palms of Madagascar.

2. Patch of forest in Vevembe harbouring several emergent trees of *Beccariophoenix madagascariensis*.





3 (top).The (partial) bridge at Madiorano, the only way to reach the Ampasimpotsy and Vevembe forests by vehicle. 4 (bottom). Careful redistribution of planks to allow inching the Landrover forward.



5. The main road with gullies near Ampasimpotsy, at the summit of the escarpment.

Although many taxa had already been discovered and described in Vondrozo during the previous trips, a new taxon, named later as *D. aurantiaca*, was found.

4) Finally, in 2016 HB, JD and MR visited Vondrozo with several others aiming to try to get to areas further away from the road. However, during the 2016 visit access was so fraught and difficult that we had to confine ourselves to working up and down along the road, rather than attempting other areas. Despite this area having already been visited we nevertheless found new palms and made new observations.

Based on the collections from the four expeditions (Fig. 6), there are now 26 palm species recorded from the Vondrozo area, with at least four mystery collections or sightings requiring further work. With such species abundance, the richness rate is particularly high for a site in the southeast of Madagascar, where sites rarely exceed 20 species. Characteristic species of the southeast such as *Dypsis mananjarensis* (Fig. 7) and *D. prestoniana* form a very characteristic component of the flora of the region. In almost all the lowland humid forest, these two species are relatively

frequent in different patches of forest. However, a neat, east-west, altitudinal gradient is noticed in floristic composition; this general pattern explains the small range of the different species. It appears that the forests of Vondrozo play an important role in the survival of several rare palms by being their refuge through offering optimal conditions throughout the zone. Out of the 26 recorded species, six species were recorded and described for the first time from Vondrozo (*Dypsis aurantiaca*, *D. culminis*, *D. dracaenoides*, *D. gronophyllum*, *Ravenea beentjei* and *R. hypoleuca*); some of these species have been recorded more recently from other sites. In the lower part of the escarpment, around 500 m above sea level, such as on the hills around the village of Madiorano (Fig. 8), the palm flora is composed of representative species of the lowlands of the southeast as well as some vicariant species, for example *Dypsis culminis*, *D. fibrosa*, *D. nauseosa*, *Dypsis pinnatifrons* and *Ravenea julietiae*. In the ridge forest on the summit of the local escarpment, between 600–700 m asl., the palm flora is dominated by submontane species, such as *Dypsis eriostachys*, *D. utilis* and *Ravenea krociana*. In this zone, the palm flora is very heterogeneous as floristic



6. The 2016 inventory team preparing a herbarium specimen of *Dypsis pinnatifrons*.

composition may vary rapidly according to the type of substrate. For instance, in Vevembe, on white sands, *Beccariophoenix madagascariensis* and *D. saintelucei* are the most

abundant species. In swamp forest nearby, *D. utilis*, *D. gronophyllum* and *R. beentjei* occur. Finally, towards the west on the road to Ivohibe, in relatively sclerophyllous forest (Fig. 9), the palm flora becomes poorer; *D. mananjarensis* is now rare while *D. procumbens* and *R. madagascariensis* dominate.

The following is a checklist of all palm species recorded from Vondrozo, with notes on their distribution range and ecological preferences. This is the first compilation documenting the extraordinary palm flora of Vondrozo. Two papers including the description of new taxa from Vondrozo were published earlier (Rakotoarinivo & Dransfield 2010; Eiserhardt et al. 2018), but neither of them catalogued the 26 species of the area:

***Beccariophoenix madagascariensis* Jum. & H. Perrier**

IUCN category and criteria: Vulnerable B1ab(iii)+2ab(iii).

An arborescent palm up to 20m tall (Fig. 10), known to occur from five disjunct areas between Mantadia and Fort Dauphin, between 0–1200 m asl. The population in Vevembe (Vondrozo) is the largest known in Madagascar and is estimated to consist of more than 900 mature individuals. [Herbarium specimen from Vondrozo (HS hereafter) = *Rakotoarinivo 514* – K, TAN].

7. Patch of forest near Vevembe, dominated by a large population of *Dypsis mananjarensis*.





8 (top). Hills near Madiorana largely covered with lowland humid forest. 9 (bottom). Sclerophyllous forest at Anivontany, on the road to Ivohibe.

Dypsis aurantiaca Eiserhardt & Rakotoarin.
preliminary assessed as Data Deficient.

Clustering understory palmlet, known only from a few individuals on the hill of Manambidala, close to Ampasimpotsy (Eiserhardt et al. 2018) [HS = *Eiserhardt* 106 – K, MO, P, TAN].

Dypsis culminis Rakotoarin. & J. Dransf.
Endangered B1ab(ii,iii)+2ab(ii,iii); D.

Clustering understorey palm with long entire bifid leaves and inflorescence reminiscent of those of *D. procumbens* (Rakotoarinivo & Dransfield 2010). The species was discovered at Madiorano, Vondrozo in 2006 and then



10. Tree palm *Beccariophoenix madagascariensis* distinguished by its massive young inflorescence resembling a torpedo.

recorded in Tsitongambarika massif in 2010 (Dransfield & Rakotoarinivo 2012). [HS from Vondrozo = *Rakotoarinivo* 335 – K, TAN].

Dypsis dracaenoides Rakotoarin. & J. Dransf.

Critically Endangered B1ab(iii)+ 2ab(iii).

Clustering palm of the understory, the species has two forms with different leaf dissection ~ pinnate and very long entire bifid (Figs. 11 & 12). The dissected-leaved form of this beautiful species bears an uncanny resemblance to *Dracaena*. Discovered in 2006 (Rakotoarinivo & Dransfield 2010), the species has not been recorded elsewhere in Madagascar. [HS from Vondrozo = *Rakotoarinivo et al.* 312 – K, TAN; *Rakotoarinivo et al.* 316 – K, TAN].

Dypsis eriostachys J. Dransf.

Endangered B1ab(ii,iii)+2ab(ii,iii); D.

A clustering dwarf to shrubby palm, the species is now known to be present in the submontane forest between Mount Kianjavato and Fort Dauphin. In Vondrozo, the species seems to be restricted to sandy soil or to peat swamp forest around Ampasimpotsy [HS from Vondrozo = *Rakotoarinivo* 327 – K, MO, P, TAN].

Dypsis fibrosa (C.H. Wright) Beentje & J. Dransf.

Least Concern.

A clustering and branched understory palm. The species is usually present in lowland humid forest, from Sambirano region and Daraina to Fort Dauphin area. In Vondrozo, the species can be found in forests at Madiorano and Ampasimpotsy [HS from Vondrozo = *Rakotoarinivo* 351 – K, MO, P, TAN].

Dypsis gronophyllum Rakotoarin. & J. Dransf.

Critically Endangered B1ab(iii)+ 2ab(iii); D.

Clustering palm to 4m tall; the species has praemorse leaflets (Front Cover) like those of *D. thiryana* and *D. trapezoidea* but differs from these species in its much larger habit, its much broader and thicker leaflets and much more robust inflorescences. The species was discovered in 2006 and is known only from Vondrozo; growing in peat swamp forest [HS from Vondrozo = *Rakotoarinivo* 320 – TAN; *Rakotoarinivo et al.* 350 – K, TAN; Eiserhardt et al. 106 – K, TAN].



11. Form of the species *Dypsis dracaenoides* with entire bifid leaves.

Dypsis mananjarensis (Jum. & H. Perrier)
Beentje & J. Dransf.
Near Threatened.

A canopy or an emergent tree palm that is characteristic of the lowland humid forest in the southern part of Madagascar, from

Ampasimanolotra area to Fort Dauphin. In Vondrozo, *D. mananjarensis* seems to be the most frequent palm (Fig. 13); it can be seen in almost all patches of forest. The species colonizes dry valley bottoms, midslopes or ridge crests. [HS from Vondrozo = *Rakotoarinivo* 326 – K, P, TAN].



12. Finely dissected leaves of *Dypsis dracaenoides*.



13 (top). Group of *Dypsis mananjarensis* near the forest of Madiorano. 14 (bottom). View of the crown of *Dypsis nauseosa* from underneath

Dypsis mcdonaldiana Beentje

Endangered B1ab(iii)+2ab(iii).

The species has not been seen and confirmed during the four expeditions in Vondrozo but the specimen *Bosser 18599* (K, P) collected in 1963 has been identified as this species. Additional research is needed to resolve this case.

Dypsis nauseosa (Jum. & H. Perrier) Beentje & J. Dransf.

Critically Endangered D.

A tree palm with a crownshaft more or less open, covered with white wax and scattered scales, adaxially cherry-red (Fig.14). The species is known to occur in the lowlands between Ifanadiana and Vondrozo. In this latter site, *D. nauseosa* seems to be restricted to the hills around Madiorano. [HS from Vondrozo = *Rakotoarinivo 336* – K, P, TAN].

Dypsis nodifera Mart.

Least Concern.

A solitary slender understory palm, with grouped, twisted and fanned leaflets; inflorescence usually reddish and endosperm is deeply ruminant. The species is one of the commonest palms of humid forest, distributed from Sambirano and Montagne d'Ambre in the north to Fort Dauphin in the south. In Vondrozo, the species seems to be constantly present throughout the forest. [HS from Vondrozo = *Fihova 014* – K, TAN; *Fihova 017* – K, TAN].

Dypsis pinnatifrons Mart.

Least Concern.

A medium-sized palm of the understory, up to 12 m tall, this species is superficially very similar in habit, inflorescences and, especially, leaf form to *D. nodifera*. With flowers and fruits, *D. pinnatifrons* can be distinguished by the three stamens and a seed with homogenous endosperm. This species is one of the commonest palms in the eastern lowland humid forest of Madagascar. In Vondrozo, the species is distributed throughout the forest. Sometimes, this species forms relatively thick colonies on forest margins. [HS from Vondrozo = *Fihova 015* – K, TAN].

Dypsis prestoniana Beentje

Vulnerable B1ab(ii,iii,v); D1.

A robust tree palm, up to 25 m tall and characterized by a massive open leaf sheath and with grouped fanned leaflets; the inflorescence is also very large, reaching up to 2 m long (Fig. 15). This is a palm of the southeast of Madagascar, distributed in the lowlands from Mahanoro to Fort Dauphin. In Vondrozo, the species seems to be restricted to the lowest part of the escarpment, on the hill near Madiorano. [HS from Vondrozo = *Rakotoarinivo 333* – K, P, TAN].

Dypsis procumbens (Jum. & H. Perrier) J. Dransf., Beentje & Govaerts

Near Threatened.

A clustering slender understory palm, with scaly reddish crownshaft; the inflorescence rachis is usually orange (Fig. 16). This species occurs generally in submontane or montane forest of the eastern escarpment between Mananara Avaratra to Andohahela. In Vondrozo, it inhabits bamboo-rich montane forest in Anivontany, on the road to Ivohibe [HS from Vondrozo = *Rakotoarinivo 331* – K, P, TAN].

Dypsis saintelucei Beentje

Endangered B2ab(ii,iii); C2a(i).

A subcanopy tree palm with a neat tristichous arrangement of leaves in the crown; the species can be distinguished by its light green crownshaft and the hanging proximal leaflets (Fig. 17). The species was at first thought to be endemic to Sainte Luce near Fort Dauphin but was later recorded further north in Ampasimanolotra area and then in Vondrozo. In these fragmented known sites, the species grows on temporarily inundated forest on white sands. In Vondrozo, the species is located in Vevembe. [HS from Vondrozo = *Rakotoarinivo 313* – K, P, TAN].

Dypsis tanalensis (Jum. & H. Perrier) Beentje & J. Dransf.

Critically Endangered B1ab(iii)+ 2ab(iii); D.

A solitary tree palm with pale green crownshaft, tristichous leaves and regular leaflets. It is a rare palm known to occur in Vohipeno and Vondrozo. In this latter site, *D. tanalensis* grows in inundated forest close to Ampasimpotsy. [HS from Vondrozo = *Rakotoarinivo 324* – K, P, TAN].

Dypsis tenuissima Beentje

Endangered B1ab(iii)+2ab(iii); D.



15. A robust tree palm of *Dypsis prestoniana* surviving on cleared land near Madiorano.

A dwarf palm less than 50 cm tall, with short entire leaves and spicate inflorescence. The species is known so far from Andohahela and Vondrozo. In Vondrozo, the species is rare and seems to be found only around Ampasimpotsy. [HS from Vondrozo = Rakotoarinivo 328 – K, P, TAN].

Dypsis utilis (Jum.) Beentje & J.Dransf.
Endangered B2ab(ii,iii,v).

A subcanopy palm growing in peat swamp or along watercourses; the stem branches. The species could be misidentified as *D. fibrosa* but differs by its more robust size of different parts



16. Colony of *Dypsis procumbens* in the sclerophyllous forest of Anivontany.



117. *Dypsis saintelucei* with its tristichous leaves and with hanging proximal leaflets.

and the inflorescence branched to three orders. *D. utilis* is a palm of submontane forest with a disjunct distribution between Zahamena to Vondrozo. [HS from Vondrozo = *Rakotoarinivo* 323 – K, P, TAN; *Eiserhardt et al.* 106 – K, TAN].

Masoala kona Beentje
Endangered B1ab(iii)+2ab(iii); D.

A squat palm with broad irregularly dissected leaf; sometimes the leaf is nearly entire. The



18. General habit of male plant of *Ravenia beentjei*.

upper part of the stem is covered by old leaf sheaths which trap litter (Back Cover). This species might be confused with *Marojejya insignis* but differs from the latter by its very conspicuous inflorescence. *M. kona* is known

from two distinct sites: Ifanadiana and Vondrozo area. In the latter site, the species grows with *D. gronophyllum* in occasionally inundated forest. [HS from Vondrozo = *Rakotoarinivo* 319 – K, P, TAN].



19. Close up of the leaf sheath base and the pendulous staminate inflorescence of *Ravenea beentjei*.

Ravenea beentjei Rakotoarin. & J. Dransf.
Critically Endangered B1ab(iii,v)+2ab(iii,v);
D.

A medium sized dioecious palm, with porrect leaves. Male inflorescences are pendulous with

remarkable numerous small flowers (Figs. 18 & 19) while female inflorescences are usually erect and bearing fewer number of flowers (Fig. 20). Fruits have apical stigmatic remaining and contain three seeds. The species is known only from Vondrozo forest, in the flooded area of



20. Female plant of *Ravenea beentjei* with erect pistillate inflorescence.

Ampasimpotsy. [HS from Vondrozo = *Rakotoarinivo* 317 – K, P, TAN; *Rakotoarinivo* 321 – K, P, TAN].

Ravenea hypoleuca Rakotoarin. & J. Dransf.
Critically Endangered B1ab(iii)+2ab(iii); D.

A medium-sized solitary dioecious palm. The stem is blackish brown and covered in sheath remnants in the upper part. Leaves are porrect and marcescent; leaflets are pale green on the upper surface and covered in thick white tomentum on the lower surface, like those of *R. albicans*. Discovered and described from a Vondrozo specimen collected in 2006, a new site of *R. hypoleuca* was located in Tsitongambarika massif in 2010 (Dransfield & Rakotoarinivo 2012). In both sites, the species is found on mid-slopes and near ridgetops. [HS from Vondrozo = *Rakotoarinivo* 315 – K, TAN; *Rakotoarinivo et al.* 353 – K, TAN].

Ravenea julietiae Beentje
Endangered B2ab(iii,v); D.

A dioecious species with graceful medium-sized trunk and arching leaves. In habit, this species might be confused with *R. sambiranensis* but

it is distinct in its more slender size and its pistillate inflorescence bearing a long peduncle, up to 3m long. Despite a wide distribution range, from Masoala Peninsula to Vondrozo, this is somehow a rare palm as occurrence sites are fragmented. In all known sites, the species grows on steep mid-slopes or near ridge crests. In Vondrozo, the species is found in the hills around Madiorano. [HS from Vondrozo = *Rakotoarinivo* 334 – K, P, TAN].

Ravenea krociana Beentje
Endangered B2ab(iii).

A majestic solitary palm with ventricose trunk. Leaves are porrect in the crown. Staminate inflorescences are pendulous and protected by several large and conspicuous bracts. Pistillate inflorescences are at first erect but become pendulous at fruiting stage. Fruits are relatively large compared with other species of *Ravenea*. The species distribution range is in submontane forests between Ampasimanolotra and Andohahela. In Vondrozo, the species is found only on the flat flooded plain in Vevembe, next to the habitat of *Beccariophoenix madagascariensis*. [HS from Vondrozo = *Rakotoarinivo* 332 – K, TAN].

***Ravenea madagascariensis* Becc.**

Least Concern.

A graceful dioecious medium-sized palm, with leaves erect in a shuttlecock or slightly arching. Either staminate or pistillate inflorescences are erect inside the crown and the inflorescences are barely covered with an elongated bract. This palm occurs in montane forest between Marojejy to Midongy Atsimo but occurs also in the Manakara coastal region. In Vondrozo, *R. madagascariensis* is restricted to the relatively drier area of Maropaika, on the road to Ivohibe. [No herbarium specimen; sight records only].

***Ravenea robustior* Jum. & H. Perrier**

Near Threatened.

A majestic dioecious palm with columnar or rarely ventricose trunk, with a conspicuous bulbous base. Leaves are porrect and held in shuttlecock in the crown. Inflorescences are erect at anthesis but pistillate inflorescences become pendulous and spreading in the fruiting stage. Fruits are small. This is one of the commonest palms in humid forests in Madagascar, with a distribution range from Sambirano and Montagne d'Ambre to Fort Dauphin area, in the lowlands or in the middle altitude zones. In Vondrozo, the species is most frequent in the drier forest between Vevembe and Maropaika. [HS from Vondrozo = *Rakotoarinivo* 352 – K, TAN].

***Ravenea sambiranensis* Jum. & H. Perrier**

Least Concern

A slender dioecious palm with cylindrical trunk and leaves strongly arching but porrect in the crown. Staminate and pistillate inflorescences remain erect until they fall from the plant; inflorescences are bright orange and covered by elongated bracts. *Ravenea sambiranensis* is among the commonest palms of the humid forest, mostly in the lowlands but also occasionally at middle altitudes between Sambirano region and Dariana to Fort Dauphin areas. In Vondrozo, the species is constantly present in humid forests. [HS from Vondrozo = *Rakotoarinivo* 325 – K, TAN]

Palm diversity in Vondrozo is remarkably high. Our expeditions showed that species turnover may vary rapidly from two adjacent hills or from two close habitats. The species list presented here is probably still far from complete as only a small part of this relatively large forest area has been explored so far. Of

the 26 species known from these forests, six are Critically Endangered, nine are Endangered, and two are Vulnerable. These assessments (Rakotoarinivo et al. 2014) show that on the basis of palm diversity alone these forests are worth preserving – and of course, palms form only a tiny percentage of the organisms present. In addition, our knowledge of the palms of the area remains fragmentary; we are absolutely certain that further searches would turn up more treasures, and we hope that interest in the palms of Vondrozo will continue. For instance, a single juvenile plant of *Orania* (leaflets praemorse with ramenta and white scales on the undersurface) has been spotted in the mountains next to the village of Madorano. Unfortunately, the voucher does not allow us to identify correctly the species at this stage. Similarly, new undescribed taxa may also occur in this forest. Some unidentified forms of species from two genera, *Dypsis* and *Ravenea*, were noticed during the last expedition in 2016 (Fig. 21). Undoubtedly, additional exploration is needed and appears to be fundamental for conserving this extraordinary palm flora of Vondrozo.

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***Livistona australis*: the First Case of Species Conservation in Australia**

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The Cabbage Tree Creek Flora Reserve, Victoria, conserves Australia's southernmost population of *Livistona australis* (R.Br.) Mart., the Australian cabbage-palm. Instigated by Victorian government botanist Baron Ferdinand von Mueller, protection of the species was first established in 1871 with enactment of a government proclamation prohibiting the cutting or removal of the palm. This paper provides a brief history of how *L. australis* became Australia's first species-specific plant conservation subject.

In Australia, very few conservation areas have been established to specifically protect individual plant species. Most instances of conservation, such as in national parks and reserves, are relatively broad-scale and based on whole-of-habitat appraisal, the inter-connectedness of plant species with other biota, and the mitigation of threats to rare or threatened species within sometimes rare or unique habitats (Bradshaw 2012, Broadhurst

& Coates 2017). Apart from *Livistona australis* (R.Br.) Mart. (Australian cabbage palm), as conserved in the Cabbage Tree Creek Flora Reserve in Victoria, the few examples of other instances of species-specific conservation of historical note include the establishment of Bunya Mountains National Park in 1909 for the protection of *Araucaria bidwillii* Hook. (Bunya pine) (Anon. 1909), and the establishment of The Palms National Park in

1950 to protect a remote and unique inland population of *Archontophoenix cunninghamiana* (H.Wendl.) H.Wendl. & Drude (Picabbean or Bangalow palm) (DNPRSR 2013). Both parks are in southeast Queensland.

Prominent amongst the persons who first promoted conservation and expressed awareness of the threats to Australian plants and landscapes was Baron Ferdinand von Mueller (1825–1896), Australia's leading botanist of the latter half of the nineteenth century and Victorian government botanist 1853–96. Apart from his work as a taxonomist, explorer and botanical entrepreneur, Mueller actively promoted Australian plants for their health benefits and medicines, as potential crops and pasture plants, for fibers and building materials, and for their ornamental characteristics (Mueller 1872, 1895). Mueller presciently endorsed the establishment of "Floral Commons," notional precursors to modern national parks and conservation reserves. He described such places as "where the endemic riches are greatest, there also the danger is more imminent of these being swept out of existence, unless timely measures are adopted for the reservation of some sequestered spot, to which rural occupations should never be allowed to have any access with their disturbing influence on primeval harmonies. Such spots should be proclaimed for all times the people's inalienable property, and every inhabitant or visitor of the locality should consider himself the co-preserver of such areas, so as to aid in preventing accidental invasion or casual ignition or intentional spoliation" (Mueller 1890, p. 10). In addition, and seemingly in contradiction to his ideas on what would today be considered as environmental idealism, Mueller also proclaimed the establishment of commercial forestry reserves thus ensuring that a continuous and managed supply of native timbers could be made available for ongoing colonial development and expansion (Mueller 1879, Whitehead 2008). As noted by Mueller at that time, such forests in Australia "remain almost unguarded, become extensively reduced, and in some localities are already annihilated" (Mueller 1871a, p. 1). Mueller was also active in the trialing of introduced plants and was coincidentally responsible for the introduction of some that were to become serious weeds, for example the blackberry (*Rubus fruticosus* L.) (Mueller 1875). The subsequent negative environmental impact through acclimatization of plants and animals

at the time had unpredictable outcomes (Gillbank 2007). Thus Mueller put into focus a growing awareness in colonial Australia of the impending loss of "the original features of our primeval forests" through expansion and development (Mueller 1870, p. 10), and that actions were needed to halt the "merciless sacrifice of the native forests" (Mueller 1870, p. 8).

Among the plants that Mueller took an especial personal interest in was *Livistona australis*. This is Australia's most widespread palm species, occurring from Paluma Range, Queensland (ca. 19°S), intermittently along the eastern seaboard and with an isolated southernmost population in East Gippsland, Victoria (ca. 38°S) (Dowe & Jones 2011). In some areas where it was once very common it is now rare or extirpated, mainly through forest clearance for timber, pastoralism, agriculture and urbanization. In spite of this, it is otherwise adequately conserved in a number of national parks and conservation areas (Dowe 2010).

Mueller's first personal encounter with *L. australis* was during an exploratory expedition in eastern Victoria in March 1854 when he observed the species at Brodribb River and Cabbage Tree Creek (Barnard 1904). In his annual report as government botanist for 1854, Mueller wrote that he had "reached, in the middle of March, the country beyond the mouth of the Snowy River, the most southerly locality in which palms exist in the Australian Continent ... the stately *Corypha* palm or *Livistonia australis* [sic], one of the 'princes of the vegetable world,' attains here the height of more than sixty feet, and may be deemed one of the most useful productions of our Flora, furnishing in its young leafstalks and terminal bud the palm cabbage, a food equally wholesome and delicious, whilst the fan-shaped leaves are eagerly collected for the manufacture of hats" (Mueller 1854a, p. 5).

Mueller revisited the "Cabbage-tree country beyond the Snowy River" in February 1855 in anticipation of collecting flowers of those plants of which he had only collected fruits in March 1854. Curiously there are no known surviving herbarium specimens of *L. australis* collected by Mueller despite his usual thoroughness in gathering specimens of Australian plants. Mueller initially implied in his reports that he was the first European to observe the palms at Cabbage Tree Creek, although later he rescinded this assertion and

noted that members of the McLeod family, who were looking for cattle pasturage in the Snowy River/Brodribb River area, had seen the palms in the years prior to his visit. The McLeods abandoned their attempts at permanent settlement in the area because of conflict with the indigenous inhabitants (Wakefield 2010). However, Mueller wrote that “at all events, I was the first, 35 years ago, under the danger of attacks from then murderous natives, to render known publicly the existence of this Fan-palm so far south, and to identify the genus and species” (Mueller 1889). Mueller’s description of “murderous natives” reveals a common attitude of the European colonists towards the indigenous inhabitants at that time. One-sided conflict largely saw the indigenous peoples annihilated through massacres and mass poisonings in the Gippsland area as European settlement was established (Gardner 2001).

Livistona australis was first described (as *Corypha australis* R.Br.) by Scottish botanist Robert Brown (1810) for a taxon that he observed in the Sydney/Hawkesbury River, New South Wales, area in 1802-03. The taxon was later transferred to *Livistona* by Martius (1838). Despite Brown’s original description being very brief, Mueller had no doubts about the identity and nomenclatural status of *L. australis* at his

first observation of the species at Cabbage Tree Creek. Although a greatly expanded description of the species was provided by Martius in *Historia Naturalis Palmarum*, Mueller did not have access to that publication at initial encounter. Mueller’s first known record of receiving a copy of Martius’s work was in 1865 (Mueller 1865). Other descriptions of *L. australis* that were available to Mueller were iterations of Brown’s original description in publications in his library, for example in *Enumeratio Plantarum* (Kunth 1841). Mueller was to eventually describe a number of new *Livistona* species from Australia (Dowe & Maroske 2016) (i.e., *L. alfredii* F.Muell., *L. drudei* F.Muell., *L. leichhardtii* F.Muell., *L. mariaae* F.Muell. and *L. ramsayi* F.Muell. [= *Licuala ramsayi* (F.Muell.) Domin]), and he often used *L. australis* as the basis of synoptic comparison referencing leaf outline, fruit shape and armature as distinguishing specific characters.

At first by necessity, *L. australis* became a food item for colonists who settled in remote locations where the palm grew. The palm heart was consumed as either a fresh or cooked vegetable but with increasing sophistication of the settlers, it became more of a novel and extravagant culinary item. There is no record of Indigenous people in Victoria consuming the palm heart before European settlers

1. Cabbage tree hat made from the leaves of *Livistona australis*, ca. 1860, with a silk puggaree. State Library of Victoria.





2. *Livistona australis* at Cabbage Tree Creek, from Spencer and French (1889), *Victorian Naturalist* 6 (1–2), fig 3. Source BHL with acknowledgment.

revealed the practice to them. A distinctively styled hat, known as the cabbage tree hat (Fig. 1), was fashioned from the leaves (Mueller 1872). There were a few styles with varying heights of the crown, but all had a wide brim and were often fine examples of craftsmanship (Maynard 1994). To weave the hat, the leaf was boiled, dried and bleached and the segments were separated into thin strips. Numerous cottage industries were established to produce the hat in the period 1820–60, and it became a ubiquitous, somewhat nationalistic item worn by both male and female colonists throughout the country (Kiddle 1961, Renew 1993).

Early protection of *Livistona australis* in Victoria

Permanent European settlement in East Gippsland, Victoria, around Brodribb River and Cabbage Tree Creek commenced in the early 1870s, and the clearing of native forests for pastures and cultivation progressed rapidly (Wakefield 2010). Because of the swampiness of the environment associated with *L. australis*, and the relatively greater density of the vegetation along streams, some innate protection was provided to at least part of the population. Mueller became aware of the impact that land clearing was having on the palm and instigated actions to preserve the remaining populations.

With regards to threats to palms generally, Mueller commented on the destruction of palms for their edible cabbage. He wrote that “wherever the Nekau Palm of New Zealand [*Rhopalostylis sapida* H.Wendl. & Drude] is accessible to the mining population of New Zealand it is scarified for the sake of the edible central portion of the apex of the stem, and thus it must in many districts there share the fate of the Australian Cabbage Palm (*Corypha australis* [*L. australis*]), which is annihilated now in many localities” (Mueller 1866, p. 1045). Mueller continued with his observations of exploitation, and wrote that “in a spirit of vandalism, a fan-palm, after a hundred years’ growth, is no longer allowed to raise its slender stem and lofty crown in our own forests of Gipps Land, simply because curiosity is prompted to obtain a dishful of palm cabbage at the sacrifice of a century’s growth” (Mueller 1870, p. 10).

In May 1871, Mueller wrote to James McCulloch, Victorian government Chief Secretary, suggesting that the remaining palms at Cabbage Tree Creek should be placed in a reserve for their ongoing protection (Mueller

1871b). A proclamation was enacted 7 July 1871 by the Commissioner of Crown Lands and Survey James Macpherson Grant stating that “no person, although he be duly licenced, or otherwise authorized, shall cut or remove any Cabbage-palm (*Corypha australis*) in East Gippsland” (Victorian Government Gazette 1871, p. 1059).

Further action in conserving the palms was instigated in 1886, when the local government of Tambo Shire council “moved and the president seconded, that about 100 acres be reserved on Cabbage Tree Creek, where the cabbage tree palm grows” (Anon. 1886). Naturalist Walter Baldwin Spencer and colleagues from the Field Naturalists’ Club of Victoria took an excursion to the palms in January 1889 (Spencer & French 1889) (Fig. 2). They soon after formed a delegation to the Minister of Lands John Lamont Dow, and the reserve was extended to 8500 acres (Lucas 1889). The proclamation, 22 March 1889, stated that at Cabbage Tree Creek the land should be reserved for “the growth and preservation of timber, in addition to and adjoining the land reserved therefore by orders of the 18th February 1887, and the 21st February 1888” (Victorian Government Gazette 1889, p. 1043). In the Field Naturalists’ Club report of 1889, it was noted that “the noble palm trees, the only specimens of their order which are indigenous to Victoria, will be secured from destruction” (Lucas 1889 p. 47).

Although the precise extent of the population of *L. australis* in Victoria prior to European settlement will never be known, according to Mueller it was “between the Brodribb and Snowy-river sparingly and on a rather circumscribed locality on the Cabbage tree river” (Mueller 1854b). A detailed population count undertaken in 1996 described the population as “except for a few outliers, the Victorian distribution is a single stand of at least 52 mature trees on alluvial flats at Cabbage Tree Creek” (Orscheg & Parsons 1996). A further assessment was provided in 2001, in which additional individuals and small groups were recorded farther downstream along Cabbage Tree Creek, near Lake Curlip and along the lower Brodribb River. In addition, a small population has been reported at Howe Range in far eastern Victoria just inside the NSW/Victorian border (Fisher 2001). In total, the entire Victorian population appears not to exceed 80 mature individuals. Recent informal observations by the author



3. A tall individual of *Livistona australis*, Cabbage Tree Creek Flora Reserve. Photo: J.L. Dowe (December 2018).



4. Juvenile leaf of *Livistona australis*, Cabbage Tree Creek Flora Reserve. Photo: J.L. Dowe (December 2018).

indicate that the Cabbage Tree Creek population remains stable with seemingly sustainable levels of recruitment of seedlings, juveniles and subadults (Figs 3–5). Most of the known population is now contained within the Cabbage Tree Creek Flora Reserve (1700 ha), which was established in 1979 and therefore provides perpetual legal protection for the species and fulfillment of Mueller's aspiration to conserve for future generations what he termed one of the "Princes of the vegetable world."

As with many species-specific conservation projects, the ongoing protection of the species cannot be fully guaranteed. Although the location is legally protected by Victorian state law, threats such as fire, biological alterations and climate change must be considered and acted upon. It is recommended that a detailed assessment be made of *L. australis* at Cabbage Tree Creek to include reproductive viability and a demographic profile of the population.

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Postscript

The bush fires that raged across much of south-eastern Australia, from September 2019 through to January 2020, have resulted in a significant ecological impact on many rare and threatened plant and animal species, as well as loss of human life and destruction of thousands of homes, infrastructure and other properties. It has been with good fortune that the population of *Livistona australis* at Cabbage Tree Creek Flora Reserve escaped any fire impacts, although intense and destructive fires raged within the vicinity. The thousands of volunteer and professional fire officers are thanked for their efforts under extremely daunting and risky conditions, and without whom the Cabbage Tree Creek Flora Reserve may have suffered the same fate as many other parts of eastern Victoria.

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Ravenea cycadifolia

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UK

A dwarf species of *Ravenea*, well known for some time in cultivation, is described and named for the first time.

This striking species of *Ravenea* first came to my notice in the 1990s when Rolf Kyburz, a nurseryman from Queensland, sent me pictures of a squat palm looking just like a cycad, growing on a steep slope above Mahatalaky, just north of Toalagnoro (Fort Dauphin) in the far south of Madagascar. Although the habit photographs were out of focus, they did at least give a good impression of the palm. A close-up of a staminate inflorescence confirmed the generic identification as *Ravenea*. The dwarf habit suggested *Ravenea nana* (Beentje 1994), but *R. nana* is a much less squat, more slender palm lacking the striking cycad-like appearance (at least as shown by herbarium specimens).

Subsequently, photographs (Figs. 1 & 2) of what appears to be the same palm arrived from Toby Spanner, RarePalmSeeds.com, in Germany. Taken by a local collector working for the seed exporter Gunther Gottlieb, the photo of habit suggested his palm to be exactly the same species. A close-up of the crown showed an infructescence with unusually large fruits. This palm entered the trade as *Ravenea "cycadifolia."* Individuals are now beginning to flower and fruit in Hawaii (Figs. 3 & 4) and in La Réunion (Figs. 5–7) (and probably elsewhere), and it is now opportune to describe and name the palm. The very distinctive habit with short squat stems, the crown with an unusually large number of leaves and the fruit size that seems out of proportion to the rest of the plant, make this species highly distinctive (and desirable).

Recently, I have become aware of further undescribed species of *Ravenea* from the Fort Dauphin area, from photographs sent by Olivier Reilhes, which together with the unusual *Ravenea declivium* described by Mijoro Rakotoarinivo and myself from Tsitongambarika just a little north of Mahatalaky suggest that this southeast corner of Madagascar is a hotspot for *Ravenea* and deserves much closer exploration.

In *Palms of Madagascar* (Dransfield & Beentje 1996) the new palm would probably key out, based on habit, to the poorly known *Ravenea nana*, but *R. nana* has a short slender stem, many fewer leaves in the crown and smaller fruit.

The material of *Ravenea cycadifolia* on which this description is based was obtained from Floribunda Palms and Exotics, Mountain View, Hawai'i.

Ravenea cycadifolia J.Dransf., *sp. nov.*

Squat solitary palm differing from other species in the genus in the short stem and many crowded arcuate leaves, the whole palm appearing cycad-like, and the particularly large pale yellow to buff brown fruit with sublateral stigmatic remains borne on a conspicuous beak.

Solitary, very short-stemmed palm; stem of the type plant 8 cm tall (in the wild to 1 m tall), overall height with leaves 120 cm; internodes very short. Leaves very numerous and crowded in the crown, at least 66 and probably more



1. Hillslopes near Mahatalaky, southeast Madagascar (Photo: G. Gottlieb, via Toby Spanner).

in the wild, to 1 m long or more; sheath split throughout its length, densely caducous dark brown tomentose; petiole 40–46 cm long, 7 × 3 mm in section, flattened adaxially, ridged abaxially, with scattered dark brown tomentum; rachis to 60 cm long, with scattered caducous dark brown tomentum; leaflets arcuate, regularly arranged, 21–22 on each side of the rachis, leathery, glossy green; basal leaflets 25–28 × 1 cm, mid-leaf leaflets linear to narrow lanceolate, acuminate 26 × 1.2–1.3 cm, distal leaflets 7 × 0.4–0.6 cm, lamina glabrous adaxially, abaxially with scattered ramenta along the mid rib. Inflorescences solitary, interfoliar at first, becoming infralobar, yellow green at anthesis, becoming green in fruit; staminate inflorescence 51–60 cm long, branched to 1 order; prophyll 14.5 × 1.7 cm, papery, densely covered in caducous dark brown tomentum; peduncle 30–32 × 0.2 cm; peduncular bract 1 similar to the prophyll 14–18 × 1.8 cm, tomentose as the prophyll; second and third peduncular bracts exceeding the first and prophyll, leathery, 40–57 cm long, 1.7 cm diam. (unopened), adaxially creamy yellow at anthesis, dark brown tomentose abaxially; rachillae 2–7 cm long, 2 mm diam., glabrous; flowers borne on short pegs to 0.5 mm high, c. 2 mm distant; rachillae bracts narrow triangular acuminate, 2 × 0.3 mm. Staminate

flower 12 × 6 mm, with cupular calyx with 3 short narrow triangular lobes to 2 × 0.3 mm; petals triangular, acuminate, connate very briefly at the base, 2 wider than the third, the wider 10 × 4 mm, the narrow 10 × 2 mm; stamens 6, biseriate, the antisepalous distinct, the antipetalous adnate briefly to the petal; anthers 2.5 × 0.7 mm; pistillode terete, brown 2 × 0.5 mm. Pistillate inflorescence similar to the staminate but with apparently shorter rachillae. Fruit pale green turning yellowish to

2. *Ravenea cycadifolia*, habit in Madagascar (Photo: G. Gottlieb, via Toby Spanner).





3. *Ravenea cycadifolia*, staminate plant, Floribunda Palms and Exotics, Hawaii (Photo: W.J. Baker).



4. *Ravenea cycadifolia*, detail of staminate inflorescence (Photo: W.J. Baker).



5. *Ravenea cycadifolia* in the garden of Olivier Reilhes, La Réunion (Photo: O. Reilhes).

buff-brown at maturity, oblate or irregularly globose, 20–23 mm diam. with the stigmatic remains borne on a distinctive sublateral beak to 4×4 mm. Seed dimensions not known (seed not preserved). (Fig. 8).

Specimen examined: Cultivated. USA, Hawaii. Hawaii, Mountain View, Floribunda Palms and Exotics, 14 Nov. 2017, W.J. Baker 1457 (Holotype: K).

DNA was extracted from leaf material of the type collection made by Bill Baker and analyzed by Josephine Connelly in a preliminary study of the phylogeny of *Ravenea* under the supervision of Wolf Eiserhardt in Aarhus University, Denmark. In the resulting trees, *Ravenea cycadifolia* (as “*Ravenea* sp. 3”) is confirmed as a distinct taxon and occurs in one tree in a position sister to the true *Ravenea glauca* of Andringitra. The fruit, however, is much more reminiscent of the so-called *Ravenea glauca* of Isalo, which seems not to be the same as the true Andringitra species.

The description of the mature fruit was drawn up from a fruiting specimen in Olivier Reilhes’ garden in La Réunion, where the seeds appear

to have germinated while still borne on the rachillae. Sadly all seedlings died.

Acknowledgments

I thank Josephine Connelly, Aarhus University, for sharing the results of her preliminary phylogenetic study of *Ravenea* and Olivier Reilhes, Gunther Gottlieb (via Toby Spanner) and Bill Baker for allowing reproduction of photographs. As always, Jeff Marcus of Floribunda Palms and Exotics in Hawai’i generously provided material for herbarium specimens and information, and Toby Spanner of rarepalmseeds.com helped with information concerning the history of export of this species from Madagascar. Lucy T. Smith prepared the analytical drawing.

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6. Close-up of crown of *Ravenea cycadifolia* with almost ripe fruit (Photo: O. Reilhés).



7. Mature fruit of *Ravenea cycadifolia* (Photo: O. Reilhes). Inset: Mature fruit of *Ravenea cycadifolia* with seed germinating through the fruit wall (Photo: O. Reilhes).



8. *Ravenea cycadifolia*: A. habit; B. leaf diagram; C. mid and apical leaflets; D. base of trunk; E. inflorescence; F. staminate buds on rachilla; G. staminate bud whole; H. staminate bud LS; I. fruit. Scale bar: A = approx. 1 m; B = 20 cm; C = 7 cm; D = 20 cm; E = 4 cm; F = 6 mm; G & H = 4 mm; I = 15 mm. Drawn by Lucy T. Smith from Baker 1457.

Calyptrocalyx reflexus, a New Species Described from Cultivation

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1. *Calyptrocalyx
reflexus*: plant in
cultivation,
Floribunda
Palms, Hawaii
(Photo: Bill
Baker).



This attractive species differs from all other members of the genus by its reflexed leaflets.

This unusual species of the Papuan and Moluccan genus *Calyptrocalyx* was first introduced into cultivation in Australia, said

to be from north-western Papua New Guinea. JM acquired second generation seed from Australia. In Floribunda Palms Hawaii, the



2. *Calyptrocalyx reflexus*: detail of leaf, Floribunda Palms, Hawaii (Photo: Bill Baker).

seedlings flourished, and it became immediately obvious that, in leaf form, the palm is unlike any other member of the genus with its distinctive, conspicuously reflexed leaflets. In Australia it was known as the reflexed-leaved *Calyptrocalyx*.

We describe it here as new, using the appropriate epithet *reflexus* because of its leaves with unusually reflexed leaflets. Its relationships with other species of the genus are not obvious based on morphological characters (Dowe & Ferrero 2001). JM observed that the ripe fruit is reminiscent of that of *C. caudiculatus* in being purple-black, but the leaves of that species are very different, with

regularly arranged usually sigmoid leaflets with long drip tips.

***Calyptrocalyx reflexus* J.Dransf. & J.Marcus, sp. nov.**

Small solitary palm immediately distinguishable by its leaves displaying slightly irregularly arranged, reflexed or divaricate leaflets; inflorescence a solitary spike or with three equal spikes within a common prophyll; fruit purple at maturity; endosperms ruminant. Type: USA: Hawai'i (cultivated): Floribunda Palms and Exotics, Mountain View, near Hilo, 14 November 2017, W.J. Baker 1453 (Holotype: K).

3. *Calyptrocalyx reflexus*: inflorescence, Floribunda Palms, Hawaii (Photo: Bill Baker).

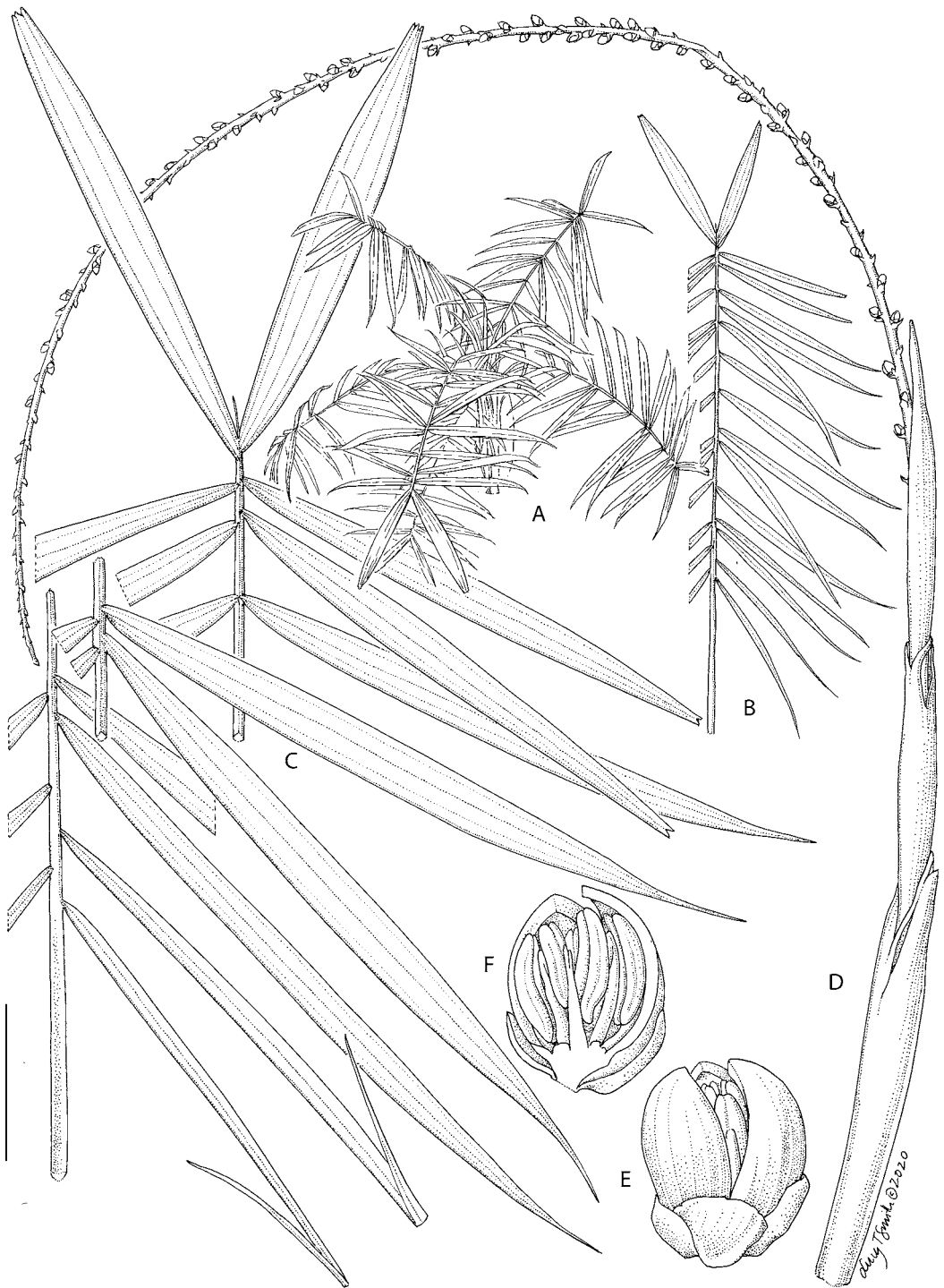




4. *Calyptrocalyx reflexus*: open staminate flowers, Floribunda Palms, Hawaii (Photo: Bill Baker).

Solitary, small, unarmed, pleonanthic, monoecious palm. Stem very short, to ca. 30 cm tall, erect, ca. 3 cm diam. Leaf irregularly pinnate, to 80 cm long, young leaf emerging purplish tinged; petiole 17 cm long, 8 × 5 mm wide, adaxially channeled at the very base,

distally flattened adaxially, bearing abundant scattered brown scales; rachis 65 cm long, ± triangular in section, tapering to 1.5 mm diam.; leaflets 13–15 on each side of the rachis, arranged singly or in pairs, the distance between the single leaflets or pairs uneven



5. *Calypstrocalyx reflexus*: A habit; B leaf diagram; C mid and apical leaflets; D inflorescence; E staminate bud; F staminate bud. Scale bar: A = 40 cm; B = 15 cm; C = 8 cm; D = 4cm; E & F = 2.5 mm, Drawn by Lucy T. Smith from Baker 1453.

ranging from 1–9 cm, leaflets in leaflet pairs strongly divaricate, most single leaflets reflexed or diverging from the rachis at 90 degrees, the

apical pair diverging at a more acute angle but nevertheless appearing divaricate, rachis continuing as a short thread between the

apical pair to 2.5 cm long, basal leaflets long acuminate, distal leaflets briefly bifid; basal leaflets 36 × 0.6 cm, mid-leaf leaflets 43 × 2 cm, apical pair 27 × 3 cm, leaflets glabrous adaxially, with scattered brown ramenta abaxially. Inflorescences solitary or with 3 equal axes in a common prophyll, spicate, interfoliar, 92–94 cm long, arcuate, curving out of the crown; peduncle 20–25 cm long, 4 mm diam, with scattered dark scales; prophyll 13 × 1.6 cm, flattened, papery, with scattered dark brown scales, disintegrating into fibers; peduncular bract similar to the prophyll, 18 × 1 cm, disintegrating into fibers; rachilla part of spike 37–65 cm long, with scattered caducous dark brown scales and bearing superficial triads, pits scarcely evident; rachilla bracts triangular 1–1.5 × 1 mm. Staminate flower buds 3 × 1 mm; sepals 3, free, imbricate, rounded, 0.7 × 0.7 mm keeled, faintly striate, minutely ciliate on margins; petals valvate, conspicuously striate when dry, 2.5 × 1.5 mm; stamens 9, white, to 2 mm long with filament

0.5 mm, anthers 1.5 × 0.2 mm, dorsifixed, versatile. Pistillate flowers known only as very young buds. Fruit globose, purple, 14 × 13 mm, with a very short apical beak to 1 × 1 mm. Seed ellipsoid, 12 × 8 mm covered by thin pale brown endocarp; endosperm ruminant, embryo basal.

Specimen examined. USA: Hawai'i (cultivated): Floribunda Palms and Exotics, Mountain View, near Hilo, 14 November 2017, *W.J. Baker 1453* (Holotype K).

Acknowledgments

We thank Bill Baker for making the specimen that forms the basis of this description. Lucy Smith prepared the analytical drawing.

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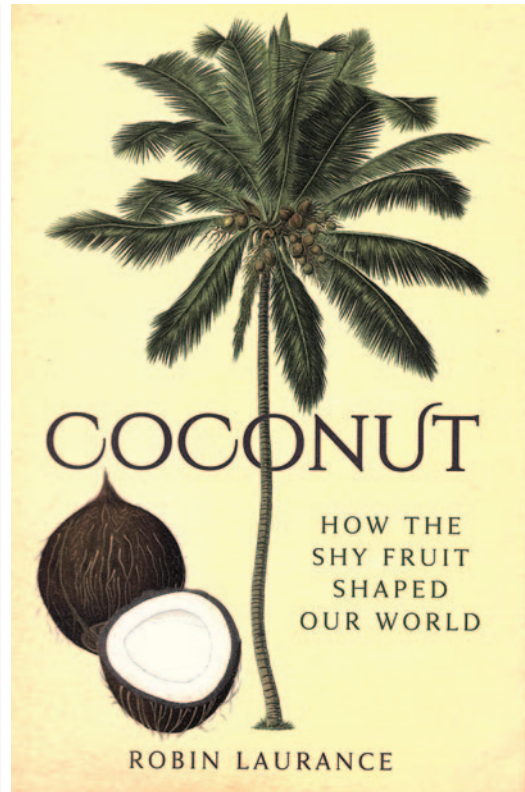
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PALM LITERATURE

COCONUT: HOW THE SHY FRUIT SHAPED OUR WORLD – Robin Laurance, The History Press, Stroud, UK. 2019. Hardcover. ISBN: 978 0 7509 9061 5. Price: £15.99. 223 pages, color and black and white illustrations.

Robin Laurance, a freelance photojournalist, has written a breezy romp through the ramifications of the coconut in human society, past and present. Organized into a prologue and eight chapters, with catchy titles such as *Sex and Mutiny*, *The Coconut Goes to War* and *For God and Country*, the author explores how coconuts have been used over the years, from basic food to the industrial development of soap and candles, the use of activated charcoal from coconut endocarps (for example, for gas masks), the use of coconut oil in the development of napalm and its immense significance in the cultural life of coconut growing regions of the world. The book ends with the sad tale of the German eccentric naturalist August Engelhardt who decamped from Berlin to an island in the Bismarck Archipelago off New Guinea in the early 1900s to bask nude in the sun's rays and live off coconuts, hoping to attract a whole community of *cocovores*, a doomed enterprise.

The book meanders through coconut facts, sometimes repeating, sometimes digressing far from the palm into the biography of artists, socialites and industrialists, but always entertainingly. I found it altogether diverting, but ultimately somewhat frustrating. The bibliography that supports the information in the book consists of a mere six books, two of which deal with the history of Unilever and Proctor and Gamble, one concerns a modern-day drug smuggler, one a history of Hinduism and only two directly with coconuts. Yet much in the book that relates directly to coconuts is unreferenced, or perhaps mentions an author without a bibliographic source. Readers of *Principes*/PALMS may remember Hugh Harries' highly original articles on Darwin and the Robber Crab and the origin of the Coconut Shy in England. Robin Laurance does acknowledge Hugh Harries for the former but without bibliographic reference. However, the contents of the Hugh Harries' 2004 article in



PALMS "Fun made the fair coconut shy" are extracted in all their detail and reproduced with no acknowledgement or references at all. Hugh Harries' article has even provided the inspiration for the book's subtitle, which for the most part seems rather too contrived to be appropriate.

While a review should concentrate on the actual contents, I cannot help mention the lack of any discussion of the effects of coconut disease and the twelve-line paragraph that glibly summarizes the botany of the coconut is really inadequate – this majestic palm deserves a better botanical pen-picture to guide the general reader through the way coconuts are used – and why no mention of the importance of coconut leaves in Balinese art and village life, which must be familiar to every tourist that visits the island? To say that coconut fossils 37 million years old have been found in Gujarat is also very misleading – these fossils may indeed be *cocosoid* but they are not equivalent to modern *Cocos nucifera*.

In summary, this is a fun read with much to divert, but I feel it is flawed by the lack of references.

JOHN DRANSFIELD

Photo Feature

Washingtonia filifera in Arizona



A relic population of *Washingtonia filifera* in the Kofa Mountains, in Yuma County, Arizona, USA, exists on a knife-edge. Living in a steep, dry canyon, these palms receive just two inches (five cm) of rainfall a year and only about three hours of sunlight. Regeneration in this population is nil.

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