

The Palms of Tsitongambarika, Southeast Madagascar

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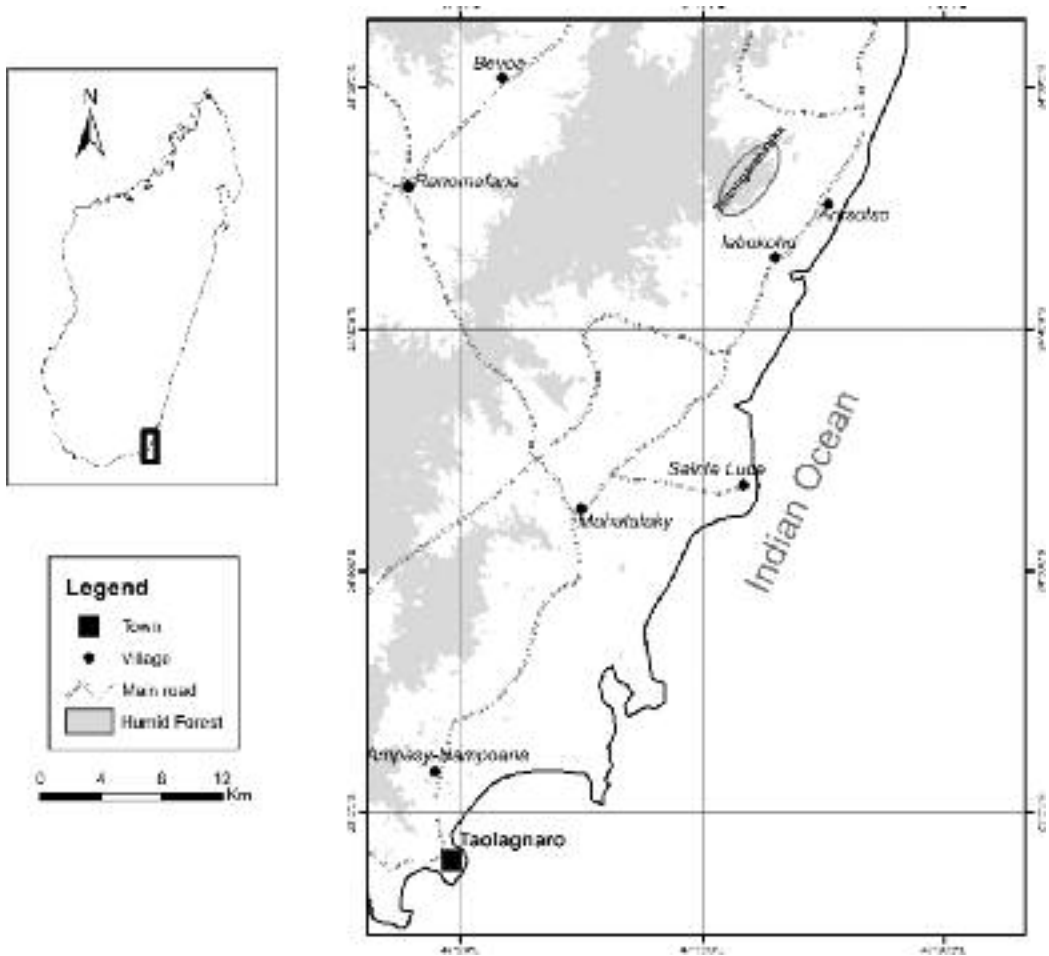
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Tsitongambarika is a forested area in the extreme southeast of Madagascar, lying just to the north of Taolagnaro (Fort Dauphin) (Fig. 1). Although it harbors substantial areas of good forest cover and is moderately easy to access, botanical exploration of the area has only recently begun.

Much recent botanical activity in southeast Madagascar has concentrated on the highly threatened littoral forests at Sainte Luce and elsewhere on the coastal plain north of Taolagnaro, the site of the QMM (QIT Madagascar Minerals) is managed by Rio Tinto Iron and Titanium to exploit the mineral sands that occur in the flat coastal lowlands at the foot of the mountain ranges in this part of southern Madagascar. The deposit of high grade ilmenite (titanium dioxide) is considered to be the largest undeveloped deposit of the mineral in the world. QMM runs a very active biodiversity program, aimed at minimizing the impact of mining on the fragile vegetation. Even before the start of mining, the whole area was under immense human pressure, particularly from burning during the dry season, to make farms for growing rice. The presence of QMM and the associated botanical activity has undoubtedly added immensely to our knowledge of plant

diversity there and has the potential to do much for the long-term conservation of these fragile ecosystems.

Beyond the coastal lowlands lie spectacular hills, the southern end of the eastern mountain system that runs along almost the entire length of the eastern coast of Madagascar. On the road north from Taolagnaro towards Sainte Luce these rugged coastal hills are clearly visible, some of them covered with good looking forest and with the much higher range of the Chaîne Anosyenne rising up behind. It is this area of coastal hills, separated from the main mountains of the Chaîne Anosyenne that has been referred to as Tsitongambarika (BirdLife International 2011). Tsitongambarika forms the water catchment of streams and rivers that are of crucial importance for irrigated rice cultivation in the coastal plain. In the southern part one of these rivers carries the only known population of



1. Map showing the southeast corner of Madagascar and the position of Tsitongambarika.

the extraordinary aquatic palm *Ravenea musicalis*. Towards the northern end of Tsitongambarika several of the river catchments provide habitat for another aquatic palm, *Dypsis aquatilis*. Recent botanical collecting within the Tsitongambarika area by biodiversity staff of QMM in collaboration with staff of Missouri Botanical Garden, has turned up an astonishing number of novelties, perhaps as many as 70 new plants (BirdLife International 2011) including a new genus of Asteraceae (P. Lowry, pers. comm.). Little was known about the palm flora of the area and no palm collections seemed to have been made on these coastal hills, so for some time the area has been high on a list of priority areas for palm surveying.

In fact it was to be a couple of years before we could both find the opportunity to visit Tsitongambarika together. Encouraged by Pete Lowry (Missouri Botanical Garden) we made contact with Johny Rabenatoandro, Faly

Randriatafika and David Rabehevitra at QMM in Taolagnaro and made firm arrangements for a visit in September 2010. Our party comprised MJR, JD, Soejatmi Dransfield (searching for bamboos) together with Ramisy Edmond and Mara Bergé, local naturalists who have collaborated with most of the botanical surveys of this area, and whose knowledge was most impressive. Throughout our visit to Tsitongambarika, we received superb logistical help from QMM.

On 21 September 2010 we left the capital Antananarivo by air and arrived in Taolagnaro (Fort Dauphin), delighted to be back in this scenically spectacular part of Madagascar. On the following day we drove north to Mandena to the headquarters of QMM to have meetings with QMM environment staff and then back in the town of Taolagnaro where we bought provisions for the trip.

On 23 September we drove north, picking up Ramisy Edmond, and then heading for the



2 (top). Ivohibe stands proud above the anthropogenic grassland. 3 (bottom). Our camp near the edge of the forest.

List of Palms Observed

Beccariophoenix madagascariensis
Dypsis aquatilis
Dypsis brevicaulis
Dypsis culminis
Dypsis elegans
Dypsis eriostachys
Dypsis fibrosa
Dypsis lilacina nov. sp.
Dypsis mananjarensis
Dypsis nauseosa
Dypsis nodifera
Dypsis prestoniana
Dypsis psammophila
Dypsis pustulata nov. sp.
Dypsis saintelucei
Dypsis subacaulis nov. sp.
Orania longisquama
Ravenea declivium nov. sp.
Ravenea hypoleuca
Ravenea sambiranensis

village of Antsotso, the nearest village to the isolated mountain of Ivohibe, Tsitongambarika, reaching the village shortly after noon. The journey requires three ferry crossings. In Antsotso we negotiated with the village headman, Soja Armstrong, for entrance to the forest (this requiring payment to CoBa, Communauté de Base, an association of village members empowered to implement development plans for natural resources), for a guide (Armstrong himself) and Mara Bergé, who would act as cook and guide and for five porters. In fact, the daily tasks of the guide and cook seemed to be interchangeable and for most of the time we were accompanied by Mara Bergé and Ramisy. At 2 p.m. in the full afternoon sun we started the trek across anthropogenic grasslands towards the massif of Ivohibe.

Ivohibe rises to 677 m out of the coastal lowlands as an isolated peak (Fig. 2) (incidentally, this is not the only mountain called Ivohibe in Madagascar). Good, relatively undisturbed forest clothes the upper slopes forming a forest cover about 27,000 ha in extent (BirdLife International 2011). The mountain looked extremely tempting as we walked through the hot dry grasslands. Nearing the base of Ivohibe, we began to see

remnants of Malagasy vegetation along streams, such as clumps of *Ravenala* and species of *Pandanus* and abundant *Nepenthes madagascariensis*. *Dypsis aquatilis* appeared and our spirits rose.

We reached our camp site at 3.30. We camped on a cleared ridge-top about 30 m from an excellent rocky stream with waterfalls, the last reliable water on that side of the mountain (Fig. 3).

For the next two days we made day long excursions into the forest, each involving a steep trek up to the forest margin. Once into the forest, we began to find exceptionally interesting palms and we realized that Ivohibe is a site of major palm significance.

Finally on 26 September we broke camp and walked out through the grasslands to the road where we were picked up by the driver from QMM and driven back to Taolagnaro.

Ivohibe is composed of a substantial block of igneous rock. In places the relief is very high and the underlying rock exposed as cliff faces or bluffs. The southwestern ridge-top which we visited is generally narrow and carries a relatively low crown forest that physiognomically resembles montane forest despite its low elevation of about 400 m. Where the

4. Open forest rich in *Dracaena* spp, *Pandanus* spp and palms, on thin soil overlying rock.





5 (left). *Beccariophoenix madagascariensis* on Ivohibe has very slender inflorescences. 6 (right). Mara Bergé holds inflorescences of *Beccariophoenix madagascariensis*; note how few rachillae there are.

underlying rock is exposed or near the surface, the forest tends to be rather open, with abundant palms, pandans and *Dracaena* (Fig. 4). There is an abundance of moss belonging to Leucobryaceae. At the time of our visit (towards the end of the dry season) there were no running streams above about 250 m but there is plenty of evidence of seasonal water courses within the forest, particularly in areas where the bedrock is exposed.

Notes on the Palm Species Observed

Beccariophoenix madagascariensis (Figs. 5, 6)

On Ivohibe, *Beccariophoenix madagascariensis* was seen only on ridge-tops or growing on thin soil overlying rock outcrops. We saw perhaps 20 mature individuals and many seedlings and rosette palms. One individual had been cut, perhaps about 12 months before our visit, with evidence of removal of the cabbage for food. *Beccariophoenix madagascariensis* on Ivohibe is more slender than elsewhere in Madagascar and the inflorescences, in particular, are remarkably slender, with long peduncles and few (about 8) rachillae. Seedlings are indistinguishable from seedlings at nearby Sainte Luce and further north at Vondrozo near Farafangana and at Mantadia near Andasibe.

Dypsis aquatilis (Fig. 7)

This aquatic palm grows as solitary rosettes in the beds of slowly flowing sandy streams in the flat lowlands at the foot of Ivohibe. Isolated individuals became apparent as we walked in from the main road through the anthropogenic grasslands. Nearer the foot of Ivohibe the palm was more abundant and we saw probably about 75 individuals. It grows together with rheophytic pandans and *Ravenala*. Several individuals were in flower. We did not see this species growing in closed forest – all populations occur in areas that are denuded of native vegetation, apart from the presence of *Ravenala* and other rheophytic plants that, presumably, survive the grassland fires by virtue of growing in streambeds.

Dypsis brevicaulis

Only one individual was seen growing beside the path in rather open forest on sandy soil at approximately 300 m elevation. There were several dead inflorescences. Although there must surely be more individuals on Ivohibe, *D. brevicaulis* appears to be a rare palm on Ivohibe.

Dypsis culminis (Fig. 8)

This is one of the commonest palms on steep slopes and ridge-tops on Ivohibe. It was described as recently as August 2010 from



7. *Dypsis aquatilis* grows in streambeds with rheophytic *Pandanus* sp.

Vondrozo (Rakotoarinivo & Dransfield 2010), where it was regarded as being critically endangered and thus the record for Ivohibe not only represents a major extension in range but also provides a much improved conservation prognosis for the palm. It is a clustering species with stems to 4 m tall and entire bifid leaves. The inflorescence is sparsely branched with moderately robust rachillae. In some places, the undergrowth of the ridge-top forest is dominated by this species.

***Dypsis elegans* (Fig. 9)**

This is an exquisitely beautiful palm with solitary slender stems and interruptedly pinnate leaves with dark green leaflets. Inflorescences are highly branched. We estimate that we saw about 25 mature individuals of this palm and numerous seedlings. Elsewhere it is known only from the Manombo Reserve, Farafangana, where it is regarded as critically endangered (Dransfield & Beentje 1995). Its discovery in Ivohibe is thus of considerable conservation significance.

Dypsis eriostachys

Confusingly similar to *D. culminis*, this species is generally smaller, has solitary stems, more

finely branched inflorescences and hairy rachillae. Elsewhere it is known from a few localities from Vatovavy to Midongy. In Ivohibe, it is widespread on hill slopes and ridge-tops, often growing intermingled with *D. culminis*.

Dypsis fibrosa

Surprisingly we saw only one colony of this widespread and usually abundant palm. Unaccountably rare on Ivohibe, the colony comprised two clumps of dichotomously branching aerial stems. Inflorescences were rather smaller than usual.

***Dypsis lilacina* (Figs. 10, 23)**

This species appears like a miniature extremely slender form of *D. pustulata* with which it grows. It lacks the sheath warts and the inflorescences are much more slender, have lilac-colored rachillae with slender lilac-colored staminate flowers with six stamens with elongate anthers. We have been unable to match this with any known species and thus describe it here as new.

Dypsis mananjarensis

This widespread southern tree palm is common in Ivohibe but we saw only juvenile



8 (upper left). *Dypsis culminis*, an abundant clustering palm of the undergrowth. 9 (upper right). *Dypsis elegans*, previously only known from Manombo, much further to the north. 10 (bottom). *Dypsis lilacina*, showing lilac-colored inflorescence, long petioles and abundant indumentum.

individuals, distinctive in their plumose leaves with “mealy bug” scales on the petioles and leaf sheaths. Mature tree palms glimpsed through binoculars on an otherwise bare rocky outcrop towards the summit of Ivohibe may belong to this species or *D. prestoniana*.

Dypsis nauseosa

We saw a few mature individuals and seedlings of this tree palm, distinctive in its epetiolate leaves and very regularly arranged leaflets. Elsewhere it has been recorded as far south as Manombo.

Dypsis nodifera

This species, one of the most widespread of all palms in Madagascar, is moderately abundant in Ivohibe. The specimen we collected has rather narrow flat leaflets lacking the characteristic swollen leaf bases found in typical populations.

Dypsis prestoniana

As with *Dypsis mananjarensis* this species was seen only as juvenile rosettes growing in anthropogenic grasslands. As mentioned above, tall palms seen through binoculars on a rock face near the summit of Ivohibe may belong to this species.

Dypsis psammophila (Fig. 11)

This species was abundant in rather open forest developed on thin soils on rock faces and outcrops and on ridge-tops. In some individuals there was substantial aerial branching forming entanglements in the forest, reminiscent of *D. serpentina* and its relatives.

Dypsis pustulata (Figs. 12–14, 23, Front Cover)

This and *D. lilacina* grow together, intermingled in the undergrowth of ridge-top forest together with *Dypsis saintelucei* and *D. culminis*. It is a solitary or clustering palm with stems to 5 m tall, ca. 3 cm diameter. The leaves are rarely more than 8 in the crown, are strongly arcuate and have few distant, sigmoid, grouped dark green leaflets. The most remarkable feature of the palm is the leaf sheath, which is covered, towards the sheath mouth, with irregular warty excrescences. At first we thought that this feature might be pathological but every single individual of the species displayed it. In cross section the warts appear to be composed of files of cells; the wart surface is somewhat corky. We know of no other Madagascar or, indeed, any palm that

11. Branching stems of *Dypsis psammophila*.





12 (left). *Dypsis pustulata*, showing the few, somewhat sigmoid grouped leaflets. 13 (right). *Dypsis pustulata*, crown and inflorescence

displays such warts. The inflorescences are interfoliar, and have few robust long rachillae. Staminate flowers are globular, creamy yellow, relatively large and have six stamens with more or less sagittate anthers. It is described as new below.

Dypsis saintelucei (Fig. 15)

This iconic palm is astonishingly abundant in the forests of Ivohibe, being particularly conspicuous on ridge-tops and in small crown forest developed on thin soils overlying rock outcrops. We estimate that we saw over 500 mature individuals and countless seedlings. It varies substantially in size, depending on the aspect. It is small (to 5 m tall or less) with very close internodes on exposed ridge-tops, while in more sheltered sites it can reach 8 m tall.

Dypsis subacaulis (Figs. 16, 24)

This is a very short-stemmed or almost acaulescent solitary palm with leaves not exceeding 40 cm long, with few narrow linear leaflets and spicate or furcate inflorescences. Inflorescence structure and leaves are somewhat reminiscent of *D. procumbens*. It was moderately abundant in a valley bottom near the forest margin. We have been unable to match it with any known species, so describe it as new below

Orania longisquama

We observed two individuals of *Orania longisquama* growing beside the stream in the lowlands near our encampment. Both were rosette juvenile palms, immediately identifiable by the spiral leaves and praemorse leaflet tips. Previously, Manombo was the most southerly locality for this species.

Ravenea declivium (Figs. 17–19, 25)

This astonishing palm represents perhaps our most exciting find on Ivohibe. It is an acaulescent (“stemless”) solitary palm restricted to rock outcrops, tending to grow on the lip of cliffs and on outcrops beside dry stream courses. It has a very short stem, decumbent at the base, ca. 35 cm diameter and covered with old leaf bases. There are about 8 leaves to 2 m long in the crown; petioles are glaucous, and the leaflets are few in number, distant, curved, very dark green and hooded, and unusually broad; they have an almost succulent texture. Male inflorescences are solitary or multiple in the leaf axils and females are solitary. We found material in old inflorescence and in bud. In all we estimate that we saw about 50 mature palms and rather few juveniles and seedlings. This is undoubtedly undescribed and a most unusual species in the genus.



14 (top). *Dypsis pustulata*, close up of flowers. 15 (lower left). *Dypsis saintelucei* showing the long pendulous basalmost leaflets. 16 (lower right). *Dypsis subacaulis*, an untidy palm of the forest undergrowth.

Ravenea hypoleuca (Fig. 20)

This species was described as recently as August 2010 (Rakotoarinivo & Dransfield 2010) from Vondrozo where we assessed its conservation status as Critically Endangered. In Ivohibe we found a well-structured population of about 25 mature individuals, numerous rosette palms

and seedlings. The species is instantly recognizable by its strongly discolorous leaflets (dark green above and gleaming white beneath). We saw old male and old female inflorescences. The presence of this rarity in such a healthy population in Ivohibe emphasizes the importance of this locality for palms.

Ravenea sambiranensis (Fig. 21)

We found several individuals of this very widespread species. It is distinctive in its arcuate leaves and multiple male inflorescences.

Description of New Species

Dypsis lilacina J. Dransf. & Rakotoarin., sp. nov. Slender clustering palm with few leaves in the crown, the lanceolate leaflets few in number and rather distant, arranged in groups of 2 or 3; inflorescences with few lilac-colored branches, with lilac-colored flowers, the stamen filaments inflexed and anthers medifixed. Type: MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM538 (holotype K, isotypes MO, TAN) (Fig. 22)

Clustering palm with 2–3 stems, up to 2 m tall. Stems 1.5–1.9 cm diam., internodes dark green with abundant caducous dark reddish brown scales; internodes greenish brown, 2.1–4.7 cm; leaf scars paler, 2–5 mm wide. Leaves ca. 8 in crown, to 80 cm long, held ± erect and rather lax; crownshaft not well defined, 25–35 cm long, 15–22 mm wide; sheaths tending to split partially long before



17 (above). *Ravenea declivium* showing glaucous leaves with relatively few, broad leathery leaflets. 18 (below). *Ravenea declivium*, decumbent stem; one inflorescence bud emerges between living leaf bases.





19 (left). *Ravenea declivium*, leaf rachis and emerging leaflets covered with wax and punctiform scales. 20 (right). *Ravenea hypoleuca* has few stiff leaves.

abscission, to 16 cm long, 3.5 cm wide when opened out, 2 short membranous auricles at the base of the petiole, the whole sheath covered abaxially with caducous dark brown scales and drying striate; petiole 27–35 cm long, 4 mm wide near the base, tapering slightly distally, \pm triangular in section, bearing sparse caducous red-brown indumentum; rachis 35–50 cm long; leaflets narrow lanceolate, long acuminate, 9–12 on each side of the rachis, arranged in distant groups of 2 or 3; basal leaflets 18–20 \times 0.5–1.5 cm, mid leaf leaflets 15–23 \times 0.8–1.3 cm, apical leaflets 10–12 \times 0.5–1.5 cm; leaflet surfaces glabrous. Inflorescence interfoliar, 30–55 cm long, branched to 2 or 3 orders; prophyll persistent, to 30 cm long, 6 mm wide, 2-keeled; peduncular bract caducous, not seen, inserted up to 20 cm above the prophyll; peduncle to 20 cm long, 3.5–4.5 mm diam.; first order branches 15–16 in all, the basal 2–4 branched to the third order, next few to the second order, the remainder unbranched; rachillae rather distant, slender, lilac, 1.5–6.5 cm long, 1 mm diam., bearing rather distant flower groups. Staminate flower at anthesis lilac, in bud pointed, ca. 2.1 \times 1.1 mm; sepals rounded, ca. 7 mm diam., the margins entire and with irregular keels; petals striate, 1.7 \times 1.1 mm, broad triangular; stamens 6; filaments 2 \times 0.2

mm, inflexed in distal 0.4 mm; anthers medifixed 1.2 \times 0.4 mm; pistillode narrow ovoid, ca. 0.4 mm high. Pistillate flower known only from very immature globular buds, 0.5 mm diam. Fruit not seen.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsofso village, 24° 34' 0.5" S, 47° 11' 56" E, alt. 418 m, 25 September 2010, M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM538 (holotype K, isotypes MO, TAN).

Conservation status CR (B2ab(ii,iii,v);D). Known only from the ridge top of Ivohibe forest where the area of occupancy is less than 1 km square and where fewer than 20 clumps are recorded. The forest is quite well preserved at the moment but any disturbance in the future may affect the quality of the habitat and thus the population size.

Dypsis pustulata J. Dransf. & Rakotoarin., sp. nov. Single-stemmed or clustering palm, distinctive in the presence of irregular pustules on the leaf sheaths, the sigmoid leaflets few in number and grouped, the inflorescence branched to 2 orders with staminate flowers at anthesis globose, with whitish petals and sagittate anthers. Type: MADAGASCAR.



21. Ramisy Edmond stands besides *Ravenea sambiranensis*.

Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7791* (holotypus K, isotypi MO, TAN) (Fig. 23).

Solitary or clustered palm, to 6 m tall, occasionally with aerial branching. Stem 21–25 mm diam.; internodes 20–30 mm long, dull brown; leaf scars ca. 3 mm wide. Leaves ca. 9 in the crown, held \pm erect in a rather lax crown; crownshaft well developed, 20–30 cm long, ca. 2.1–3.1 cm diam., mid green; leaf sheath 13–17 cm long, 5.4–6.7 cm wide when opened out, mid green, covered with scattered caducous dark brown scales and with 6–13 or more irregular rounded pustules near the base of the petiole, these green when first emerged, becoming corky and grey with age, pustules up to 1.2 cm wide and standing ca. 5 mm proud of sheath; leaf to 1.25 m long; petiole ca. 35 cm long, 8 \times 5 mm wide, tapering to 5 \times 3 mm at the insertion of the basalmost leaflets, adaxially flattened, bearing scattered caducous dark brown scales; rachis up to 90 cm long, scaly as the petiole; leaflets ca. 14 on each side of the rachis, arranged singly or in groups of 2 or 3, slightly fanned within the groups, dark green, cucullate; basal leaflets 26–30 \times 1.3–1.5 cm; mid leaf leaflets 25–32 \times 2.8–3.6 cm; apical leaflets 6–9 \times 1.2–1.5 cm; all leaflets ending in

drip tips to 4 cm long; leaflet surfaces glabrous apart from bands of caducous dark brown scales along margins. Inflorescences interfoliar, branched to 2 orders; peduncle ca. 30–35 cm long, flattened at the base, ca. 9 mm wide, distally rounded in cross section, ca. 4 mm diam., densely covered with dark brown indumentum; prophyll adnate to peduncle in basal 6–7 mm, free part 2-keeled, tightly sheathing, 15–20 \times 1.2 cm, covered with caducous dark brown scales; peduncular bract borne 9 cm above prophyll insertion, similar to prophyll but lacking keels; rachis up to 30 cm long, 4–5 mm diam. at base with dense dark brown indumentum; first order branches 11–13, the basal 5 or 6 branched to 2nd order; rachillae ca. 20–22, 9–20 cm long, 1.5–2.5 mm diam., dull green, covered with dense caducous brown scales; triads ca. 4 mm apart. Staminate flowers somewhat globular at anthesis, \pm bullet-shaped in bud, ca. 5 mm long, 5 mm wide; sepals rounded, ca. 1.5 \times 1.5 mm, irregularly emarginate, strongly keeled, glabrous; petals 4 \times 3 mm, broadly triangular, rather fleshy, white; stamens 6, 3.1 mm long, filaments 1.6 \times 1 mm, anthers \pm sagittate, 2.1 \times 1.5 mm; pistillode pyramidal, ca. 1 mm high. Immature pistillate flower obovoid, ca. 3.5 \times 2 mm; sepals ca. 3 \times 2 mm; petals ca. 2 \times 1.5 mm; staminodes 3, irregular, tooth-like, at one side of the gynoeceium; gynoeceium ovoid to pyramidal, ca. 1.5 \times 1 mm. Fruit unknown.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34' 3.3" S, 47° 11' 56.4" E, alt. 391 m, 25 September 2010, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7791* (holotype K, isotypes MO, TAN).

This unusual species forms colonies in low-crown forest on ridge tops. It occurs together with the previous species, *D. lilacina*, and two species very similar in form. *Dypsis saintelucei* and *Beccariophoenix madagascariensis* are also prominent features of the palm flora of these ridge tops. *Dypsis pustulata* is unlike any other species in the genus because of the consistent presence of the corky pustules on the leaf sheaths of every single individual observed. Pustules were sectioned in the field to investigate whether they are galls, but there was no sign of any animal within the swellings. Developing sheaths within the crownshaft already show the presence of pustules. The nature and function of these pustules is as yet unknown, but developmental material has been collected for further study.



22. *Dypsis lilacina*. A. habit; B. crown with sheaths, one leaf and inflorescence; C. detail of rachilla and flower groups; D. whole flower; E. stamen. Scale bar: A = 40 cm; B = 6 cm; C = 1.5 cm; D = 2 mm; E = 1.6 mm. A–E all from M. Rakotoarinivo & J. Dransfield RMS38. Drawn by Lucy T. Smith.

Apart from the presence of the curious pustules (Front Cover), *D. pustulata* differs from *D. lilacina* in its more robust habit, the green rather than lilac rachillae, the white rather

than lilac petals of the staminate flowers and the stamens with straight filaments and sagittate anthers rather than inflexed filaments and medifixed anthers.



23. *Dypsis pustulata*. A. habit; B. crown with sheaths and inflorescence; C. detail of pustules on leaf sheaths; D. leaf base; E. mid section of leaf; F. leaf apex; G. detail of rachilla; H. whole staminate flower; I. staminate flower, one petal removed; J. two views of stamen. Scale bar: A = 30 cm; B = 8 cm; C = 2.5 cm; D, E, F = 8 cm; G = 1 cm; H, I = 4mm; J = 2 mm. A-J all from *J. Dransfield & M. Rakotoarinivo JD7791*. Drawn by Lucy T. Smith.

Conservation status CR (B2ab(ii,iii,v);D). Known only from the ridge top of Ivohibe forest where the area of occupancy is less than 1 km square and where fewer than 20 clumps

are recorded. The forest is quite well preserved at the moment but any disturbance in the future may affect the quality of the habitat and thus the population size.

***Dypsis subacaulis* J. Dransf. & Rakotoarin., nov. sp.** Solitary or clustered undergrowth palm, somewhat reminiscent of *D. procumbens* but with very short erect stems, often appearing acaulescent, the inflorescences spicate or bifurcate and with narrow papery leaflets. Type: MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *M. Rakotoarinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM531* (holotype K, isotypes MO, TAN) (Fig. 24).

Solitary or clustering undergrowth palm, about 1 m tall, the whole palm appearing \pm acaulescent. Stem erect, very short, ca. 12 mm diam., internodes 9–10 mm long, the surface covered with dark brown caducous indumentum, much of the stem obscured by marcescent leaf bases and leaf litter. Leaves about 12 in crown, marcescent, 60–75 cm long; sheaths \pm open throughout much of their length, not forming a crownshaft, to 9 cm long, ca. 2.5 cm wide when opened out, 2 papery triangular marcescent auricles to 7 mm long present one each on either side at the base of the petiole, sheath surface densely covered with dark red-brown indumentum; petiole 11–13 cm long, ca. 3.5 \times 3 mm wide near the base, tapering distally, shallowly channelled near the base, bearing abundant caducous dark brown indumentum; rachis 50–62 cm long; leaflets 12 or 13 on each side of the rachis, \pm regularly arranged, rather distant, long acuminate; basal leaflets 17–19 \times 0.8–1.1 cm; mid leaf leaflets 23–28 \times 1.1–1.4 cm; apical leaflets 10–12 \times 0.7–0.8 cm, leaflet surface glabrous. Inflorescence interfoliar, spicate or with two rachillae only; prophyll remaining hidden by the leaf sheaths, to 8 \times 0.7 cm, papery, strongly 2-keeled, tightly sheathing; peduncular bract inserted ca. 3 cm above the base, persistent, to 12 \times 0.3 cm, it and the prophyll with scattered caducous scales; peduncle 25 \times 0.11 cm, bearing scattered caducous red-brown scales; rachilla or flower-bearing portion of the spike 14–15 cm long, 1.5–2.2 mm diam., bearing crowded triads. Staminate flowers already fallen. Pistillate flowers to 1.7 \times 0.7 mm, ovoid; sepals rounded, ca. 6 mm diam., striate; petals imbricate, 1.2 \times 1.0 mm, striate with very short triangular tips; staminodes minute, 3, dentiform; gynoeceum ovoid, 1.4 \times 0.6 mm. Fruit not known.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsotso village, 24° 34' 0.8" S, 47° 12' 14" E, alt. 182 m, 24 September 2010, *M. Rakoto-*

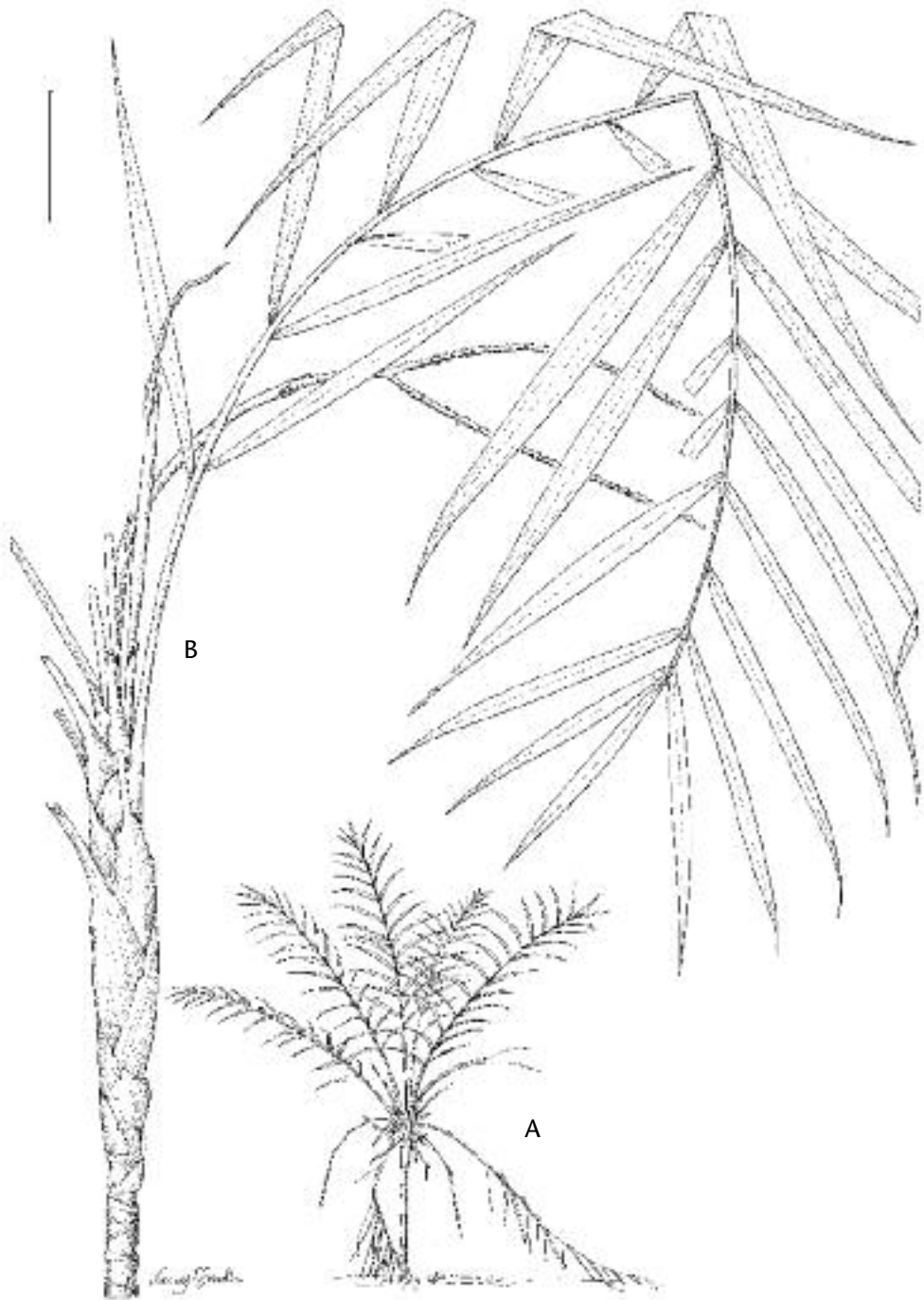
arinivo & J. Dransfield with S. Dransfield, Ramisy Edmond, Mara Bergé RM531 (holotype K, isotypes MO, TAN).

This palm does not match with any known species of *Dypsis*; it seems related to highly polymorphic *D. procumbens* but the habit and thin papery leaflets are distinctive. Unfortunately we only found material with old inflorescences.

Conservation status CR (B2ab(ii,iii,v);D). Endemic to the Tsitongambarika forest where fewer than 10 mature trees were recorded in area of occupancy estimated to be less than 2 km square. Unless protected in the future, disturbance in this forest will probably cause decline of the population size of this species.

***Ravenea declivium* J. Dransf. & Rakotoarin., sp. nov.** Differing from all other species in the genus by the combination of acaulescent habit with decumbent stem and the leaves with few, strongly coriaceous very broad glaucous leaflets. Type: MADAGASCAR: Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, *J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7786* (holotype K, isotypes MO, TAN) (Fig. 25).

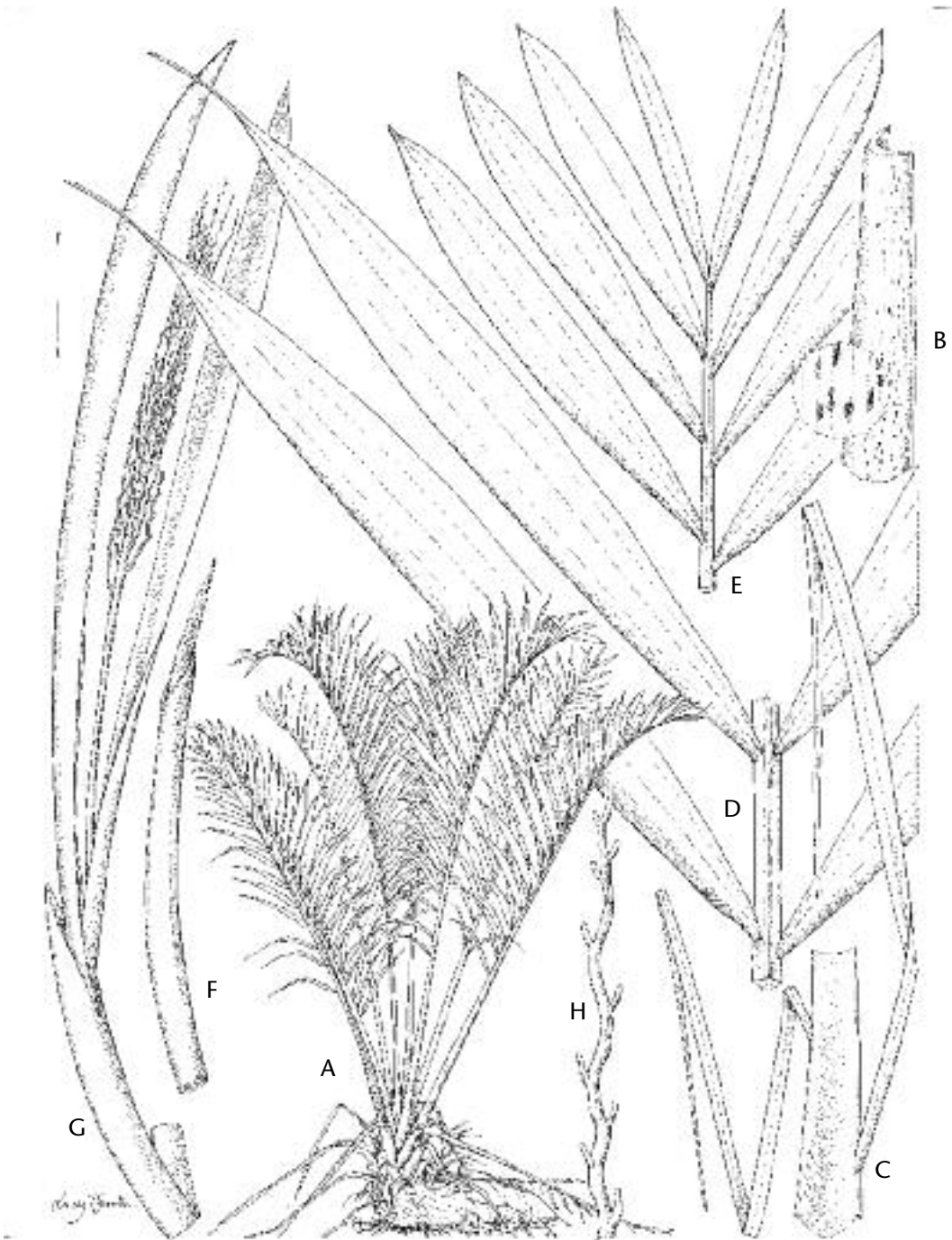
Robust palm with decumbent short stem to 40 cm diam., generally appearing acaulescent. Stem clothed in persistent shaggy leaf base remains. Leaves ca. 17 in crown appearing to be quadrifarious or quinquefaries, strongly curved, marcescent, litter trapping, to 3 m long; petiole to 1.25 m long, to ca. 5 cm wide at the base, c.1.5 cm thick at the midline, decreasing to ca. 1.5 \times 1.5 cm at the insertion of the basal leaflets, leaf sheath open, green, young leaf bases glaucous, abaxially with scattered brown elongate peltate scales, 2–6 \times 0.8–1.1 mm, and a thin covering of amorphous gray indumentum, petiole deeply channelled throughout, the margins razor sharp; rachis to 1.75 m long, arcuate, tapering gradually throughout its length, deeply channelled proximally, \pm triangular in cross-section distally, bearing abundant elongate dark brown peltate scales as the petiole; leaflets to 18 on each side of the rachis, broad, leathery, bluish-green, cucullate and with long drip tips, basal leaflets 60–70 \times 1.5–2 cm, mid-leaf leaflets 60–65 \times 6–7 cm, apical leaflets 17–28 \times 2–4 cm, drip tips terete to 75 \times 2 mm, adaxial leaflet surface glabrous, smooth and slightly glossy when fresh, abaxial surface with scattered minute brown punctiform scales and with scattered dark brown peltate scales as the rachis along the margins exposed in bud.



24. *Dypsis subaculis*. **A.** habit; **B.** crown with sheaths, one leaf and inflorescence. Scale bar: A = 20 cm; B = 6 cm. A–B all from *M. Rakotoarinivo* & *J. Dransfield* RM531. Drawn by Lucy T. Smith.

Staminate inflorescences multiple, up to 3 in the leaf axil, already dead, to 80 cm long, mostly hidden among the leaf bases; prophyll ca. 11 × 3 cm, incompletely sheathing, thin, papery, with a triangular 2-keeled tip, striate, abaxially with abundant caducous brown scales and hairs, adaxially glabrous; peduncular

bracts 3, first 17–27 × 2 cm, second 30 × 1–1.5 cm, third 42 × 8 cm; peduncle 40–60 cm long, ca. 8 mm diam.; rachis 15–30 cm long, branched to 1 order only; rachillae numerous, 8–16 cm long, ca. 1.5 mm diam., with rather distant flower scars, up to 35 in all, surface glabrous. Flowers borne on short pegs to 1.5 ×



25. *Ravenea declivium*. A. habit; B. petiole with detail of indumentum; C. tip of petiole with basal-most leaflets; D. mid-section of leaf; E. leaf tip; F. inflorescence bud; G. staminate inflorescence; H. detail of dead pistillate rachilla. Scale bar: A = 60 cm; B = 8 cm (detail = 3 mm); C, D, E, F, G = 8 cm; H = 7 mm. A–G from J. Dransfield & M. Rakotoarinivo JD7786, H from J. Dransfield & M. Rakotoarinivo JD7787. Drawn by Lucy T. Smith.

0.3 mm; staminate flowers available only as minute scarcely differentiated buds. Pistillate inflorescence solitary at the node, branched

to 1 order, 58–70 cm long; prophyll not seen; peduncle 40–48 cm long, ca. 5–6 mm diam., rounded in cross section; peduncular bracts 3,

the first 27×2 cm, the second 32×1.5 cm, the third to at least 30×1.5 cm; rachis ca. 12 cm long; rachillae numerous 6–8 \times 1–2 mm; flower scars ca. 50 per rachilla, flowers borne on short protuberances ca. 0.7 mm high. Pistillate flowers and fruit not seen.

MADAGASCAR. Toliara, Taolagnaro, Iabokoho, Tsitongambarika, Ivohibe, about 4 km west of Antsofso village, $24^{\circ} 34' 43''$ S, $47^{\circ} 12' 12.1''$ E, alt. 286 m, 24 September 2010, J. Dransfield & M. Rakotoarinivo with S. Dransfield, Ramisy Edmond, Mara Bergé JD7786 (holotype K, isotypes MO, TAN); JD7787 (K, TAN).

This distinctive species occurs perched on the lips of rock faces and along seasonal watercourses in rather open, low crown forest on hill slopes at an elevation of about 250–350 m above sea level. Soils are shallow and have a well-developed humus layer overlying a thin sandy layer.

Conservation status CR (B2ab(ii,iii,v);D). Known only from a single site in the summit area of Ivohibe forest where the area of occupancy is less than 1 km square and where only three mature individuals have been seen. The forest where this species has been recorded is not officially protected and may be subjected to human pressure that could affect the quality of the habitat and probably the loss of mature individuals.

The Significance of Ivohibe from a Palm Conservation Viewpoint

With 20 species recorded in the area, the mountain of Ivohibe, Tsitongambarika, is among the richest sites for palms in the southern part of Madagascar where similar species abundance has only been located in Vondrozo, in the mountains of Andohahela and from littoral forest at Manombo, Farafangana. The palm flora of Ivohibe is characterized mainly by rare and threatened species. Only four species (*Dypsis fibrosa*, *D. mananjarensis*, *D. nodifera* and *Orania longisquama*) are not threatened according to the latest conservation status of Madagascar palms using IUCN Redlist criteria (Rakotoarinivo & Dransfield 2012). One of the aims of QMM in surveying the biodiversity of Tsitongambarika is to discover whether species endemic to the littoral forest in Taolagnaro region might also occur in hills bordering the

coastal zone, which could thus act as alternative conservation sites after the ilmenite exploitation. In our field work we have shown that two species previously thought to be restricted to the littoral forest (*Dypsis brevicaulis* and *D. saintelucei*) also inhabit the lowland humid forest on Ivohibe. Moreover, many species have been recorded for the first time in Taolagnaro area and for several species (e.g. *Dypsis elegans*, *D. eriostachys*, *D. nauseosa* and *Orania longisquama*), the new records in Tsitongambarika represent major southwards extensions of range. Populations of these species are declining or becoming locally extinct elsewhere. Conserving these rare palms appears to be urgent as Ivohibe constitutes one of their last safe habitats.

The Need for Further Fieldwork

In the short time we spent at Ivohibe, it was not possible to explore the entire mountain and there must surely be further palms that we did not record. Elsewhere in the area known as Tsitongambarika we have no palm records at all. The view from Ivohibe in the clear weather we experienced was magnificent. Over to the west and southwest lie the mountains of the Chaîne Anosyenne. There appears to be substantial intact forest on the steep slopes, even at lower elevations. Clearly it would be well worth exploring these areas for palms.

Acknowledgments

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