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Ravenea moorei rising above the tree canopy. See article by W.J. Baker et al., p. 57. Photo by W.J. Baker.

FRONT COVER

Ravenea moorei in the Palm House at the Royal Botanic Gardens, Kew. This palm was grown from seed from the type collection made by Harold E. Moore, Jr. in the Comoro Islands in 1963. See article by W.J. Baker et al., p. 57. Photo by W. Spoelstra.

BACK COVER

Chrysalidocarpus lanceolatus (behind) and *Ravenea hildebrandtii* growing at 900 m elevation in Dindri (Ndzuani, Comoro Islands). See article by W.J. Baker et al., p. 57. Photo by W.J. Baker.

PALM NEWS

A new taxonomic and conservation appraisal of *Phoenix lallani* was presented by M.A. Kumar and colleagues, who reported that the species is thriving in the Cinque Wildlife Sanctuary and Rutland Island, Andaman Islands. They provide the first complete descriptions of the male flowers. The little-known species is noted for its ruminant endosperm, the only *Phoenix* with that condition. The authors describe the successful program to establish this potentially ornamental species in at the Dhanikhari Experimental Garden-cum-Arboretum, Nayashahar, South Andaman Island, India. The paper is published in the journal *Feddes Repertorium* 137: e70083. 2026.

In their paper “Phylogenomics and a New Fossil Synthesis Illuminate the Early Evolution of Palms (Arecaceae),” S. Bellot and colleagues present an updated phylogenetic hypothesis for the genera of the palm family based on nuclear genomic data. This paper also uses additional fossil data to calibrate divergence times and estimate past distributions. The results of this analysis suggest that palms dispersed across ocean barriers dozens of times and that the palms have tracked tropical and warm subtropical climates over time. The paper, which also includes a meticulous compilation of the palm fossil record, is a milestone in palm phylogenetics and is published (open access) in the journal *Systematic Biology*. <https://doi.org/10.1093/sysbio/syag022>

Good news from Madagascar: In their paper “Rediscovery of *Ravenea latisepta* Jum. (Arecaceae) after a century, and the conservation implications,” L. Aureglia and colleagues describe finding this endemic species, believed lost for a century, in Vohimana Reserve, Analamazoatra–Mantadia National Park and Vakona Forest private reserve. The team found only 24 individuals in a limited area and concluded that this species is Critically Endangered. Although the populations have protection, the species is not yet secure. The team believes that monitoring of the populations will be essential to identify potential threats and assess population dynamics. The paper is open access and was published in the journal *Oryx*. <https://doi.org/10.1017/S0030605326102798>



Palms of the Comoro Islands – Diversity, Distribution and Threats

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The Comoro Islands are home to four endemic species of palm, all of which are severely threatened with extinction. Here, we document the findings of two field missions, supported by the IPS Save the Species campaign, which aimed to explore the diversity of palms in the Comoros and to take action to ensure their long-term survival.

The Comoros are an archipelago of oceanic islands, volcanic in origin, lying in the Mozambique Channel of the Indian Ocean between the northern tip of Madagascar and the east coast of Mozambique (Fig. 1).

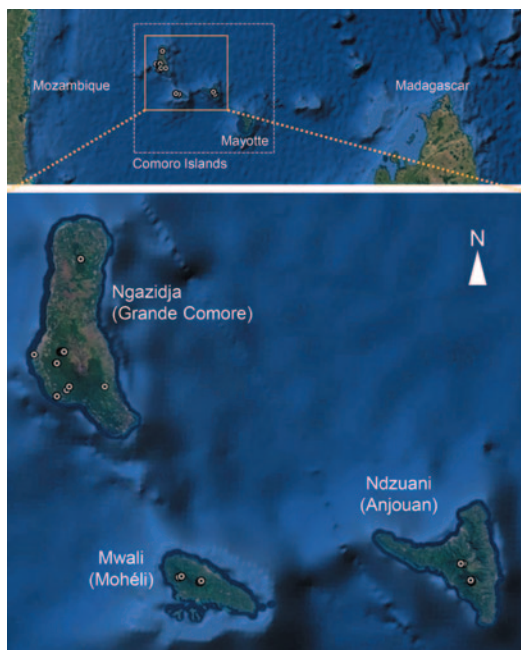
Geologically, they originated along an offshore branch of the East African Rift System, the zone in eastern Africa where the Earth's crust is slowly pulling apart, resulting in subsea volcanic activity (Masquelet et al. 2025). The islands formed in a zigzag running east to west commencing with the now submerged Zélée and Geyser banks 32 million years ago (Ma) and then Mayotte 27 Ma. Volcanic episodes that formed the remaining islands, Mwali (Mohéli), Ndzuani (Anjouan) and Ngazidja (Grande Comore), commenced around 9 Ma, 4 Ma and 1.5 Ma, respectively. The region remains volcanically active with Mt. Karthala, which dominates Ngazidja, erupting as recently as 2007, and submarine volcanic activity west of Mayotte commencing in 2018. Administratively, the Comoros archipelago comprises the sovereign Union of the Comoro and the island of Mayotte, which is currently under French administration.

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1. Map of the Comoro Islands. Lower panel shows the islands visited by the authors with dots indicating fieldwork localities.

The character of each island reflects their volcanic history and age, with Mayotte being the most eroded (highest peak 660 m), Mwali (Fig. 2) being more mountainous (up to 790 m), Ndzuanani being highly mountainous with extremely steeply incised valleys (up to 1,595 m) and Ngazidja being dominated by two shield volcanoes, rising to 2,361 m at the summit of Mt. Karthala, with gradual slopes from the summit to the sea and deep erosion yet to bite. This variation is also reflected in the ecologies of the islands, the species that grow there and the environmental impacts made by people.

The vascular plant diversity of the Comoro Islands is very rich for their total area (just over 2,000 km²) with over 1,100 native species currently recorded, including 212 (19%) endemic species (POWO 2025). This high diversity is driven in part by the varied habitats across the islands, ranging from mangrove and beach vegetation at the coast, through dry forest and scrub in the lowlands (Fig. 3), to humid forests on mountain slopes (Fig. 2) and pioneer vegetation on lava flows at the summit of Mt. Karthala. However, natural vegetation has been severely degraded throughout the Comoros, especially in the lowlands where almost no intact vegetation remains. The majority of forests persists at higher elevations, with Mwali retaining 12% of its natural forest

intact, Ngazidja and Ndzuanani 8% and 7% respectively, and Mayotte only 3% (ECDD et al. 2013, CEB 2026). The major drivers of vegetation transformation are land clearance for agriculture and construction, and invasive exotic plant species. These drivers are further exacerbated by cyclones that are frequent in the region and likely to intensify due to climate change.

The Palms of the Comoros

Given the archipelago's close biogeographic connections to Madagascar, Comoro Island palms have been taxonomically evaluated most recently by Dransfield and Beentje (1995) in *The Palms of Madagascar*, with recent nomenclatural updates by Eiserhardt et al. (2022). In addition to a small set of widespread species, four endemic species of palm are recognized in two genera that are otherwise primarily Madagascan, *Chrysalidocarpus* and *Ravenia*. Three are already known to be threatened with extinction according to the IUCN Red List of Threatened Species: *R. moorei* (Critically Endangered), *R. hildebrandtii* (Endangered) and *C. lanceolatus* (Vulnerable). The fourth, *C. cabadae*, was discovered in cultivation in Cuba (Moore 1962), but reports have emerged of its presence in the wild in Mayotte (Barthelat & Viscardi 2012, Barthelat 2019). Two further endemic species have been described but are problematic (Dransfield & Beentje 1995). The first, *C. humblotianus*, is known only from incomplete type material and has not been reported in the wild since 1884; Dransfield and Beentje treated this as an insufficiently known species. The second, *Haplophloga comorensis*, said to be from Mayotte, is regarded as a doubtful name as the original description contains little information and no type material has been designated (Baillon 1894). In addition, unusual forms, reportedly from Mayotte, of both *Chrysalidocarpus* and *Ravenia* are established in horticulture, but their identities have yet to be clarified. To understand this important group of plants better, a concerted field campaign with associated taxonomic research is required to prevent unstable taxonomy becoming an existential threat to their survival.

Ravenia moorei at Kew

Uniquely among botanic gardens, all four of the endemic palm species of the Comoro Islands are cultivated in the Palm House at the Royal Botanic Gardens, Kew. The Kew specimen of *Ravenia moorei*, a ca. 12 m-tall



2 (top). View northward from Nioumachoua to the forested mountains of Mwali. 3 (bottom). View from Lake Niamawi (Lac Salé) in northern Ngazidja showing dry forest. Photos: W.J. Baker.

male (Front Cover), is particularly significant as it is the only known plant of this species in cultivation worldwide, whereas the other species are widespread in gardens. The Kew

palm was grown from seed from the type collection made by Harold E. Moore, Jr. in Ngazidja in 1963. Curiously, Moore saw none of the other endemic Comorian palms on his



4 (top). Rainforest at 1100 m adjacent to the Mt. Karthala summit road (Ngazidja). 5 (bottom). Rainforest at 700 m in the Mahurani Forest (Mwali). Photos: W.J. Baker.

brief visit (except for glimpsing a lowland *Chrysalidocarpus* from his departing flight, most likely *C. cabadae*). At the time, he believed that he had collected *R. hildebrandtii*, a mistake he would not have made had he seen both species in the field. *Ravenea moorei* stands out as a

majestic coconut-like palm with stems up to 20 m tall and 35 cm in diameter, whereas *R. hildebrandtii* is easily distinguished as a relative dwarf. Dransfield and Uhl (1986) resolved the confusion in their account of *Ravenea* in the Comoros, in which they recognized both

species, describing *R. moorei* as new to science. In the wild, *R. moorei* is known only from forest on basalt at 600–1000 m on the western flanks of Mt. Karthala. Prior to the work described here, the extent and state of current populations was very poorly known (Keith et al. 2006), raising concerns that *R. moorei* may be at risk of extinction.

Moore distributed seed from the type gathering of *Ravenea moorei* to several botanic gardens, including the Royal Botanic Gardens at both Kew and Edinburgh, as well as Fairchild Tropical Botanic Garden but, of these, only the Kew plant survives. However, Kew's *R. moorei* is in jeopardy. An essential renovation of the iconic Victorian Palm House means that the building must be emptied of all plants during 2026. The prospects of successfully moving the *R. moorei* specimen are slim and propagation of the palm by seed is impossible as all *Ravenea* species are dioecious. Given the potential conservation importance of the Kew palm, the Palm House renovation could not proceed without gaining a better understanding of *R. moorei* in the wild. This predicament triggered an exciting opportunity to establish a program of research on the diversity, distribution and conservation of Comoro Islands palms.

Fieldwork in the Comoros

To effect this plan, a partnership was established between the Comorian National Center for Scientific Documentation and Research, the National Herbarium at Comoros University and the Royal Botanic Gardens, Kew. The partnership also included Karthala National Park in Ngazidja, Ntringui National Parc in Ndzuani and Mwali National Park. In 2023 and 2024, two missions took place in the Comoros aimed at establishing an integrated, collaborative program on the diversity and conservation of Comoro palms. Our primary aim was to undertake palm surveys across the Union of the Comoros (Ngazidja, Ndzuani, Mwali), focusing on endemic palms in general, and *Ravenea moorei* in particular, documenting the distribution, population status and threats of all species. We also sought to undertake training in palm biology, including taxonomy, field skills and cultivation, to build in-country capacity for palm research and conservation. The first mission (November 2023) focused on fieldwork in Ngazidja, whereas Ndzuani and Mwali were explored in the second mission (November & Dedember 2024), which concluded with a palm training course in Ngazidja.

Ngazidja: Fieldwork on Ngazidja took place mainly on the western side of Mt. Karthala (Fig. 4), which receives the highest rainfall on the island (6000 mm per year) and retains important stands of rainforest from around 700 m upwards. The type locality of *R. moorei* was visited near Boboni, as well as two other sites, the Karthala summit road above Mvouni and forest accessed above Mdjoiezi. A fourth day involved a hike from Djoumouachongo to Nyumbadjou, the historic plantation estate of 19th-century French naturalist and colonial entrepreneur Léon Humblot but was less successful for palm hunting due to difficulties finding access to the forest. Two days were spent in lower rainfall areas, one in La Grille massif in the north, although this was cut short by bad weather, and another above Tsinimoipanga on the eastern side of Karthala. Rainforest occurs in both of these areas, although it is significantly degraded. A final day was spent in drier areas to the west of Karthala, exploring degraded fragments of coastal forest vegetation, arguably the most threatened vegetation type in the Comoros. In the forest on the western side of Karthala above 700 m, *R. moorei*, *R. hildebrandtii* and *Chrysalidocarpus lanceolatus* were observed and collected, whereas only *R. hildebrandtii* was noted at La Grille and *C. lanceolatus* at Tsinimoipanga. In the western coastal mesophyll forest remnants south of the capital Moroni, we found *C. cabadae*, making the first formal herbarium specimen record of this species in Ngazidja. Thus, Ngazidja is the only island in the Comoros on which all four endemic species occur. A fifth, non-endemic species, *Phoenix reclinata*, was also observed in dry vegetation in the south of the island.

Mwali: Six days were spent in Mwali during mission 2. Two field days were focused on rainforest sites in the central west of the island, the first reached by walking north from Ouallah 1, and the second reached by walking south from the island capital Fomboni into the Mahurani Forest (Fig. 5). Dry vegetation was also visited on the north-east coast near Wanani and in the islands south of Nioumachoua. Of the endemic species, only *Chrysalidocarpus lanceolatus* and *Ravenea hildebrandtii* were observed. *Phoenix reclinata* occurred throughout the island, including in the islands south of Nioumachoua, but never in closed forest vegetation. A lone individual of *Hyphaene coriacea* was observed on the south coast.

	Ngazidja	Ndzuani	Mwali	Mayotte
Non-endemics				
<i>Hyphaene coriacea</i>			x	x
<i>Phoenix reclinata</i>	x	x	x	x
<i>Borassus aethiopum</i>				x
Endemics				
<i>Chrysalidocarpus cabadae</i>	x			x
<i>Chrysalidocarpus lanceolatus</i>	x	x	x	x
<i>Ravenea hildebrandtii</i>	x	x	x	x
<i>Ravenea moorei</i>	x			

Table 1. The native palms of the Comoro Islands and their distribution.

Ndzuani: Six days were also spent in Ndzuani during mission 2. Two field days were focused on rainforest sites. The first of these focused on degraded forest in Mt. Ntringui National Park, around Dindri (Back Cover) and Lake Dzilandzé. The second was reached by hiking west of Ouzini towards the Moya Forest. A third field day was used to explore dry forest west of Bimbini, although almost all intact forest in this area is now lost. Like Mwali, only two of the endemic species were observed (only *Chrysalidocarpus lanceolatus*, *Ravenea hildebrandtii*). *Phoenix reclinata* was also observed west of Bimbini.

Mayotte: Mayotte was not visited during our missions, due to a lack of capacity. However, valuable palm surveys have already been undertaken (Ludwig 1999, Pibot & Soumille 2000, Reilhes 2010, Barthelat 2019); of the Comorian endemic palms, *Chrysalidocarpus cabadae*, *C. lanceolatus* and *Ravenea hildebrandtii* are recorded there. Shortly after our second mission to the Comoros, Mayotte was devastated by Cyclone Chido in December 2024, which brought winds exceeding 200 km/h, resulting in widespread impacts for the remnant forests and the biodiversity that depends on them (Ibouroi et al. 2025). The consequences of this catastrophe for native palms are not yet known.

Palm inventory

Although palms are conspicuous throughout the landscapes of the Comoro Islands, the species that are most often encountered are introduced and cultivated, not native. The coconut (*Cocos nucifera*) is especially abundant

and extensively used by humans. The raffia palm (*Raphia farinifera*) is also found though more scattered, generally in association with human activity and is likely introduced (Dransfield & Beentje 1995). The betel nut palm (*Areca catechu*) is also commonly cultivated. We noted a small number of cultivated ornamental species (e.g. *Bismarckia nobilis*, *Dictyosperma album*, *Elaeis guineensis*, *Hyophorbe lagenicaulis*, *Hyophorbe verschaffeltii*, *Phoenix dactylifera*, *Pritchardia pacifica*, *Roystonea oleracea*) and additional species have been reported for Mayotte (Barthelat 2019). *Chrysalidocarpus lutescens*, which is so common in the horticultural flora throughout the tropics, is not widely known in the Comoros, but was observed semi-naturalized in secondary vegetation in Nyumbadjou, Ngazidja. It has potential to be invasive, though the population observed did not appear to be in good health. Barthelat (2019) considers *Bismarckia nobilis* to be native to Mayotte, but following Dransfield & Beentje (1995) we treat this as endemic to Madagascar and speculate that it might have naturalized in Mayotte.

Following our survey, we believe that the native palm flora of the Comoro Islands comprises seven species, including the four endemics. The species are unevenly distributed across the islands as described in Table 1.

Non-endemic palms

The non-endemic native palm species of the Comoro Islands (*Borassus aethiopum*, *Hyphaene coriacea*, *Phoenix reclinata*) are widespread species that are also found in Madagascar and



6. *Ravenea hildebrandtii* on Mt. Karthala (above Mvouni, Ngazidja). Photo: W.J. Baker.

continental Africa. All are palms of seasonal environments, rather than rainforests, and all are useful to humans. Although there is no

reason to doubt their native existence in the Comoros, it is conceivable that humans may have influenced their distribution. Of the non-

endemic native species, *Phoenix reclinata* is the most common and is especially abundant on Mwali. The authors of this article did not observe *Borassus aethiopum*, which is reported for Mayotte in the literature and from publicly available photographs (Ludwig 1999, Reilhes 2010, Barthelat 2019). On Mwali, a single individual of *Hyphaene coriacea* was found on the strandline of a south coast beach. It seems likely that this plant established through the arrival of a viable drift seed. This species appears to be more abundant, if locally so, on Mayotte.

Endemic palms

Ravenea hildebrandtii: This dwarf palm is readily distinguished by its relatively short stem (usually up to 3 m, but sometimes up to 9 m), stem diameter less than 10 cm and leaves with 30–45 leaflets each side of the rachis (Fig. 6). Like all species of *Ravenea*, it lacks a crownshaft and is dioecious. The females often produce inflorescences that are as long as (or longer than) the leaves (Fig. 7), a feature that is especially conspicuous when in fruit. Male inflorescences are shorter with flowers that may be white or orange-yellow (Figs. 8 & 9). Sometimes, the base of the stem is grossly swollen (Fig. 10), but this is not a consistent feature within the species, and it is also observed in *R. moorei*.

Ravenea hildebrandtii is more abundant than any other palm species in the Comoro Islands, sometimes growing gregariously in high numbers (e.g. Mt. Karthala [Fig. 11], Mahurani Forest). During our missions we observed it in montane rainforest (including degraded forest) from 800 m to over 1300 m on Mt. Karthala, but on Mwali, it is found from 300 m elevation. On Mayotte, it is also reported to occur at lower elevations of ca. 500–600 m (Pibot & Soumille 2000). Most forest at low elevations is destroyed in the Comoros, making reliable observations of the lower elevational limits of mountain species difficult. We estimate that populations on each island likely amount to ca. 1000 individuals, although a formal survey is required to obtain more exact figures. Populations on Mayotte are reported to contain only ca. 200 individuals (Pibot & Soumille 2000). There is evidence of recruitment at most sites, although at the time of our missions (November) fruits were observed on only one individual at La Grille. However, many flowering individuals were noted.

Ravenea moorei: *Ravenea moorei* is very closely related to *R. hildebrandtii* but is much larger, with stems rising to around 20 m and attaining approximately 20–35 cm in diameter. The leaves are more robust than those of *R.*

7. The female inflorescence of *Ravenea hildebrandtii* can extend far beyond the leaves (above Mvouni, Ngazidja). Photo: W.J. Baker.





8 (left). Male inflorescence of *Ravenea hildebrandtii* with white flowers (Ouzini, Ndzuani). 9 (right). Male inflorescence of *R. hildebrandtii* with yellow-orange flowers (Mahurani Forest, Mwali). Photos: W.J. Baker.

hildebrandtii, with 55–70 leaflets on each side of the rachis (Fig. 12). Like *R. hildebrandtii*, the female inflorescences can be elongated, but we have only observed them being shorter than the leaves (Fig. 13). The base of the stem is sometimes grossly swollen (Fig. 14A), as in some but not all individuals of *R. hildebrandtii*.

Ravenea moorei has the most restricted distribution of any palm in the Comoros. It is known only with certainty from high-rainfall, montane rainforest on the western side of Mt. Karthala in Ngazidja. We recorded it between 750 and 1200 m elevation in three sites: in the vicinity of the type locality above Boboni (Fig. 14B), in forest above Mdjoiezi and adjacent to the Mt. Karthala summit road reached from Mvouni. A report of the species at 500 m elevation in La Grille massif above Mitsamiouli could not be substantiated (Dransfield & Beentje 1995). More thorough exploration of the remaining forest at La Grille is required. During our missions we recorded 50 individuals, of which 12 were of adult reproductive age. However, we recognize that rainforest persists between these locations, and a systematic survey of the forests will very likely reveal more individuals. Since the missions, one of us (AM) has found additional

populations at Boboni, and also located the species near sites where we had failed to find it, namely 1 km east of Nyumbadjou and 2 km south-west of Tsinimoipanga. We estimate that the total population in Ngazidja likely numbers a few hundred. We observed three fruiting females, as well as at least one other female with signs of old inflorescences. Male inflorescences are short and can be obscured by leaf bases, making them difficult to observe in tall individuals. Seedlings and juveniles were also observed, suggesting that successful recruitment is taking place.

Ravenea moorei and *R. hildebrandtii* are known to be sister species, in other words they are each other's closest relative. We observed the two species co-occurring at two sites (Fig. 14C). Under these circumstances, it is possible that introgression (hybridization) may occur. We observed some individuals of *R. moorei* on Mt. Karthala that appeared to show intermediate morphology (more slender habit, elongated female inflorescences [Fig. 14D]), which may be evidence of hybridization. In view of the conservation value of both species, but especially *R. moorei*, genetic studies are now required to understand better the impact and implications of gene flow among the species.



10. The base of the stem of *Ravenea hildebrandtii* is often grossly swollen (Mahurani Forest, Mwali). Photo: W.J. Baker.

Chrysalidocarpus lanceolatus: The two species of *Chrysalidocarpus* are easily distinguished from *Ravenea* because they are generally

clustering palms and each stem is topped with a crownshaft. *Chrysalidocarpus lanceolatus* is distinguished easily from the other species, *C. cabadae*, by its broad leaflets. It is also distinct in its ecology, occurring only in montane rainforest at 670–1100 m elevation, whereas *C. cabadae* is a palm of low elevation, mesophyll forest (Mohamed 2019). *Chrysalidocarpus lanceolatus* is, however, rather variable (Figs. 15–18; Back Cover). It can range from a few meters in height to at least 16 m. Some forms appear solitary stemmed (although usually suckers can be observed at the base), whereas others produce as many as 20 stems. The leaflets are generally arranged in either a regular or subregular fashion and may appear plumose, sometimes being held in multiple planes (Fig. 17). We noticed that individuals from Ndzuani and Mwali tend to have more regularly arranged leaflets that are slightly ascending and drooping at the tips, while individuals in Ngazidja have leaflets arranged in a slightly plumose fashion. Inflorescences emerge between the leaves (interfoliar), but vary in size (Fig. 18). The variation within *C. lanceolatus* may be indicative of local ecotypic variation or speciation in action.

Chrysalidocarpus lanceolatus is generally observed scattered through the forest.

11 *Ravenea hildebrandtii* growing gregariously on Mt. Karthala (above Mvouni, Ngazidja). Photo: W.J. Baker.





12. *Ravenea moorei* on Mt. Karthala (above Mvouni, Ngazidja) – this female is the largest specimen that the team encountered. Photo: W.J. Baker.



13. Close-up of the crown of the large female *Ravenia moorei* on Mt. Karthala (above Mvouni, Ngazidja), showing fruiting female inflorescences that are shorter than the leaves. Photo: W.J. Baker.

Occasionally it is a dominant element of the forest (e.g. Mahurani Forest, Tsinimoipanga), but it is not gregarious to the same extent as

Ravenia hildebrandtii. We estimate that the total population across all four islands amounts to a few thousand individuals.



14. *Ravenea moorei* in Ngazidja. A. Like *R. hildebrandtii*, the base of the stem of *R. moorei* is sometimes swollen. B. The team celebrates finding *R. moorei* for the first time in the vicinity of the type locality at Boboni (left to right, Hachimia Salim, Will Spoelstra, Tom Pickering, Zakaria Cheha Mkatibo). C. *R. moorei* (left) and *R. hildebrandtii* (right) growing sympatrically above Mdjoiezi (Tom Pickering provides scale). D. A putative *R. moorei* $\times$ *R. hildebrandtii* hybrid (above Mvouni). Photos: W.J. Baker.



15. *Chrysalidocarpus lanceolatus* on Mt. Karthala, above Mdjoiezi (Ngazidja). Photo: W.J. Baker.

Chrysalidocarpus cabadae: This species is similar to its close relative, *Chrysalidocarpus lanceolatus*, but can be readily distinguished by its strongly arching leaves with ascending, narrow and

closely spaced leaflets (Fig. 19–22). It is also distinct in its ecology, being found only in coastal vegetation – we recorded individuals up to about 100 m elevation. Though said to



16. *Chrysalidocarpus lanceolatus* in the Mahurani Forest (Mwali). Photo: W.J. Baker.

be of Comorian origin when discovered in a garden in Cuba (Moore 1962), it was only recently recognized in the wild on the Comoros at Sohoa in Mayotte (Barthelat &

Viscardi 2012, Barthelat 2019). We are aware of no formal records of *C. cabadae* from Ngazidja prior to our mission, but the palm is well known to local botanists. The Mayotte



17 (left). *Chrysalidocarpus lanceolatus* leaf. 18 (right). *C. lanceolatus* inflorescence with fruit. Both images from degraded forest above Tsinimoipanga (Ngazidja; Will Spoelstra provides scale). Photos: W.J. Baker.

form appears to differ slightly in that the ascending leaflets droop a little at their apices.

On Ngazidja, the coastal forest in which this species originally occurred is severely degraded. We found *Chrysalidocarpus cabadae* persisting in three sites, one on the outskirts of Moroni south of Iconi (Figs. 19 & 20), a second west of Séléa, and a third west of Mdjoiezi-Hambou (Fig. 22). The first site may have been the population that tantalized Harold Moore from the air as he departed from the old airport at Iconi (Moore 1965). Only degraded scrub remains at the first two sites and the individuals there have rather short stems. The third site still contains some relatively high canopy forest trees and the palms there are much taller. However, *Chrysalidocarpus cabadae* can also be seen planted in the urban setting of Moroni, many specimens having been rescued from wild sites under threat by one of the authors (AM). We estimate that around 100 individuals remain on Ngazidja. This

appears to be the most threatened palm species in the Comoro Islands.

Having observed only two species of *Chrysalidocarpus* in the Comoros, we examined closely the type material of *C. humblotianus* held in the Kew herbarium (and images from the Paris Herbarium). Although the material is limited, we suspect that it may in fact be conspecific with *C. cabadae*, as other authors have also suggested (e.g. Barthelat 2019). Further taxonomic evaluations, accompanied by genetic analyses including its closest relatives, *C. lanceolatus* and *C. pambanus* from Pemba island, are currently under way.

Threats to palms in Comoros

The threats that endemic palm species face in the Comoro Islands are severe. Natural vegetation has already been lost from most of the land surface of the islands and while all of the species were observed persisting in degraded vegetation, their ongoing survival in



19. *Chrysalidocarpus cabadae* in remnant coastal mesophyll forest near Iconi on the outskirts of Moroni (Ngazidja). Photo: W.J. Baker.



20. Stand of *Chrysalidocarpus cabadae* in remnant coastal mesophyll forest threatened by agriculture and construction (near Iconi, Moroni, Ngazidja). Photo: W.J. Baker.

such habitats is questionable due to diminished recruitment, altered light and water regimes, and competition with secondary forest plants and invasive, alien species. More concerning, however, is the ongoing degradation of important palm habitat in protected areas. For example, the threats to the largest population of *Ravenea moorei* observed on mission 1 had substantially intensified by mission 2, only one year later. This site is adjacent to the Mt. Karthala summit road and falls within the ZNP (*zone de non prélèvement*, or no-take zone) of the national park. We observed 33 individuals, including 8 adults, some actively reproducing. In November 2023, some evidence of agriculture existed at this site – a field of bananas and some more bananas planted along the path – but the forest remained largely closed. In November 2024, many more bananas were present and the forest canopy had been substantially cleared (Fig. 23). Near the largest and most productive female palm, a large *Weinmannia* tree had been felled, imperilling the largest *R. moorei* and damaging the area around it in which many establishing seedlings had previously been observed (Fig. 24). Illegal forest degradation for agriculture and timber extraction is the primary risk to protected areas across the islands. Vegetation clearance is also

progressing rapidly for construction at lower elevations (a particular risk for *Chrysalidocarpus cabadae* [Fig. 25]) and some areas are also quarried for stone and aggregates for construction activities.

Forest disturbance promotes the establishment of invasive plants, which are highly prevalent in the Comoro Islands. Strawberry guava (*Psidium cattleianum*) and Koster's curse (*Miconia crenata*, formerly *Clidemia hirta*) are among the most noxious of the weed species, forming dense communities that compete with other plants and prevent their regeneration. These species are now beyond control throughout the Comoros, and their prevalence is intensified by the fact that some are useful; *P. cattleianum*, for example, is used for producing charcoal.

The core threats to Comoro Islands and species are compounded further by poorly understood impacts of climate change, to which islands are especially vulnerable. The distribution of *Ravenea moorei*, for example, appears to closely correspond to the zone of highest rainfall on Ngazidja. Should this high rainfall area become drier, there may be negative consequences for the habitat of *R. moorei* and the survival of the palm itself. Climate change may also increase the frequency and intensity of extreme



21. Stems and leaf sheaths of *Chrysalidocarpus cabadae* (near Iconi, Moroni, Ngazidja). Photo: W.J. Baker.



22. Population of *Chrysalidocarpus cabadae* in remnant coastal forest near Mdjoiezi (Ngazidja), severely threatened by construction. Photo: W. Spoelstra.



23 (left). *Ravenea moorei* persisting in forest inside Karthala National Park (Ngazidja) that has been illegally cleared for cultivating bananas and other crops. 24 (right). The largest *Ravenea moorei* photographed one year after the image in Fig. 12 imperilled by illegal timber extraction inside Karthala National Park (Ngazidja). Photos: W.J. Baker.

weather events, such as cyclones; the recent devastation of Mayotte in December 2024 by Cyclone Chido, the worst storm to hit the island in almost a century, may be an example of this.

Prospects

The two missions undertaken by the partnership have led to a more complete understanding of palms in the Comoro Islands, their diversity, distribution and their plight. It also created invaluable opportunities to raise awareness with stakeholders responsible for the protection of the natural environment in the Comoros, especially national park authorities. For example, a four-day training course was delivered by the Kew team on 25–28 November 2024 and was attended by 22 representatives from Karthala National Park, the University and CNDRS (Fig. 26). The course focused specifically on the challenge of saving palms on Ngazidja, where both of the most threatened species, *Chrysalidocarpus cabadae* and *Ravenea moorei*, occur. It concluded with a workshop to develop an outline conservation action plan, which can be read in full in our

mission report (Baker et al. 2025), but is summarized in brief here.

1. Fundamental scientific research: Basic research is required to improve understanding of the taxonomy, distribution, population biology and ecology of endemic Comorian palms, underpinned by genomic work to support conservation recommendations. *Chrysalidocarpus cabadae* and *Ravenea moorei* should be prioritized. Updated IUCN Red List Extinction Risk assessments, drawing on new evidence, should be prepared for all species, the current assessments being outdated from 1998 and lacking for *C. cabadae*. Horticultural research is needed to develop methods for mass propagation of material for restoration and ornamental plantings.

2. Habitat conservation and restoration: Known populations require monitoring and protection. Most species occur in national parks, but even there they experience significant human pressure. Special palm preserves within the national parks could be designated, potentially with the involvement of local communities as managers. Replanting



25. Felled stem of *Chrysalidocarpus cabadae* near Iconi (Moroni, Ngazidja; Andilyat Mohamed for scale). This population is intensely threatened by vegetation clearance for construction and agriculture. Photo: W.J. Baker.

of palms where their populations have been denuded could be implemented, potentially as part of long-term restoration initiatives. Horticultural infrastructure at the national parks is required to support this. *Chrysalidocarpus cabadae* presents a particular challenge, given that its populations in Ngazidja are within protected areas and are on the brink of extinction.

3. Conservation of palm trees ex situ: Comorian palms have high horticultural value and the inclusion of endemic palms in the urban landscape and gardens of the Comoros is a significant opportunity for both conserving palm germplasm and for raising public awareness of Comorian natural patrimony. Currently, native palms are rarely seen in horticultural settings, but this could change if plant material became available and awareness was raised. Cultivation in botanic gardens around the world could also be stepped up through the introduction of new accessions sourced from the wild. The international horticultural community could be enlisted to

help with ex situ conservation through distribution of legally collected seed around the world, as was achieved for *Tahina spectabilis* from Madagascar, to build a global conservation “metacollection.” This approach might be particularly effective for *Ravenea moorei*.

4. Knowledge sharing and public awareness: Comorian endemic palms have the potential to become flagship species for conservation, but to achieve this, greater awareness of the species must be raised. Our missions initiated this process within key public institutions. However, the majority of the pressure on the natural environment in the Comoros arises from activities of local people who, without information about the environmental impacts of their activities, cannot make changes towards positive biodiversity impacts. Actions might include concerted environmental education in schools to ignite passions for biodiversity early or the creation of a Comorian Palm Association, which would deploy citizen scientists to raise capacity for education, horticulture and monitoring activities. Deployment of all forms of media to communicate the story of Comorian palms and forests inside and outside Comoros will be essential.

Next steps

Implementation of conservation plans in the face of limited resources and capacity is challenging, but actions are already underway. Taxonomic and conservation genetic work is currently in progress, based on large-scale genomic sequencing of numerous field-collected samples at Kew. Staff from the University are continuing to survey the forests of Karthala, focusing on *Ravenea moorei* and are developing a clearer picture of the distribution of this species. They have also established a palm nursery supported by key students, which is successfully producing healthy seedlings of endemic palms, and are starting experimental plantings in Moroni. Emergency interventions are also routinely made by the University when needed to rescue wild palms threatened by development and replant them at safe locations. New accessions of living material of all endemic species made on the first mission have been introduced to the living collections at the Royal Botanic Gardens, Kew, some of which will be further distributed to other botanic gardens. The story of Comoro Islands palms has also been told in a number of interviews broadcast in the



26. The participants and trainers of the palm training course (November 2024) with *Ravenia moorei* in Karthala National Park (Ngazidja). Photo: N. Rakotondranivo.

Comoros and UK, as well as in a short documentary available online (RBG Kew 2025). Kew's Palm House, which played such a key role in initiating this work, will also provide an outstanding venue to share the story of Comorian palm conservation with its >2 million international visitors each year.

The palms of the Comoros encapsulate the challenges faced by tropical island species and also the many opportunities that exist to change their fate. We hope that, by igniting interest in Comorian palms, we have initiated a reversal in their fortunes, that will ensure that palms will thrive in the forests of the Comoros for centuries to come.

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New Observations of *Calamus johanis*, a Rare, Non-Climbing Rattan from Borneo

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Calamus johanis is a non-climbing rattan from the tropical Asian island of Borneo that was known to date from only a single collection from Central Kalimantan. Here, we present new observations of the species from two populations in Bukit Baka Bukit Raya National Park in West Kalimantan.

During recent field work in the Schwaner Mountains in West Kalimantan, Indonesian Borneo, one of us (H.P.) encountered a small, stemless palm bearing only one to two pairs of leaflets on each leaf (Figs. 1 & 2). The palm bore fruits covered with overlapping scales, revealing it as a member of subfamily

Calamoideae. In the Calamoideae, there are only two genera that include small stemless species, *Calamus* and *Salacca*. Among these two genera, the flowers not borne in catkin-like rachillae identified the palm as *Calamus* (Dransfield et al. 2008). *Calamus* is best known for providing the raw materials of the multi-billion-dollar rattan cane furniture industry and for its large diversity of over 400 predominantly climbing species. About 10% of the species in *Calamus* are non-climbing, however, i.e. short-stemmed or stemless (Couvreur et al. 2015). Among non-climbing *Calamus* species, only three species are known to have as few as two pairs of leaflets per leaf: *Calamus brevissimus*, *C. hosensis* and *C. johanis* (Henderson 2020). All of these occur only in Borneo and belong to the taxonomically difficult *Calamus acanthochlamys* group, which is distributed across Borneo, the Malay Peninsula and Sumatra. The *Calamus*

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1. Broad-leaved form of *Calamus johanis* bearing only a single pair of leaflets per leaf, in fruit. Inflorescences indicated by the white arrows. Photo: H. Priyandono.

acanthochlamys group includes 20 species that are characterized by their usually solitary, non-climbing stems, the lack of climbing organs and their small round fruits, which are orange to red or brown (Henderson 2020). A recent phylogenomic analysis strongly supports the monophyly of this group (Kuhnhäuser et al. 2025). Most of the species in the *Calamus acanthochlamys* group are narrow endemics, with twelve species known only from a single locality (Henderson 2020).

Two of the three non-climbing species with two leaflets per leaf, *Calamus brevissimus* and *C. hosensis*, are only known from small areas in the Malaysian state of Sarawak in northern Borneo. The third species, *Calamus johanis*, is known just from a single specimen, *Mogea* 4418. It was collected by Johanis P. Mogea and W.J.J.O. de Wilde during the Indonesian-Dutch Bukit Raya Expedition in 1982 in the Indonesian province of Central Kalimantan in central Borneo (Mogea 1987) and was described as new to science only six years ago (Henderson 2020). The specimen has two pairs of leaflets per leaf and the entire plant is only approximately one meter tall, including a stem

of ca. 20 cm length. Its fruit are described as bright orange. Only minimal information is available on the ecology of the species, with the herbarium label stating that the collected individual grew in a clump in primary rainforest at an elevation of 200 m. To our knowledge, no photographs exist of *C. johanis* in the wild.

The palm found during our field work closely matches the morphology of the type specimen of *Calamus johanis* and occurs in the same broad area of central Borneo (Fig. 3), allowing its identification to this species despite the limited understanding of *C. johanis*. Key diagnostic characters that enable this identification include the small number of leaflets, elliptic pinnae, ocreas that are split into two lobes and splitting fruiting perianths (Henderson 2020). Two individuals that we observed in fruit or flower had only a single pair of leaflets on all leaves, a character not previously observed in *C. johanis*, whose only existing specimen has two pairs of leaflets per leaf, and not known in any other non-climbing rattan palm (Henderson 2020). Given the highly incomplete knowledge of the

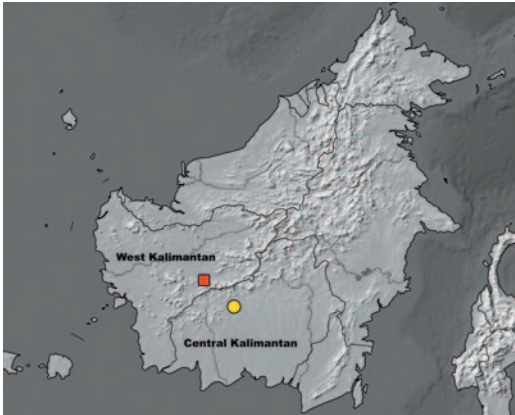


2 Narrow-leaved form of *Calamus johanis* bearing two pairs of leaflets per leaf, with Bukit Baka Bukit Raya National Park staff Dodi Marsaidi holding old infructescence. Photo: H. Priyandono.

species, we provide here a description of the ecological and morphological variation of the individuals encountered.

We observed two populations of *Calamus johanis* in the Belaban Resort in Bukit Baka Bukit Raya National Park (Table 1). *Calamus*

3. Distribution of *Calamus johanis*. Type specimen collected in Central Kalimantan (yellow circle), recent collections in West Kalimantan that are described here (red square).



johanis grew on sandy clay on hills in primary dipterocarp forest. The species was often found on ridges with thick layers of leaf litter and sometimes also on slopes, ranging from forest with dense canopy cover to relatively open habitats with ample access to light. The species is locally abundant and was found in two populations, one at an elevation of around 400 m and one just above 1000 m (Table 1), demonstrating a much broader elevational amplitude of *C. johanis* than the elevation of 200 m at which the type specimen was collected. The species usually grows solitarily, but sometimes also in small clumps with two or three individuals.

Table 1. Populations of *Calamus johanis* observed in Bukit Baka Bukit Raya National Park.

Population	Individual	Coordinates	Elevation (m)
1	1	0°36'38.30"S, 112°15'13.00"E	406
	2	0°36'28.50"S, 112°15'13.10"E	420
	3	0°36'38.20"S, 112°15'12.90"E	405
	4	0°36'38.60"S, 112°15'13.20"E	403
	5	0°36'35.82"S, 112°15'13.73"E	380
2	6	0°38'55.30"S, 112°19'48.20"E	1017



4. Young adult individual of *Calamus johanis* in fruit with a single pair of leaflets per leaf. 5 (facing page). Mature individual of *Calamus johanis* in fruit with two pairs of leaflets per leaf. Both specimens were taken from a locally abundant population. They will be deposited at Herbarium Bogoriense, Java, Indonesia, to provide new scientific records and enable further study of this species. Photos: H. Priyandono.

We conducted morphological measurements of three specimens. The stems are short, up to 20 cm long, slender, generally not seen above

ground and buried by a thick layer of leaf litter. The leaf sheaths are fully covered by spines, leaves bear one to two pairs of leaflets and





6. Pistillate (female) inflorescence of *Calamus johanis* at anthesis.

climbing organs are absent. On young plants to the early adult stage, the leaf consistently has a single pair of leaflets sized 20–31 × 5–7.8 cm, with a short petiole that is 24–30 cm long, ocreas split into two lobes that are 4.4–16 cm long and an inflorescence that is 11–26 cm long (Figs. 1 & 4). Mature plants have two pairs of longer and narrower leaflets that are 32–34

× 4.6–5.5 cm in size, a petiole ca. 62 cm long and an inflorescence that is ca. 41 cm long (Figs. 2 & 5). The infructescences are erect, branched to one order or unbranched and may be bent over at the tip at maturity. The fruits are 9–10 mm long and ca. 7 mm wide, brown to orange red and have splitting fruiting perianths (Fig. 6–8).



7 (top). Erect infructescence of *Calamus johanis*, branched to one order. 8 (bottom). Fruits of *Calamus johanis*, with splitting fruiting perianths clearly visible at the fruit bases. Photos: H. Priyandono.

While many species of the *Calamus acanthochlamys* group have a narrow geographic range of distribution (Henderson 2020), it is also possible that *Calamus johanis* occurs more widely but is often overlooked because it may easily be mistaken for a juvenile palm, similar to the recently described “underground palm” *Pinanga subterranea* that is relatively widespread in Borneo (Kuhnhäuser et al. 2023, Randi et al. 2023). The variation within the individuals observed indicates that *C. johanis* has a relatively high morphological

and ecological variability. For a better general understanding of *C. johanis* and its evolutionary relationships within the *Calamus acanthochlamys* group, more taxonomic and population genetic research are needed.

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Philip Barry Tomlinson (1932–2026)



Barry Tomlinson at the microtome. Photo: Patrick Griffiths.

News has been received that one of the titans of palm botany has died in January 2026 at the age of 93. Philip Barry Tomlinson was born in Leeds, Yorkshire, United Kingdom in 1932. He studied at the University of Leeds, graduating with a BSc in 1953 and then completing his PhD in 1956, under the supervision of Charles R. Metcalfe and Irene Manton. He held several short-term teaching posts in Leeds, Ghana and Singapore before taking up the post of research scientist at Fairchild Tropical Garden. Then, in 1971, he was appointed Professor of Botany at Harvard, based at Harvard Forest, Petersham, Massachusetts. In retirement he was Edward C. Jeffrey Professor of Biology, Emeritus at Harvard. During his career he was honored with the post of Crum Professor of Tropical Botany at the National Tropical Botanical Garden and Research Associate at Fairchild Tropical Garden. He was awarded the Steyermark Medal for Systematic Botany, Smithsonian Institution (2002), the Linnean Medal of the Linnean Society of London (1999), D. Sc. (Hon) University of Guelph,

Canada (1997), the Botanical Society of America Merit Award (1988), the Montgomery Medal of Fairchild Tropical Garden (1976) and in 2020 the Robert Allerton award for extraordinary contributions to botany and horticulture by the National Tropical Botanical Garden.

Barry's speciality was plant anatomy but scarcely the rather dry subject of transverse sections. Barry's interest in plant anatomy was strongly linked to functionality. He worked in collaboration with C.R. Metcalfe at the Jodrell Laboratory at the Royal Botanic Gardens, Kew on the grand surveys of the anatomy of dicotyledons and monocotyledons, publishing in 1961 *The Anatomy of Palms* as Volume 2 of the *Anatomy of Monocotyledons* series. He contributed several essays on basic palm structure to *Principes*, papers that provide very useful introductions to the structure of palms. Papers followed on the leaf base in palms, the vascular skeleton of the coconut, flowering in *Metroxylon* and dichotomous branching in *Nypa*, among other subjects. His palm work

culminated in his book *The Structural Biology of Palms*, a major contribution to palm botany where he showed how tissues and organs can be understood in a highly integrated way to demonstrate the interrelationships of functional processes such as photo-assimilation, absorption, transport, storage, reproduction, dispersal, establishment and protection against predators. This was always Barry's interest and approach to palms – structural biology.

In the decades since *The Anatomy of Palms* (1961) palm systematics changed dramatically with the discovery of many undescribed palm genera and species and a greatly improved understanding of phylogenetic relationships within the family, thanks to the increasing use of molecular analysis. A new survey of palm anatomy was clearly needed. Barry's final palm magnum opus is his 2011 *The Anatomy of Palms; Arecaceae – Palmae*, co-authored with James W. Horn and the late Jack B. Fisher, a

sumptuous volume, superbly illustrated throughout with color micrographs amply showing the sheer diversity and beauty of the internal structure of palm leaves. His contribution to our current understanding of the structure of palms and how they function is immense. That is not all – he published widely on other tropical plants, publishing for example *The Botany of Mangroves* (1986) and co-authoring with the late Francis Hallé and Rolf Oldeman *Tropical Trees and Forests: an Architectural Analysis*.

Barry was a renowned teacher and had a series of PhD students and collaborated with a wide circle of palm scientists. He was a tall imposing figure with a soft Yorkshire accent only slightly modified by his long residence in USA and a dry sense of humor. He was a very special botanist whose contribution to our understanding of palms is immense.

JOHN DRANSFIELD

Linking Indigenous and Scientific Knowledge to Describe an Edible Palm

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Upon arriving in the territory of the Cacua in the northwest Amazon, the first fruits that the indigenous people offered J.C.C. and R.C.-L. to eat were those of a new species, which they call *táam*. This is the story of how *Attalea taam* was encountered through taste and of the subsequent participatory research program with the Cacua to describe it as a species new to Western science.

What first took J.C.C. and R.C.-L. to the Vaupés department of Colombia in 2024 was nothing at all related to *táam*. The aim of our first trip was to document and help preserve the medicinal knowledge of the Cacua indigenous people. The Cacua are one of six traditionally semi-nomadic Makú groups from the north-

west Amazon (Becerra 2012), known to anthropologists as the “people with blowguns” (Silverwood-Cope 1990) (Fig. 1). The curare (arrow poison) of these Makú groups was widely esteemed and traded in the region. To date, however, no ethnobotanical monograph on the Cacua exists beyond the scattered

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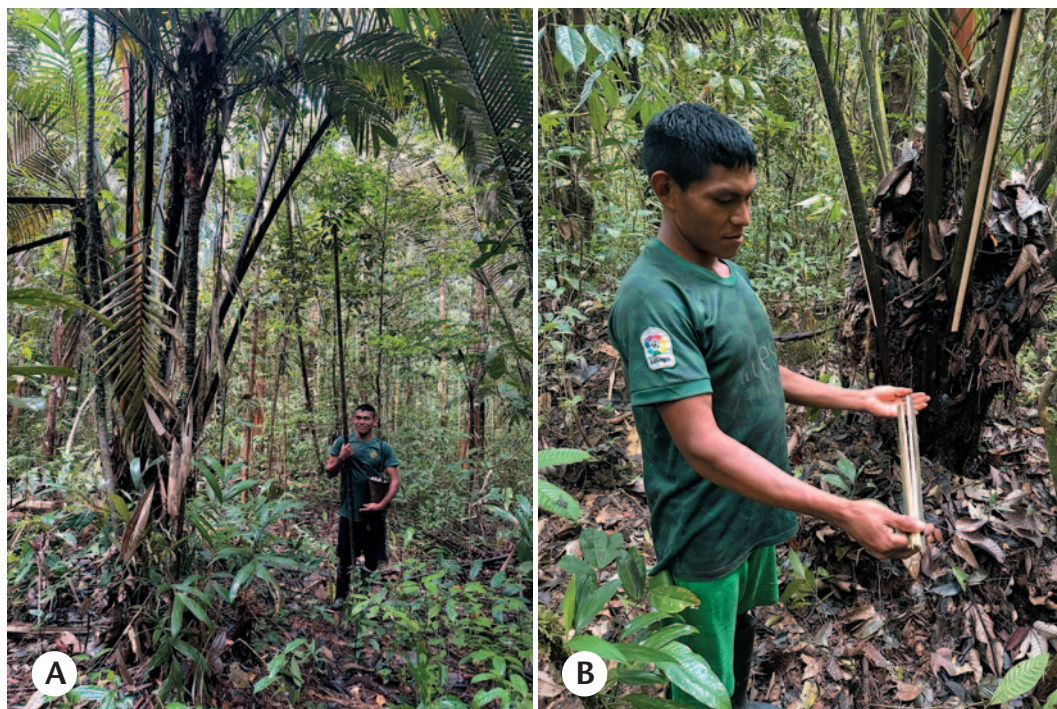
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1. Cacua hunter and co-author Juan Carlos López, with a blowgun. B. The petiole of the juvenile individual of *tãam* is used to make the *llerao*, which is a raised drying rack to dry cassava (*Manihot esculenta*).

reports compiled by Schultes (1990) and Becerra (2023). Anticipating the erosion of Amazonian plant knowledge, Richard E. Schultes stated that the Makú's "extensive knowledge of their useful plants merits urgent study" (Schultes & Raffauf 1990). So far, however, only 13 useful species are reported in the literature for the Cacua (Becerra 2023).

An unknown edible palm fruit

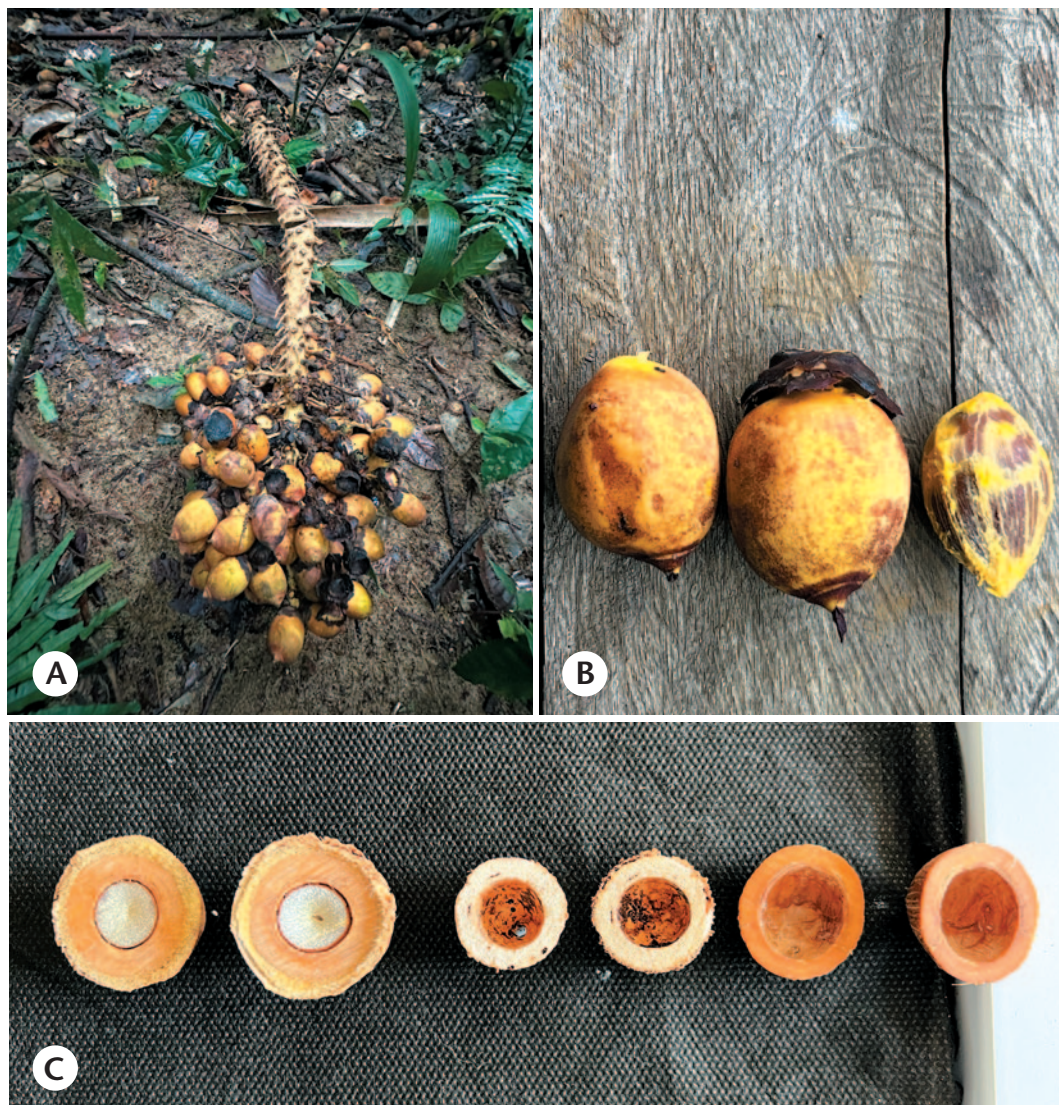
In March 2025, J.C.C. and R.C.-L. arrived at Wacará after a 2-hour flight from Bogotá to Mitú, a 2-hour car ride to the Vaupés river, a boat crossing of the river and a 2-hour hike. By the time we reached Wacará, we were exhausted and dehydrated. It was then that a group of Cacua children and our main Cacua collaborator, Samuel López-Pérez (S.L.-P.), offered J.C.C. and R.C.-L. the yellow, sweet and refreshing fruit of *tãam* (Fig. 2). We had never seen this fruit before and were aware of *Attalea butyracea* as the only species of *Attalea* to have an edible mesocarp.

Despite this fortuitous encounter, research initially proceeded as planned—at that time, J.C.C. and R.C.-L. could not have imagined how profoundly *tãam* would reshape our research agenda. Still, the daily work continued, conducting ethnobotanical interviews with Cacua elders and collecting

plant specimens, with a focus on healing plants. As a result of this work, 45 morphospecies were collected with S.L.-P., J.C.L.-G., D.L.-N., L.L. and H.P. (hereafter "Cacua collaborators"), which they use to treat 18 ailments. The ethnobotany of the Cacua is so under-documented that a single week of participatory research yielded much more information than had been published previously. Still, during these walks we could not but wonder about the unusual palm fruits we tasted on our first day.

On the third day, J.C.C. and R.C.-L. and Cacua collaborators made a three-hour hike to summit the Cerro Amanecer. At its base, on the sandier soils, we found a tall-stemmed palm (which the Cacua call *tah*) to be very common (Fig. 3). We identified it as *Attalea septuagenata*, thus extending its known geographic range from the previously known small area along the Mirití-Paraná river in the Colombian Amazon (Galeano & Bernal 2010) to the Vaupés. Thrilled to unravel this new geographic record, we took this opportunity to collect *tah* and show the Cacua how palm specimens are collected and pressed.

Tãam was always in our minds during informal discussions with the Cacua and slowly J.C.C. and R.C.-L. started to put the pieces of the *tãam* puzzle together. S.L.P. shared that he only



2. Fruits of *Attalea taam*. A. Infructescence. B. Fruits, two intact and the third with edible mesocarp largely removed. C. Fruits cross-section showing the absence of fibers in the endocarp. From left to right. Whole fruit with all parts. The fruit in the middle is an old fruit showing the locule and the fruit at the right shows the endocarp without fibers.

knew of *táam* growing in agricultural plots. Accordingly, we learnt that the plot where we first saw *táam* belonged to a *Cacua* who migrated from Brazil, raising the possibility that the species may have been introduced. To double check that the species was not already documented in Brazil, we shared photographs of the fruit with our friend professor Henrik Balslev (H.B.) from Aarhus University and asked him for scans of the palm tree flora of Brazil (Lorenzi et al. 2010), which he shared with us. However, no species in existing monographs (Glassman 1999, Lorenzi et al. 2010, Galeano & Bernal 2010, Henderson 2020) matched the morphology of *táam*.

Two days before departing, J.C.C., R.C.-L. and *Cacua* collaborators hiked to the summit of Cerro Avina, the tallest mountain in the area, which reaches 434 m in elevation. We hiked with three *Cacua* men and two *Cacua* women. The ascent was tough and the hike from the base to the summit took nearly an hour, including three pauses to rest. But the views were well worth the effort (Fig. 4). The Cerro Avina is majestic, covered by a stunted or lithophytic flora of no more than eight meters high, where Araceae, Apocynaceae, Bromeliaceae, Clusiaceae, Ericaceae, Myrtaceae, Melastomataceae and Rubiaceae predominate. From the summit, the views encompass the



3. *Attalea septuagenata* habit. Inset. Inflorescence.

Cacua's magnificent lands. The Cacua explained the key geographic markers of their territory and this would later guide and inspire us when making the species' distribution map, as described below. When the sun became unbearable, we retreated to the forest interior to share a lunch of three tuna cans and a bag

of *farina* (a toasted, coarse, grain-like flour produced from grated bitter cassava root). Beyond experiencing the unique flora and views, this hike was a turning point for the story of *táam* for it was here that one of the two Cacua women told us that *táam* grows in the wild and Hernando Pavón, a Wanano



4. Cerro Avina. A. View from Cerro Avina of the Indigenous Cacua territory, where at least seven species of *Attalea* grow. B. Summit of Cerro Avina, an important site in Cacua mythology.

collaborator settled in Wacará, went so far as to bet his daily wage that we would find *táam* in the forest the next day! Lunch was followed

by a ceremony of *mambe* (roasted coca leaves, ground and mixed with *Cecropia* ashes), *rape* (tobacco snuff) and *ambil* (tobacco paste), and



5. A. Cacua collaborators. B. David López-Navarro, eating the mesocarp of *táam*.

we returned in high spirits to Wacará encouraged by the prospect of encountering *táam* the next day.

Finding *táam* in the forest

On our last day in Wacará, three elders and a young hunter accompanied J.C.C. and R.C.-L. into the forest (Fig. 5). With quiet confidence, they guided us along a narrow trail toward the habitat of *táam*, a place they knew well. The walk took about 45 minutes, the path winding through dense vegetation and uneven terrain. When we finally reached the site and saw the palm (Fig. 6), we stopped in amazement. It was enormous and striking, unlike anything that we had encountered. Our surprise quickly turned into joy and laughter and we embraced one another, excited by the possibility that we were looking at a species new to science. The young Cacua hunter J.C.L.-G. skillfully climbed the tall trunk to collect a leaf and an inflorescence, so we could prepare a proper botanical specimen.

As we began taking measurements and notes, J.C.L.-G. showed us how the petiole of a young individual of *táam* could be crafted into a traditional tool called a *llerao* (Fig. 1B), which is used to dry cassava and prepare cassava bread. Watching the process connected the plant not only to the forest but also to daily life and subsistence.

Later, one of us (J.C.C.) asked whether we could collect an immature fruit bunch. The request was met with silence, and the men exchanged concerned looks. Sensing their

hesitation, R.C.-L. gently suggested that we avoid cutting the unripe fruits since that would compromise the Cacua's food. Accordingly, we collected an infructescence that had already been harvested and left on the ground a few days earlier.

The Cacua collaborators, J.C.C. and R.C.-L. spent the rest of the afternoon photographing the palm, searching for additional individuals and hearing about its many uses and the animals that feed on its fruits. As the light began to fade, we returned to Wacará, where we carefully pressed and preserved the specimens, ending the day with a sense of discovery and gratitude.

Working together

Even after J.C.C. and R.C.-L. left Wacará, the team of Cacua and western researchers continued working together. While the Cacua made several hikes to locate more populations of *táam*, J.C.C. studied its floral morphology at the Department of Systematic and Evolutionary Botany of the University of Zurich and Carolina Isaza (C.I.), Universidad Militar Nueva Granada, Colombia, examined some of the characters in the voucher specimen. Next, R.C.-L., J.C.C. and H.B. discussed the new characteristics of the palm tree during a Zoom meeting, and all authors agreed that it was a new species. After that, J.C.C. and R.C.-L. developed a draft manuscript, which was shared with all the co-authors who contributed to an improved version of it. From these investigations, J.C.C.,



6. *Attalea taam*. The individual from which the type specimen was gathered.

R.C.-L., C. I and H.B found several remarkable floral characters of *táam*, which, together with other vegetative characters convinced us of the novelty of the species. Unlike other *Attalea* species, *táam* has an orange stem, male flowers with three stamens (Henderson [2020] reports 5–70 as the range for *Attalea*), staminate petals

that are spatulate and covered with clustered trichomes on the adaxial surface, the abaxial petal surface is ribbed and its endocarp is lacking fibers in cross section.

Once the species was well delimited, R.C.-L. and J.C.C contacted Lucy Smith (L.S.) at the

Royal Botanic Gardens, Kew and asked her to illustrate the species, crossing our fingers that she would agree. We were thrilled to hear her positive response. After sharing with L.S. the draft manuscript and field and microscopy photographs, we waited for her first draft. This was not the first time we had collaborated with L.S. and we knew her work would be absolutely perfect. Later, L.S., J.C.C and R.C.-L. met online to review the illustration and to double-check some terms. For example, we had recorded stellate hairs, but as pointed out by L.S., these were clustered trichomes. Finally, we received the final illustration. We were extremely pleased with its quality, level of detail and unique composition with the Cacua next to the palm. This is the first illustration of a new palm species that includes the indigenous co-investigators alongside the palm.

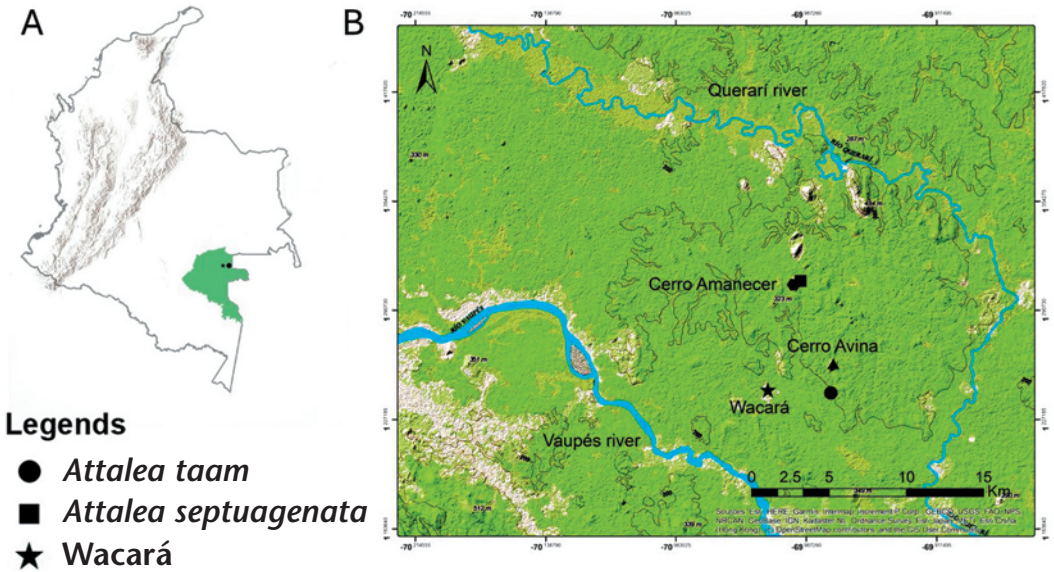
Having a draft manuscript and illustration, we started work on the distribution map of *táam*. Our first drafts were generic maps showing the department boundaries in Colombia and a dot showing the location of *táam* (Fig. 7). While informative, these did not reflect the participatory work behind the paper and paled in beauty with Lucy's illustration. One day, whilst driving back to Zürich from the Swiss Alps, R.C.-L. and J.C.C reflected on how unique it would be to make a participatory map like those of Mónica Naranjo Uribe (www.nomada-ediciones.com), who we had met a few years ago. That evening, we wrote

to M.N.U., describing the story of *táam*, the research with the Cacua and the illustration by Lucy. To our joy, M.N.U. immediately replied and agreed enthusiastically to embark on this collaboration. We then contacted Samuel López-Pérez, our main Cacua collaborator, and he made a preliminary map showing the distribution of *táam* in their lands, which M.N.U. refined over several drafts. Once the map was drafted, we set a date in August 2025 to return to Wacará to share the manuscript and illustration and run a participatory mapping workshop with M.N.U. and the Cacua (Figs. 8 & 9). This trip would turn out to be one of the most rewarding experiences of our careers.

“Indigenous peer review”

Our third visit to Wacará took place in August 2025. New members of our team included the artist M.N.U. and palm ecologist Ingrid Olivares, based at the University of Zurich. The first day, we met with the community in the ceremonial house and shared a traditional communal breakfast at 6:30 a.m. of cassava bread, chili stew (*manicuera*) and beverages made from *Oenocarpus bataua*. After breakfast, J.C.C. presented the results of our investigations since March, showing the unique morphology of *táam* (Fig. 8). Next, the Spanish version of the manuscript was translated into Cacua on the spot by the secretary of Wacará. Then came a feedback session where the Cacua pointed out some omissions or inconsistencies

7. Conventional maps. A. Study area in Colombia, Vaupés department (green). B. Typical map showing species distributions alongside the limited geographic knowledge available for Amazonia from official sources.



(e.g., the animals that feed on *táam*). Finally, M.N.U. projected the first draft of the map to spark the participatory mapping phase. Immediately, several Cacua started discussing and drawing on the ground what resembled rivers and hills. Eventually, it transpired that the map needed major adjustments; the Cacua believed that it had to be redrawn. Having worked with several different indigenous groups of the Colombian Amazon, M.N.U. had come prepared. She unrolled a large sheet of paper for the Cacua to redraw from scratch the map in a process that took several hours. One Cacua led the drawing of the map, while his peers provided input on the orientation and names of the hills and creeks.

During our stay at Wacará J.C.C., R.C.-L., I.O. and M.N.U. did three things to expand the information presented in the map. First, M.N.U. made a workshop with the school children to illustrate the plants and animals that grow in the Cacua's territory. Second, we conducted several in-depth interviews with Cacua elders on the geography and biodiversity of the region. Third, we made a full-day trip to Cerro Madre Monte that

required spending the night in a temporary house. This trip allowed us to locate five additional populations of *táam*, which were not previously depicted on the map. The day before leaving, we hiked with the Cacua elders and children to the summit of the Cerro Amanecer. There, M.N.U. displayed the map and the Cacua elders explained to the youth the geography of the territory.

Overall, this process, which I.O. coined as the "indigenous peer-review," enabled us to share the draft manuscript within communities well before submitting it to an academic journal and to obtain feedback from indigenous contributors. It was not only a necessary step for improving the manuscript and map, but also for socializing the work with all Cacua residents of Wacará.

The last part of this wonderful history was when, on 30 September 2025, we submitted the paper to *Phytotaxa* and two months later, received positive comments from two reviewers. Then, we addressed all comments to improve the manuscript and resubmitted it. On December 31, 2025, we received the

8. Peer review by the Cacua indigenous people. A. J.C.C. Sharing the manuscript. B. Tiberio Gallego, reading the manuscript in Cacua language. C. Participatory mapping workshop.





9. Participatory map from Wacará, showing the location of *táam* and other geographic features of the region. Note that the first 15 enumerated items on the map are species of palms.

news that the paper was accepted and the paper was published on January 23, 2026. (Copete et al. 2023).

What *táam* taught us

Continuous engagement with the Cacua to locate, collect, map and disseminate *táam* led to three key insights. First, that alternative approaches to how taxonomists collaborate with local partners in the field are not only possible but highly valuable. Historically, many palm species were described by taxonomists without fully involving in the entire research process their Indigenous and local field assistants on whose lands collections were made. For example, Alfred Russell Wallace worked with thousands of assistants who himself reported as providers of key information on species limits, geographic distributions and uses, yet none were co-authors in his publications (van Wyhe, 2018; Copete et al. 2023). Practical constraints—such as the tradition among taxonomists of not revisiting the same sites—and historical sociopolitical realities likely shaped these approaches. However, more collaborative and inclusive methodologies are increasingly feasible and beneficial in contemporary research contexts. Furthermore, they are increasingly advocated to redress the colonial legacies of taxonomy and natural history collections (Park et al. 2023).

In this study, we implemented a participatory approach to describe a species long recognized by Indigenous and local communities. The process included four stages: participatory taxonomy, ecology, geography and indigenous peer review. Ongoing collaboration with the Cacua led to their inclusion as co-authors of the manuscript and species description, illustrating a model for more inclusive and ethically engaged taxonomic research. Second, we emphasize the value of participatory mapping, which can significantly enhance scientific understanding while also supporting knowledge transmission within communities. As demonstrated through the *táam* map, this approach improved our understanding of the species' distribution and ecology, helping to address the Wallacean information shortfall (lack of knowledge about species' geographic distributions) and Prestonian information shortfall (lack of knowledge about species abundances) (Hortal et al. 2015). It also provided opportunities to engage younger community members and deepen our appreciation of Cacua cultural knowledge.

Finally, we highlight the importance of an indigenous peer review process—defined here as sharing manuscript drafts with communities well in advance of submission to academic journals—as a key component of ethical and intercultural research when the species was collected and described based on traditional knowledge. We highlight these cases but it is important to clarify that for species described as new based on herbarium specimens, it is less feasible to apply the methodology described here. Moreover, we acknowledge that funding and logistical constraints can pose challenges. In our case, rather than focusing exclusively on academic dissemination, we prioritized returning to Wacará to conduct the indigenous peer review. Together, these experiences taught us that sustained and community-centered engagement can both advance palm taxonomy and reorient scientific practice toward more ethical, inclusive and meaningful forms of knowledge production.

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