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FRONT COVER

One of the most diverse species in New Caledonia is *Basselinia deplanchei*, which can have leaves with numerous pinnae, as here in Forêt de Saille, or only a few pinnae. See article by D. Hodel, p. 143. Photo by D. Hodel.

BACK COVER

A population of *Attalea speciosa* upon a rocky, slope along the margin of the Iriri, a major tributary of the Xingu River. See article by R. Salm et al., p. 121. Photo by R. Salm.

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The crownshaft of *Basselinia humboldtiana* is purplish but the color is often concealed by thick, tannish, felt-like indumentum, as here on Mt. Nékando. See article by D. Hodel, p. 143. Photo by D. Hodel.

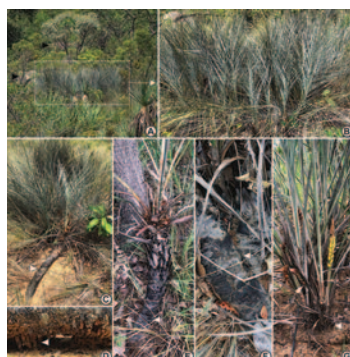
PALM NEWS

Lectins are a diverse group of proteins with the capacity to recognize and bind to specific carbohydrates. They bind to cell membranes, causing membrane disruption or cell agglutination. They are widespread in the Plant Kingdom, and their metabolic roles are varied but understudied, especially in palms. In medicine, lectins are of great interest for their potential to target cancer cells while leaving healthy cells intact. A new study by Osman et al. offers the first account of *Phoenix dactylifera* lectins and their organization.

These results can be used for further structural and functional analyses of their potential anticancer properties. The paper is freely accessible. *Saudi Journal of Biological Sciences* 30(6): 103676. 2023. <https://doi.org/10.1016/j.sjbs.2023.103676>.



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As part of ongoing research on the palms of the Serra do Cabral, an isolated massif in the southwest of the Espinhaço Range in Minas Gerais State, Brazil, Sant'Anna-Santos and colleagues have described a new species of *Syagrus* with grass-like, glaucous blue foliage. The species is named *S. carvalhoi* and is assessed as Critically Endangered. It is the second species of grassy *Syagrus* from the Espinhaço Range. The paper is open access and available here: *Plant Ecology and Evolution* 156: 129–145. 2023. <https://doi.org/10.5091/plecevo.101027>.

The protean *Calamus javensis* has long puzzled taxonomists seeking to describe and classify its many variations. Using morphological characters, Atria et al. (2023) recognized only two varieties, *C. javensis* var. *javensis* and *C. javensis* var. *polyphyllus*. Furthermore, they recognized 11 informal taxa within *C. javensis* var. *javensis* and presented identification keys, descriptions and notes of all the recognizable taxa in the complex. The study is published in the *Nordic Journal of Botany* e03763. <https://doi.org/10.1111/njb.03763>.



William J. Baker

***Coccothrinax crinita* in the Botanical Garden Jena (Germany) Infested by a Pupillarial Palm Scale**

GÜNTER KÖHLER¹ AND KLAUS SCHRAMEYER²

The Halimococcid *Colobopyga washingtoniae* (Ferris 1942) is recorded for the first time from the palm genus *Coccothrinax*, native to Cuba, in a glasshouse in Germany.

Worldwide about 200 species from ten scale insect families occur on palms. They can also cause considerable damage in glasshouses in botanical gardens (Howard et al. 2001). The family Halimococcidae (Pupillarial palm scales) comprises 23 species that are all associated with Pandanaceae or Arecaceae, including the genus *Colobopyga* with 11 species (Table 1)

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(García Morales et al. 2016; last accessed 2 June 2023). For this genus, first put into the Phoenicococcinae (within the Diaspididae), Brown and McKenzie (1962), using cytological studies, established the new family Halimococcidae, the species of which form sclerotized, airship-like containers as juveniles and adult females. In contrast, Phoenicococcidae (also adapted to palms) do not secrete and construct scales. In Diaspididae, the dorsal scale contains the two larval exuviae, and the ventral scale forms a thin waxy covering.

Origin

Coccothrinax crinita (R.D.Hoyt) Becc. (Fig. 1) is endemic to Cuba (Moya & Leiva 2000). A few individuals originating from western Cuba (Pinar del Río) were introduced to the



1. A healthy *Coccothrinax crinita* from Cuba in the Botanical Garden Jena, Germany, March 2023. Photo by G. Köhler.

Botanical Garden Jena in the 1980s. Since the 1960s the Garden has been working on the Flora de Cuba Project in close cooperation with the Botanical Garden of Havana, Cuba. In 2015 an infestation of leaves by an unknown pest species was noticed. A heavily infested part of

a leaf, about 15 cm long (Fig. 2), was sampled by gardeners in the tropical glasshouse and sent via the Fa. Sautter & Stepper GmbH (a specialist in beneficial insects against pests) to K. Schrameyer (Phytopathological Service, Heilbronn) in January 2016. For microscopic

determination, adult females were macerated in 10% potassium hydroxide solution and embedded in Euparal. Specimens were identified as *Colobopyga washingtoniae* (Ferris 1942), a species belonging to the small family Halimococcidae. The slides with the voucher specimens are deposited in the Schrameyer collection, which in the near future will be given to the State Museum of Natural History Karlsruhe, Germany.

Köhler (1987) studied an infestation of *Colobopyga coperniciae* on *Colpothrinax wrightii* brought from the National Botanic Garden in Havana to the glasshouse of the Botanical Garden Jena in the 1980s. The infestation led to the defoliation of the palm until it was presumably eradicated. In the intervening years, the scale insect genus was not seen in the glasshouse.

Attack and Control

Recently, large colony of the scale insect was localized around the densely folded base of the *Coccothrinax crinita* leaf (Fig. 2), with different developmental stages between waxy threads (Figs. 3 & 4). The palm was repeatedly treated with NeemAzal, a biological insecticide produced from the seed of the neem tree containing azadirachtin, which has a partly

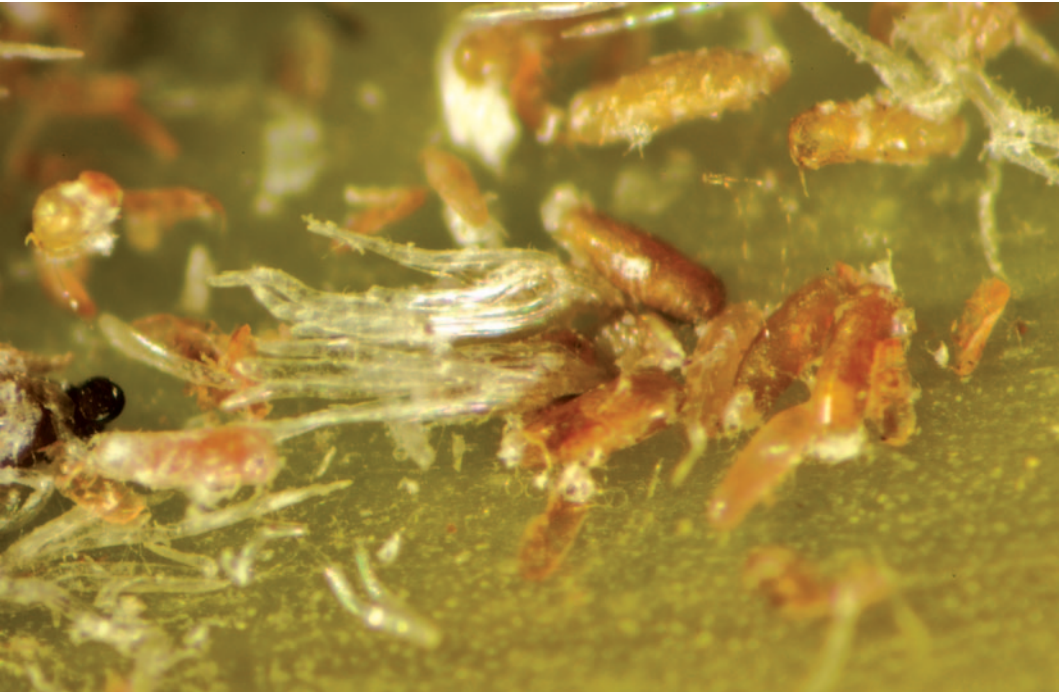
systemic effect against sucking insects. However, the heavily damaged palm died later in the year, due either to injury from the scale insect or to an overly wet site in the greenhouse, and the dead palm was destroyed. It seems rather curious that such a population explosion of the scale insect, probably introduced with this palm, occurred more than 30 years after the importation of the palm and the last known infestation in the greenhouse. As far as is known, no other palm was affected by this scale insect, so the infestation did not come from other palms in the greenhouse. However, according to records from the Botanical Garden, chemical pesticides were regularly applied until around 2015, after which point the gardeners transitioned to management through biological control. Predatory ladybird beetles (*Chilocorus*, *Rhyzobius*) and parasitic wasps (Aphelinidae) were spread in rotation every three weeks as control agents. Perhaps these were not effective against *Colobopyga washingtoniae*, and an alternative should be considered for future pest management.

Notes

The halimococcid species *Colobopyga washingtoniae* was determined with the key of Deitz (1979), and later confirmed by Maurice

2. Base of the *Coccothrinax* leaf blade, heavily attacked by *Colobopyga washingtoniae*, February 2016. Photo by K. Schrameyer.





3. Juvenile colony of *Colobopyga washingtoniae*. Photo by K. Schrammeyer.

Jansen (Wageningen). The adult female (0.7 mm in length) lives within the sclerotized second instar skin 0.8 mm in length (Fig. 4 & 5A), whereas the nymphs are cylindrical and 0.3 mm in length (Fig. 3). The female differs from other *Colobopyga* species in bearing a ring of disc pores anterior to the vulva (absent in most of the other species) and a pygidium with one pair of flattened setae (without or with two pairs in related species) (Fig. 5B). The species was described by Ferris (1942) as *Palmaricoccus washingtoniae* from type material from Mexico (Baja California, Cataviña) on *Washingtonia robusta*, but later Ferris (1952) erected a new genus *Colobopyga*. Until now this was the only known locality and host plant (García Morales et al. 2016). The present record of *C. washingtoniae* is the first evidence both for *Coccothrinax crinita* as a new host palm genus and species and perhaps also for Cuba (Mestre Novoa et al. 2015), assuming its importation with the palm.

Acknowledgments

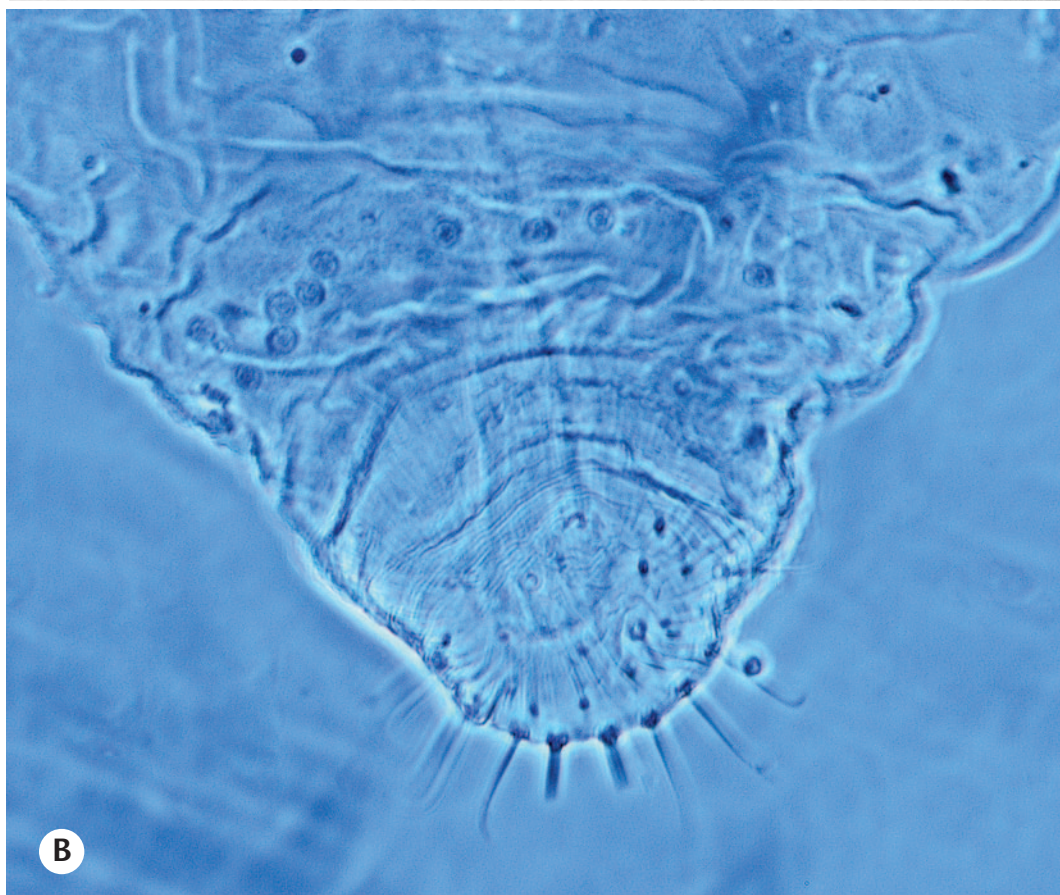
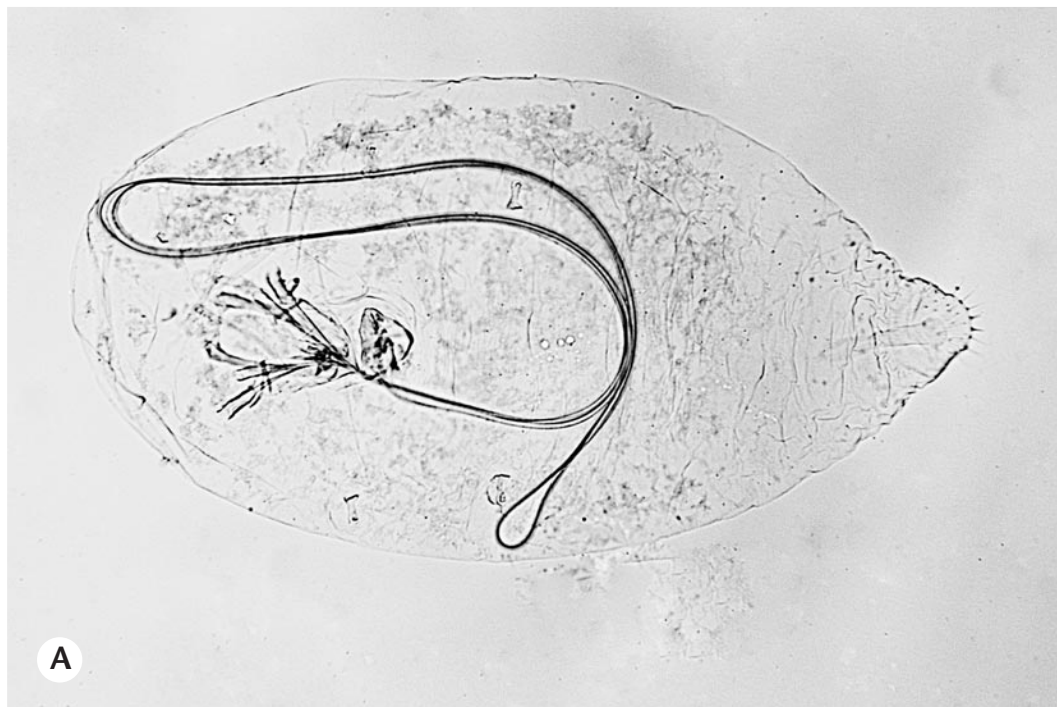
Valuable information on the infected palm and control measures was provided by Dr. Stefan Arndt (Scientific Director of the Botanical Garden Jena) and Tobias Pfeil (Head Gardener). The scale species determination was confirmed by Maurice Jansen (Wageningen, NL).

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4. The *Colobopyga* female lives inside the heavily sclerotized and bottle-like second instar exuviae. Photo by K. Schrammeyer.





5. *Colobopyga washingtoniae*. Slide mounts of (A) adult female, (B) female pygidium. Photos by K. Schrameyer.

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Table 1: *Colobopyga* species and host palms (from Köhler 1987 and García Morales et al. 2016).

<i>Colobopyga</i> species	Palm species	Region
<i>C. attaleae</i>	<i>Attalea cohune</i>	Mexico
<i>C. australiensis</i>	<i>Howea</i> sp.	Australia
<i>C. browni</i>	<i>Pritchardia martii</i>	Hawaiian Islands
<i>C. coperniciae</i>	<i>Colpothrinax wrightii</i> , <i>Copernicia hospita</i>	Cuba
<i>C. hedyscepes</i>	<i>Hedyscepe canterburyana</i>	New Zealand
<i>C. kewensis</i>	<i>Borassus</i> sp., <i>Howea forsteriana</i>	Hawaiian Islands, Lord Howe Island (Australia), Tanzania
<i>C. magnani</i>	<i>Chamaerops humilis</i>	Argentina
<i>C. palmicola</i>	<i>Howea forsteriana</i>	Norfolk Island (Australia)
<i>C. pritchardiae</i>	<i>Pritchardia hardyi</i> , <i>P. martii</i>	Hawaiian Islands [Molokai]
<i>C. sabalis</i>	<i>Sabal</i> sp.	Mexico
<i>C. washingtoniae</i>	<i>Coccothrinax crinita</i> , <i>Washingtonia robusta</i>	Cuba, Mexico

A New Species of *Licuala* from Royal Belum State Park, Perak, Malaysia

SAW LENG GUAN¹

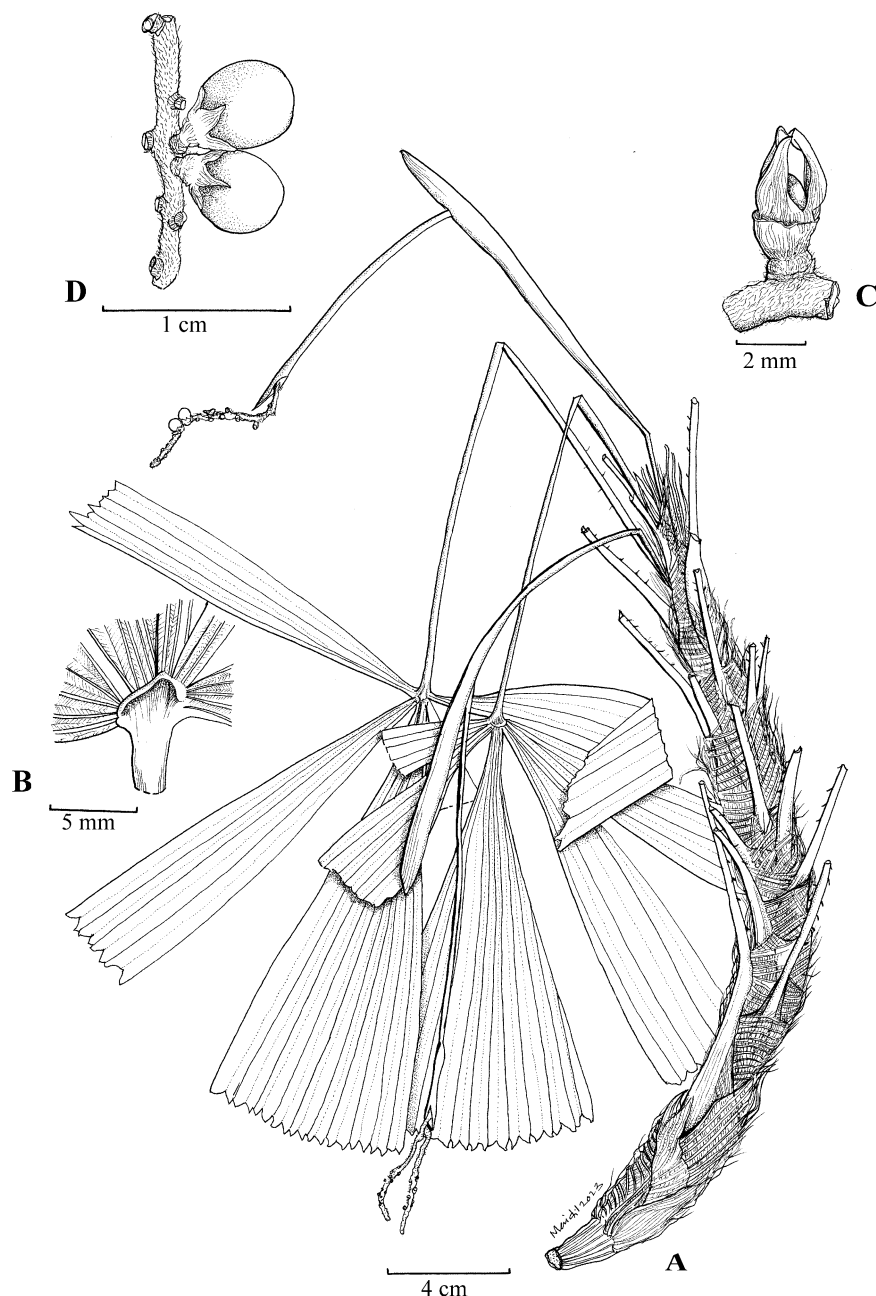
A new *Licuala* (Coryphoideae: Trachycarpeae: Livistoninae) is described and illustrated here. The species has a much-reduced inflorescence not common among *Licuala* species in Peninsular Malaysia and Thailand.

The genus *Licuala* Wurmbe has 174 species and is distributed in the tropical regions of Bhutan to Vanuatu (POWO 2023). The genus is most diverse in Malesia with two main centers of diversity, one on the Sunda Shelf in the Malay Peninsula and Borneo, and the other on the island of New Guinea on the Sahul Shelf (Saw 2012). *Licuala* in the Sunda Shelf is well documented by three recent accounts covering Thailand, Peninsular Malaysia, Singapore and Borneo (Barfod & Saw, 2002, Saw 1997, 2012).

In March 2022, an expedition was organized to explore the Gunung Ulu Temin area of the Royal Belum State Park, Perak, Peninsular Malaysia. The area has never been botanically

explored. During the expedition, a new species was discovered. The new species is easily recognizable by its very reduced inflorescence structure. Four major inflorescence types are recognized in *Licuala* (Saw et al. 2003). These range from the most generalized structure with a few superposed branched partial inflorescences (Type 1 in Saw et al. 2003), to inflorescences with multiple spicate superposed partial inflorescences (Type 2), to inflorescences with only one partial inflorescence with multiple rachillae (Type 3), and to inflorescences that are spicate (Type 4). In Peninsular Malaysia and Thailand, most species have only Types 1 and 2 inflorescences. Until the discovery of this species, the only species with a much-reduced inflorescence (Types 3 and 4) in Peninsular Malaysia and Thailand is *Licuala kingiana* Becc., this species has a spicate or bifurcate inflorescence. In Borneo, however, it is commoner with eleven species exhibiting Types 3 and 4 inflorescences (Saw 2012).

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1. *Licuala hairulii*. A. habit; B. hastula of leaf; C. flower with immature fruit; D. fruits on rachilla. A–C drawn from FRI 80075; D from FRI 80099. Drawn by Mohamad Aidil Nordin.

***Licuala hairulii* Saw, sp. nov.** (Figs. 1–4) Type: Peninsular Malaysia, Perak, Hulu Perak, Royal Belum State Park, Gunung Ulu Temin. 3 March 2022. Saw & Mohd. Hairul FRI 80075 (holotype: KEP [in 3 sheets KEP297437, KEP297438, KEP297439]).

Diagnosis: A distinct species with much-reduced inflorescence, with only one partial inflorescence with spicate or bifurcating rachillae. This species superficially is similar to *Licuala collina* Saw, and can be easily distinguished by its usually stemmed habit,

entire middle leaflets, striated calyx and corolla; *L. collina* has acaulescent habit, a bifid middle leaflets and non-striated calyx and corolla.

Solitary to clustering, pleonanthic, stems to 1.5 m tall, diameter 1.4 cm. Crown with 10–15 leaves. Petiole 12–27 cm, ca. 3 mm wide

near base, ca. 1.5 mm towards apex, drying pale greenish gray; spines towards the base, irregularly spaced, largest near petiole base, ca. 3 mm long; lamina palmate, orbicular, ca. 25–28 cm across; leaflets 5, central leaflets largest, lateral leaflets smaller; central leaflets wedge-shaped, entire, sessile, 9–12 costulate, 13–15.5

2. *Licuala hairulii*, with acaulescent habit.





3. *Licuala hairulii*, with stemmed habit.

× 6–8.5 cm; lateral leaflets narrowly elliptic with truncated apex, progressively smaller towards base, 2–4 costulate, 13–16 × 1–3 cm. Inflorescence interfoliar, spreading to patent, ca. 17–36 cm long, spicate or bifurcating with only 1 partial inflorescence; prophyll 14–21 ×

0.5–0.8, papery, laterally flattened, lanceolate-tubular, mouth spitting widely to one side with a pointed apex, covered with caducous indumentum; peduncle 10–27 cm long; peduncular bract absent; rachis bract similar in shape as prophyll, much reduced to scale



4. *Licuala hairulii*, infructescence with immature fruits.

like to $2\text{--}3.5 \times 0.2$ cm, covered with caducous indumentum subtending a spicate or bifurcating rachillae; rachillae 2–5 cm long, ca. 1 mm diameter, densely covered with fine translucent white and brown simple hairs. Flowers (based on young fruiting specimen) solitary, loosely arranged around the rachillae, on floral stalk, floral stalks subtended by small scale-like triangular bracts; calyx membranous, striate, cyathiform with pedicelliform base and truncated apex, covered with simple hairs at pedicelliform base and apically glabrous, $1.3\text{--}1.5 \times 2$ mm; corolla tubular at base breaking into 3 lobes, drying black, fleshy, glabrous, striate, lobes 3×2 mm; androecium and gynoecium not seen. Immature fruits globose, glabrous, smooth epicarp, green, 6 mm across.

Distribution: Currently the species is known only from the type location. It is a rare palm, only five plants were seen during the field visit, all within the type location. The location is very close to the Thai border, the species could possibly be recorded in Thailand.

Additional examined specimen: Malaysia, Perak, Hulu Perak, Royal Belum State Park, Gunong Ulu Temin. 3 March 2022. Saw &

Mohd. Hairul, FRI 80099 (KEP [in 2 sheets KEP297440, KEP297441]).

Habitat: Upper hill dipterocarp forest on ridges and upper slopes of ridges, at 725–792 m altitude.

Notes: Superficially, it resembles *Licuala collina* Saw from Sarawak in Borneo. *Licuala hairuli* differs from *L. collina* by its stemmed habit, entire central leaflets, truncated calyx, and striated calyx and corolla. The latter species has acaulescent habit, bifid central leaflets, calyx breaking into 3 lobes, and non-striated calyx and corolla. In Peninsular Malaysia, it differs from *Licuala kingiana* by its smaller leaves, lamina ca. 25–28 cm across, its spreading to patent inflorescences, thin rachillae ca. 1 mm wide, flowers arranged solitary along the rachilla, cyathiform calyx with pedicelliform base, and a glabrous corolla drying black; *L. kingiana* has larger leaves, lamina ca. 35–50 cm across, erect inflorescences, thick rachillae ca. 3 mm wide, flowers in groups of 2 or 3 near base, cylindrical to cyathiform calyx without pedicelliform base, and a densely hairy corolla drying brown.

Etymology: The species is named after Mohd. Hairul Mohd. Amin who jointly collected the type specimen.

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I wish to thank the Flora of Peninsular Malaysia project for organizing the expedition. I am grateful to the Ministry of Water, Land and Natural Resources for providing financial support (SPPIII No. P23085100010021 & P23085100018003) under the Flora of Peninsular Malaysia project. Mohamad Aidil Nordin prepared the drawings for the species.

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Apparent Competition Among Large Arborescent *Attalea* Palms Mediated by Bruchid Beetles in Eastern Amazonia

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The arborescent palms *Attalea maripa*, *Attalea phalerata* and *Attalea speciosa* co-occur through a vast region of southern and eastern Amazon, but specimens of individual species rarely occur mixed. Instead, these palms commonly form groves with distinct boundaries between one another. We hypothesized that apparent competition mediated by a seed predator common to these species, the bruchid beetle *Speciomerus giganteus*, may be responsible for this distribution pattern. Seed predators typically respond to the density of adults of their prey species. Therefore, if palms share a seed predator, seed predation should be more closely correlated to all *Attalea* palms considered together than to one or another alone. In order to investigate this hypothesis, we mapped the distribution of adult *Attalea* of the different species and placed experimental stations regularly

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dispersed across areas dominated by different palms containing groups of *A. maripa* seeds, to quantify seed predation probability. The probability of seed predation by the bruchid beetles was better correlated with the distribution of all *Attalea* palm species combined than with each species alone. The results support the hypothesis that there is a shared predation of bruchid beetles among those palm species, and therefore, these beetles can be responsible for the separation between populations of these palm species.

The action of specialist herbivores imposing high levels of seed or seedling mortality that is dependent on conspecific population density is a well-recognized mechanism for the maintenance of the diversity of tropical forest

trees by preventing local dominance of any plant species (Janzen 1970, Connell 1978, Comita et al. 2014). In the opposite process, a large proportion of seed mortality in tropical forests seems to be caused by shared enemies.

1. *Attalea maripa*.



Those species, which eat seeds of a group of species with similar characteristics, possibly exert a very strong influence in shaping the distribution of trees in those ecosystems by

keeping populations of different species with shared seed predators apart (Ali & Agrawal 2012, Garzon-Lopez et al. 2015). This falls within Holt's (1977) concept of apparent

2. *Attalea phalerata*.





3. *Attalea speciosa*.

competition. According to him, “two species are in apparent competition whenever the presence of either species leads to a reduced population density of the other species at equilibrium” due to the mechanism of shared predation.

Here, we investigate a putative case of apparent competition in a tropical forest in the Xingu River basin, Eastern Amazonia, involving three native plant species, the large arborescent palms *Attalea maripa* (Aubl.) Mart. (Fig. 1), *Attalea phalerata* Mart. ex Spreng. (Fig. 2) and



4. The bruchid beetle *Specimerus giganteus*. A. *S. giganteus* viewed from different angles. B. *Attalea maripa* seed with (above) one *S. giganteus* egg at the point of the yellow arrow and (below) with *S. giganteus* exit hole. C. One experimental enclosure used in the seed predation experiments.

Attalea speciosa Mart. (Fig. 3), and an invertebrate seed predator, the bruchid beetle

Specimerus giganteus (Bruchinae) (Fig. 4), which predates upon seeds of all *Attalea* palms

(Delobel et al. 1995). In a previous study, we investigated palm community changes along a topographic gradient from floodplain to terra firme that follow a relatively narrow third order tributary of the Xingu River (Salm et al. 2015). We found that *A. phalerata* exhibited its highest density in the floodplain and decreased in density after the floodplain limits within the first tens of meters from the stream, disappearing completely in areas more distant from the floodplain, and being replaced by *A. maripa* (Salm et al. 2015).

Detailed soil studies, including *A. maripa*, show that tall arborescent palms, a category that includes the three *Attalea* studied here, are generalists in relation to edaphic gradient (Ruokolainen & Vormisto 2000). Thus, we believe that the clear-cut separation among the areas dominated by either species is a consequence of the disproportionally harmful effect of bruchid seed predation upon whichever palm that would initially be the rarest among the two indirect competitor species. The initially rarer species would suffer more from seed predation to the point of exclusion, since this species would have a much lower number of seeds for recruitment, if compared to the dominant species, not being able to stand a massive seed predation probability. Therefore, the seed predator would cause the exclusion of one species or another from a given habitat that is otherwise suitable for them, reducing their effective niche. The separation of clusters of *Attalea* palm species seem to be a widespread phenomenon across the Amazon. As one travels through roads across the deforested areas of the Amazon, where the trees were cleared but large palms are often spared either due to some resistance to fire or to provide some shade for the cattle, separate clusters of different species *Attalea* palms can generally be seen.

The aim of this study is to explain why, in regions where more than one *Attalea* species co-occur, they grow in separate but adjacent groups. We hypothesize that the species disjunct distribution can be explained by means of apparent competition. Because seed predation probability is expected to correlate with the density of prey species adults (Janzen 1970), if the bruchid beetle shares its predation activities among species of *Attalea*, then seed predation probability in a plot including clusters of more than one species should be more closely related (higher *r*- and lower *p*-values) to the abundance of all *Attalea* species than to only the seed conspecific or other *Attalea* alone.

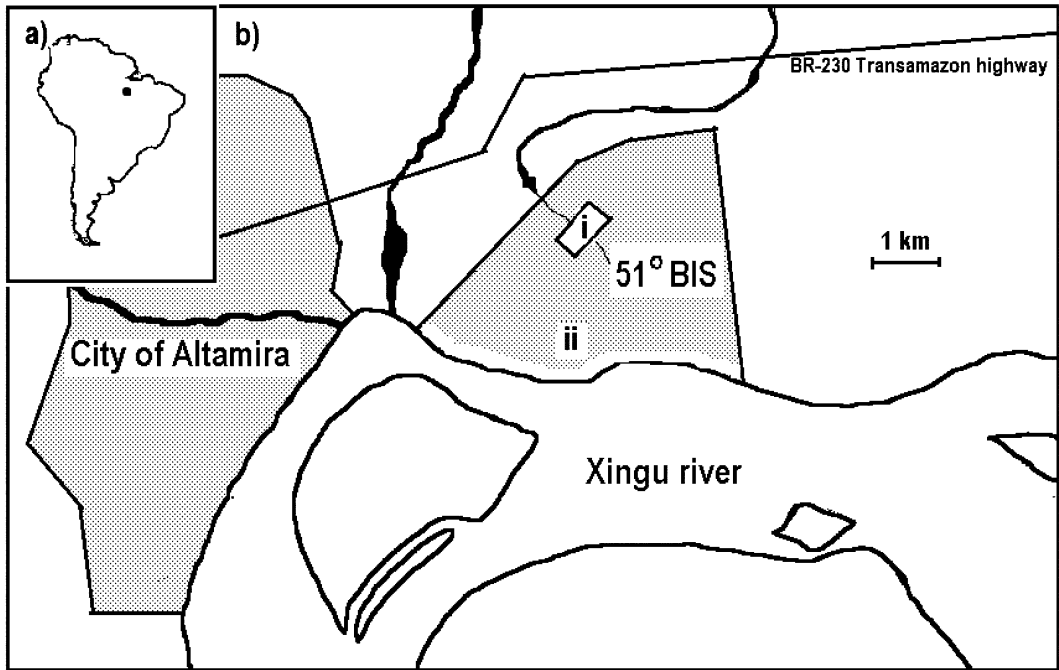
As noted above, tall arborescent palms of the genus *Attalea* tend to be generalists in relation to edaphic factors (Ruokolainen & Vormisto 2000), and our own observation shows that *A. maripa*, in another study site 500 km south in the same Xingu River basin, where it is the only species of this genus, is widely distributed in all areas outside floodplains (Salm 2005, Salm et al. 2007). Nevertheless, it could be argued that the disjunct distribution can be explained by substantial changes in soil characteristics rather than the action of seed predation by bruchids. Therefore, we also made simple soil analyses (color, and water and organic matter content) to evaluate this hypothesis that changes in soil characteristics explain the separation of *Attalea* palm populations.

Materials and Methods

We conducted our study in a 1,035-ha. terra firme forest remnant of the Xingu River basin, Eastern Amazonia, at the fringes of the city of Altamira: the 51st Forest Infantry Battalion (51st BIS) area (3°11'S, 52°10'W), belonging to the Brazilian Army (Fig. 5). Total annual rainfall for the studied area is approximately 2,000 mm, on average. Climatic patterns show two distinct seasons marked by heavy precipitation from January to May followed by four to five months of extremely low rainfall beginning in July (less than 100 mm but frequently close to nil) (Lucas et al. 2009).

Several mammal species eat the pulp of *Attalea* fruits, dropping intact seeds, virtually all of them, within 25 m from the parent trees. Rodents are also capable of gnawing and peccaries can crack seeds. Tapirs (*Tapirus terrestris*) are the only species capable of swallowing many whole seeds of these species, defecating them intact at distant sites, which may have a positive effect for the seed in terms of the probability of escaping bruchid attack (Fragoso et al. 2003). It is after they are at least partially stripped of flesh that these palm fruits are infested by eggs of the bruchid (Silvius & Fragoso 2002). The seeds of *A. speciosa*, on the other hand, are much larger and surrounded by fibrous pericarp, being consumed by peccaries (Desbiez et al. 2009) and rodents (Smith 2015).

At the continental scale, the distribution areas of *A. maripa* on one hand and *A. phalerata* and *A. speciosa* together, on the other hand, are largely complementary, with *A. maripa* dominating the Amazon basin while the other two species surround its eastern and southern



5. Study site. A: Within the map of South America, the position of the city of Altamira, in the margin of the Xingu River, a major tributary of the right margin of the Amazon. B: The 1,035-ha area of the 51st Jungle Infantry Battalion Forest Camp (51st BIS) in the margin of the Xingu River, close to the city of Altamira, and to the Transamazon highway (BR-230), crossed by the studied perennial stream with (i) the position of the studied Stream Plot and (ii) the Xingu River Margin Seed Stations.

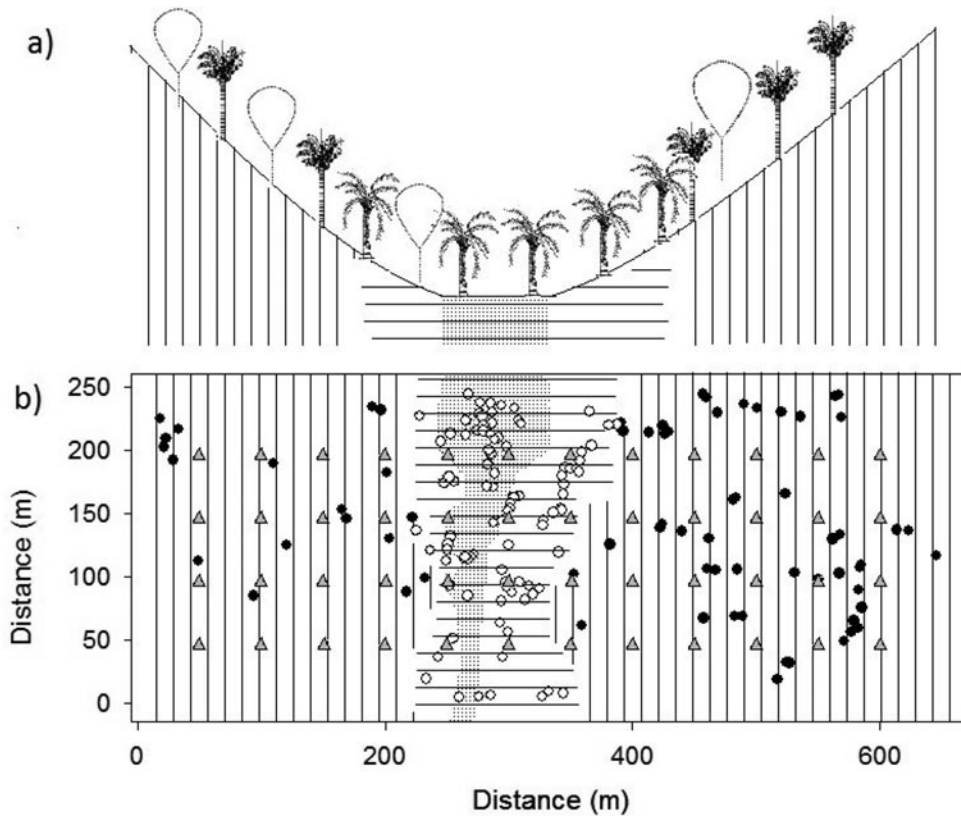
borders, with *A. phalerata* spreading towards the vast floodplains of the Pantanal and the central Brazilian plateau and *A. speciosa* being more broadly distributed across the northeastern state of Maranhão State and all over Central Brazil, reaching the northwestern limits of the state of Minas Gerais (Henderson et al. 1995). Despite their complementary distribution, there is a wide area where they overlap, which includes large parts of the Xingu River basin where the three species compete for territory. No *Attalea* species can survive severe flooding, but milder flooding can be tolerated only by *A. phalerata*, and not by *A. maripa* and *A. speciosa* (Henderson et al. 1995). In relation to *A. maripa* and *A. speciosa*, the potential distribution of *A. phalerata* extends further towards flooded areas due to physiological and anatomical factors that allow this species to dominate the Pantanal floodplains. Flooded areas are, therefore, refuges, where *A. phalerata* cannot be displaced by the other two species. All these three *Attalea* species can survive well in *terra firme* areas. Elsewhere, where not found in sympatry with *A. phalerata*, *A. maripa*, although absent from floodable areas, occurs frequently in very humid places at the edges of floodplains (Salm et al. 2007) and river margins. However, in our

study area, only *A. phalerata* is found in the *terra firme* areas in the proximities of the floodplains and only *A. maripa* and *A. speciosa* can be found in the *terra firme* areas further away from the floodplains and there is a clear-cut boundary between their populations.

To investigate the possible role of the bruchid beetle *Speciomerus giganteus* in influencing the distribution patterns of the large arborescent *Attalea* palms, we performed two experiments, described below (Fig. 6).

The Stream Plot

First, we delimited a 250 m × 650 m (16.25 ha) grid centered at the 51st BIS grove with its main axis perpendicular to the grove. The stream is relatively narrow (1–3 m wide) and shallow (up to 60 cm deep), a third order tributary of the Xingu River, and it is bordered by a floodplain that spans from a few meters to tens of meters in width along the riverbanks. This seasonal floodplain contains highly organic hydromorphic soil. The floodplain is surrounded by moderately to very steep hills with well-drained soils (hereafter referred to as *terra firme*). This plot is occupied only by *A. maripa* and *A. phalerata*. The palm *A. speciosa* is not found in this area. Within the grid, all



6. The study plot with areas dominated by the palms *Attalea maripa* (vertical lines), *Attalea phalerata* (horizontal lines) and floodable areas (dotted areas). a) Schematic representation of the 51st stream valley section. b) Study plot seen from above with *A. maripa* palms (black circles), *A. phalerata* (white circles) and experimental stations represented (gray triangles).

adult palms of both species were mapped with the assistance of a portable GPS Garmin 78S. Adults were identified as palms with signs of reproductive activities. The palm *A. maripa* dominated areas on the two banks of the stream, while the seasonally flooded central areas and their surrounding *terra firme* forests were dominated by *A. phalerata*. We established 48 experimental stations along the study area, which were placed on the forest floor, at a distance of at least 50 m from one another, spread along four 600 m-long trails within the grid (Fig. 6). Enclosures were made of 20 cm-long sections of 10 cm-wide PVC tubes sealed at both extremities with iron mesh (with mesh size 1.5 cm wide) fixed at the tubes with adhesive tapes, which allowed the entrance of bruchid beetles but protected fruits from being removed by vertebrates (Fig. 4C). We measured seed predation on *A. maripa* fruits because they were available in much larger numbers, since the species is frequently found in deforested areas outside the protected site, where, due to

high insolation, palms begin to produce fruits at much lower heights and can be easily collected to be used in experiments. Therefore, we used fruits of this species for seed predation experiments. Groups of 10 peeled fruits of *A. maripa* were left within each enclosure at the seed stations for the period of a week during rainy season (resulting in 480 *A. maripa* fruits used). At the end the week period, the enclosures were collected and each of the fruits were checked for bruchid eggs. The whitish eggs of *S. giganteus* are approximately 1 mm long, and are laid individually, so they are easily spotted and counted with the naked eye (Fig. 4B).

For statistical purposes, the sampling units were each of the 48 experimental stations for the period of a week. To investigate the effect of adult *Attalea* palms on the probability of seed predation in *A. maripa*, we performed Spearman correlations between the number of infected fruits on each seed station and the abundances of (1) *A. maripa* adults found in a

25 m radius around the seed station (2) *A. phalerata* adults found in a 25 m radius around the seed station, and (3) both *Attalea* species pooled together.

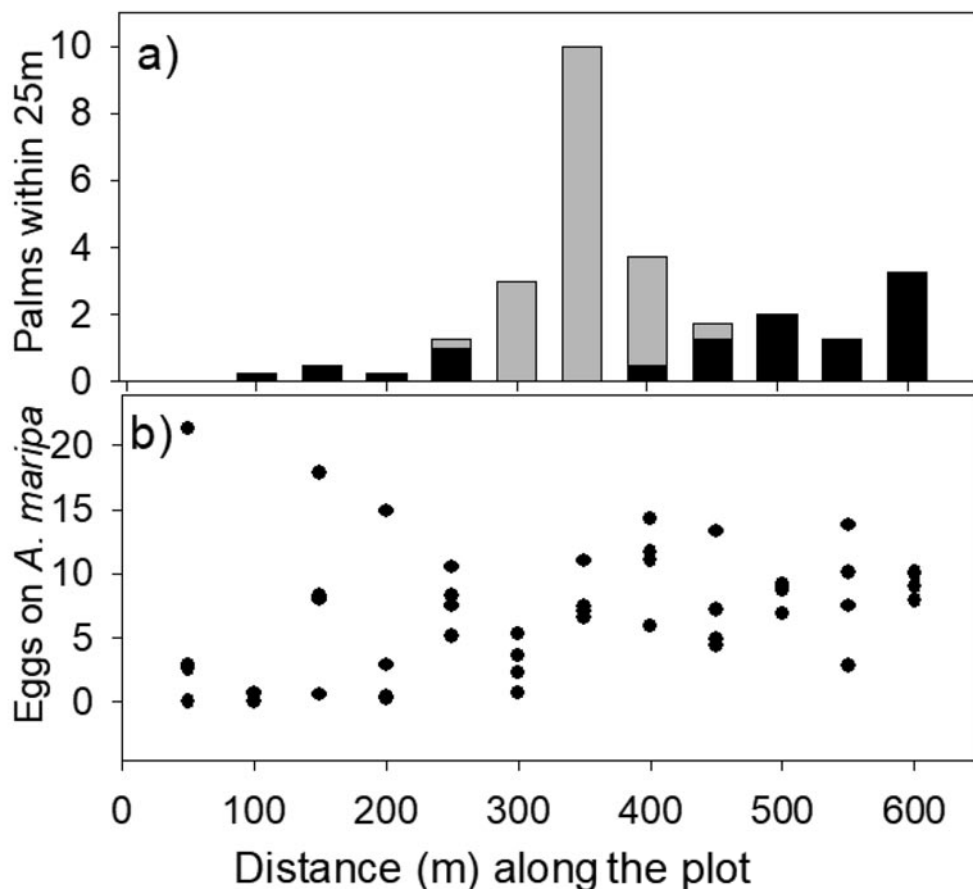
To evaluate the hypothesis that substantial changes in soil characteristics rather than the action of seed predation by bruchids could explain the sharp distribution boundary between the populations of *A. maripa* and *A. phalerata* at the *terra firme* around the 51st BIS grove, soil samples were collected at each predation experimental station, and taken to the laboratory for analyses. For soil collection, the litter layer was discarded and soils samples of the first 20 cm of the soil were conditioned in plastic bags. The examined parameters were percentage of humidity, texture and color. Humidity was measured comparing the weight of fresh samples with oven-dried soil samples according to the formula: percentage of humidity = $100 \times (\text{Fresh soil weight} - \text{Dried soil$

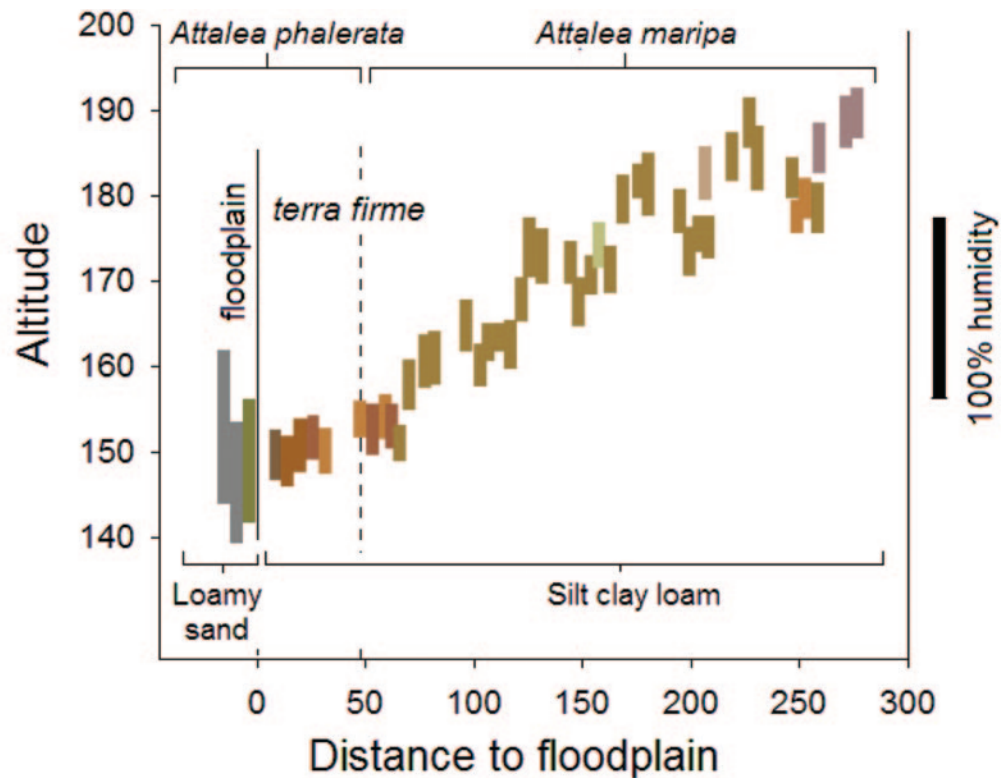
weight)/ Fresh soil weight. A Spearman test for correlation was made between soil water content and distance to the stream to verify if there was any gradient of soil humidity. Soil texture was classified with wet samples using the flow chart proposed by Rowell (1994) and color was defined with dry samples compared under sunlight with the Munsell Color (1975) chart.

The Xingu River Margin Seed Stations

Secondly, we set 41 seed-stations every 100 m along 5,600 m of the limit of the 51st BIS Forest Infantry Battalion with the Xingu River (Fig. 5). Every station was placed 50 m away from the river margin. We identified and counted all adult palm individuals at 25 m around the stations (1963.5 m²). The palms were identified in the field with the assistance of the guide *Flora Brasileira – Arecaceae (Palmeiras)* (Lorenzi et al. 2010). Due to the morphological diversity of palms, different criteria were used to assign

7. Infestation by the bruchid beetle *Speciomerus giganteus* eggs along the 650m long grid that crosses the 51st BIS stream. a) Bars represent the number of adult palms at 25m radius around each seed station (*A. maripa* in black and *A. phalerata* in gray). b) Average number of *S. giganteus* eggs upon *A. maripa* seeds in seed stations along the grid trails.





8. Soil characteristics of the samples collected along the studied grid system. X and Y axis represent distance to floodplain and altitude (m) of the collected samples in relation to sea level. Bar widths are proportional to the percentage of water sample weight; texture was determined according to D. L. Rowell (1994) flow chart and the colors were assigned according to the Munsell Soil Color Company (1975) chart.

individuals of different species to an adult class, following methodology applied by Salm et al. (2007). First, among those species that develop a subterranean stem (a stem that emerges to the surface at its approximated adult size diameter, like *A. maripa* or *Astrocaryum aculeatum*), the individual palms with an external and visible stem or with signs of present or past reproductive activity were considered adults. Secondly, the non-clonal arborescent palms whose stems thicken to its adult size after it emerges to the surface (like *Oenocarpus distichus* or *Socratea exorrhiza*) were considered adults when DBH was ≥ 5 cm. Finally, among abundant clonal species (like *Astrocaryum gynacanthum* or *Euterpe oleracea*), we counted those genets that revealed signs of reproductive activity as adults, and each clump as one individual. We did not find any climbing palms (*Desmoncus* spp.) within our sampled area. We tested for correlations between the abundance of each palm species and all the other individual palm species found within the 25 m radius circles among those species that have at least 10 individuals, in total.

PVC tube enclosures (described above) containing 10 peeled fruits of *A. maripa* were left in each station, retrieved one week later and taken to the laboratory, where the eggs of the bruchid beetles *Speciomerus giganteus* upon each fruit were counted. Again, we used Spearman correlations to predict the number of infected *A. maripa* fruits in relation to the number of palms of (1) *A. maripa*, (2) *A. phalerata*, (3) *A. speciosa* and (4) all *Attalea* palms pooled together found in a 25 m radius around the seed stations.

Data were analyzed with the aid of the statistical software SPSS (Version 20.0.0). Both datasets had responses which lacked a normal distribution and homoscedasticity; therefore, all hypothesis tests were non-parametric. Resulting *p*-values were corrected using the Holm-Bonferroni method (Holm 1979).

Results

The Stream Plot

Palms of the genus *Attalea* were found all over the study grid. Their highest density was found in the *Attalea phalerata* dominated area at the

center of the plot comprising the floodplain and adjacent areas. The palm *Attalea maripa*, on the other hand, was found at the extremes of the grid beyond the *A. phalerata* distribution area (Fig. 7a).

The eggs of the bruchid beetles *Speciomerus giganteus* were found in seeds of the palm *Attalea maripa* nearly everywhere across the study grid (Fig. 7b). A total of 83.3% of *A. maripa* fruits were found infested by an average of seven bruchid eggs per fruit. However, the attack probability varied in space. Predation upon *A. maripa* seeds was significantly related to the presence of *A. maripa* (Spearman's rho: $n=48$; $r=0.367$; $p=0.01$), but not to *A. phalerata* alone (Spearman's rho: $n=48$; $r=0.201$; $p=0.085$), using an adjusted alpha of 0.016. Nevertheless, the presence of adult palms of both *Attalea* species combined around each experimental station explained better the average number of bruchid eggs upon *A. maripa* seeds (Spearman's rho: $n=48$ $r=0.474$; $p<0.001$).

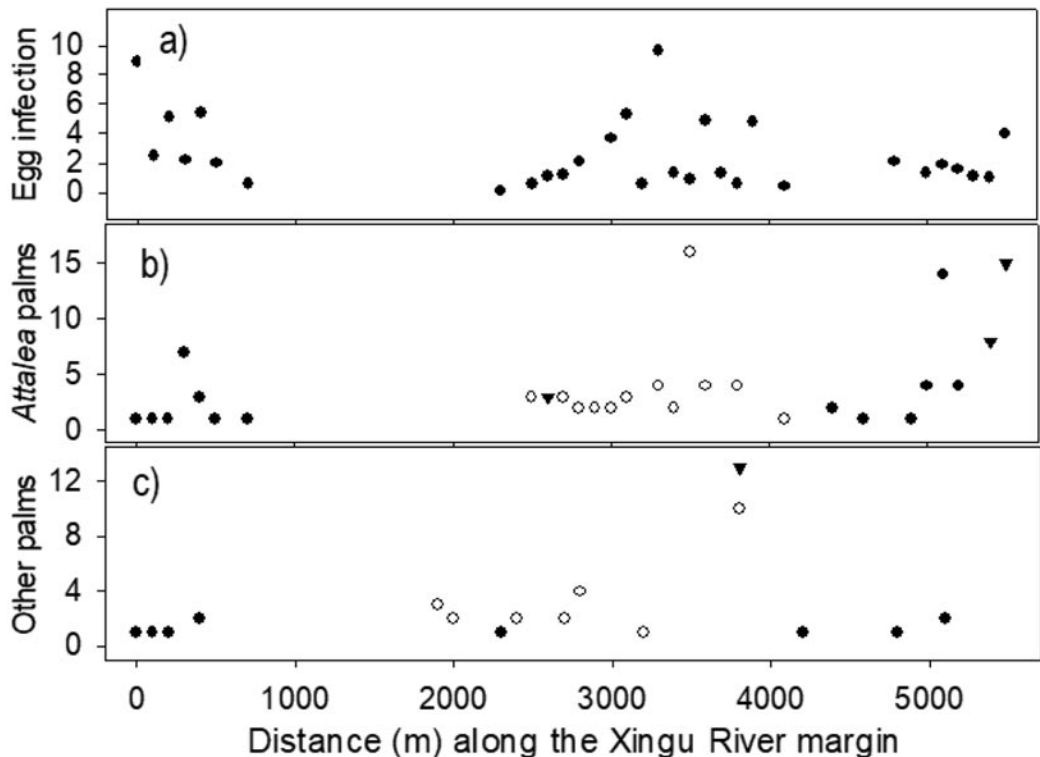
The soil analysis revealed a marked discontinuity between the characteristics of

the samples collected on *terra firme* and on the floodplain and no observed change in the region where the palm species populations are replaced one by the other. The *terra firme* samples all together had an average water content of 24.9% and were significantly drier than the floodplain area samples (Mann-Whitney U: $p<0.001$), with 74.3% of their weight represented by water. Within the *terra firme* area, there was no correlation between distance to floodplain and soil water content (Spearman's rho: $r=0.036$; $p=0.815$). All the *terra firme* soil samples were classified as "silt clay loam" while the floodplain samples were classified as "loamy sand." In relation to the color, the floodplain samples were variations of gray (olive gray and gray) while in the *terra firme* the soil colors were variations of brown, yellow and red (Fig. 8).

The Xingu River Margin Seed Stations

We found a total of 171 individual adult palms within the 80,503 m² sampled, within the 41 examined 25 m radius circles along the 51st BIS forest battalion along the Xingu River margin, belonging to 11 species: *Astrocaryum*

9. Along the 5600 m of the Xingu River margins within the 51st BIS forests, a) average number of *Speciomerus giganteus* eggs laid upon groups of 10 *Attalea maripa* experimental seeds. b) number adult *Attalea maripa* (black circles), *Attalea phalerata* (white circles) and *Attalea speciosa* (black triangles). c) number of non-*Attalea* palms, *Astrocaryum tucuma* (black circles), *Euterpe oleracea* (white circles) and *Mauritia flexuosa* (black triangle).



gynacanthum Mart. (sometimes considered a synonym of the next taxon) (3 individuals), *Astrocaryum aculeatum* G. Mey. (10 individuals), *Astrocaryum murumuru* Mart. (3 individuals), *Attalea maripa* (41 individuals), *Attalea phalerata* (46 individuals), *Attalea speciosa* (26 individuals), *Euterpe oleracea* Mart. (24 individuals), *Geonoma maxima* (Poit.) Kunth (2 individuals), *Mauritia flexuosa* L.f. (13 individuals), *Oenocarpus bacaba* Mart. (1 individual) and *Oenocarpus distichus* Mart. (2 individuals). Among the species that had at least 10 individuals, we found a negative correlation between the occurrence of *A. phalerata* and *A. maripa*. The palms of *A. speciosa* were found in only three points and, probably due to this sampling limitation, we found no significant correlation between the occurrence of this species and any other palm species. We also identified positive correlations between *A. phalerata* and *M. flexuosa*, and between *M. flexuosa* and *E. oleracea* (Table 1).

The experimental seeds of *A. maripa* were infected by eggs of the bruchid beetles *Speciomerus giganteus* over a large portion of the edge of the 51 BIS forest along the Xingu River margin, apart from a 1-km section where nearly no palm of any species was found (Fig. 7). A total of 35.2% of *A. maripa* fruits were found infested by an average of 1.4 bruchid eggs per fruit. Attack probability again varied in space and Spearman correlation tests showed that the best predictor to explain the predation of *A. maripa* seeds based on adult palm distribution is the one that considers the presence of all *Attalea* adults around seed stations (Spearman's rho: $n=41$; $r=0.453$; $p=0.004$) than either *A. maripa* (Spearman's rho: $n=41$; $r=0.113$; $p=0.720$), *A. phalerata* (Spearman's rho: $n=41$; $r=0.312$; $p=0.048$) or *A. speciosa* (Spearman's rho: $n=41$; $r=0.062$; $p=0.350$), with an adjusted alpha of 0.0125.

Discussion

The distribution pattern of *Attalea* palms at the studied forest on the Xingu River valley, with their respective populations neatly separated by sharp boundaries frequently not crossed even by a single individual of the congeneric species, suggests an ecological explanation. Despite previous studies showing that tall arborescent palms of the genus *Attalea* tend to be generalists in relation to edaphic factors (Ruokolainen & Vormisto 2000) and observations made elsewhere in the Xingu River basin, that where *A. maripa* is the only species of this genus, it is widely distributed

in all areas outside floodplains (Salm 2005, Salm et al. 2007), it could still be considered that abiotic environmental parameters would be the best candidates for such an explanation. However, no visible clear-cut environmental change coincides with the species transition point, an impression that is confirmed by the soil analyses of the "stream plot," showing a single breaking point on soil parameters precisely on the limit of the floodplain and its surrounding *terra firme* (both areas dominated by *A. phalerata*), somewhat distant from the limit from *A. maripa* and *A. phalerata* distribution areas. Likewise, in the second studied area, along the Xingu River margin, where we also studied palm seed predation patterns, we found separated clusters of each one of the three studied large *Attalea* palms and found significantly negative correlations between the abundance of *A. maripa* and *A. phalerata*, with no obvious environment element coinciding with the transition points.

The experiments made here revealed that the probability of a palm seed of either *A. maripa*, *A. phalerata* or *A. speciosa* being infested by a bruchid beetle *Speciomerus giganteus* egg is better explained by the abundance of reproductive adults of all *Attalea* species together rather than with just their respective conspecifics alone. Because seed predation probability is often related to the density of conspecific adults (Janzen 1970), the results support the idea that this bruchid species acts as a shared enemy between species of *Attalea*, imposing reciprocal damage for all palm species, and therefore generating the conditions for apparent competition between these palms.

The mechanisms by which the shared predation of the bruchid beetles *S. giganteus* upon the *Attalea* palms create or reinforce the physical separation of the groves of these palm species is not obvious, since the beetles inflict mortality over all species with roughly the same probability from the point of view of an individual seed. In general, when the seeds of a plant are brought to an area not occupied by conspecific adults, they have a numerical disadvantage of hundreds or even thousands to one in relation to the resident species. However, this disadvantage is often counterbalanced by the fortune of entering a space "free of enemies" (Holt 1977), giving to this seed or future growing seedling a relative advantage over the residents. As pointed out above, this is the basis of the so-called Janzen-Connell mechanism. The mechanism is based

Table 1. Multiple Spearman correlations among the number of different palms (with at least 10 individuals) sampled at 25 m radius circles around the 56 Xingu River Margin Seed Stations. We marked in bold significant correlations with $p \leq 0.05$.						
Palms	<i>Attalea maripa</i>	<i>Attalea phalerata</i>	<i>Attalea speciosa</i>	<i>Astrocaryum aculeatum</i>	<i>Euterpe oleracea</i>	<i>Mauritia flexuosa</i>
<i>Attalea maripa</i>	-	$r = -0.142$ ($p = 0.015$)	$r = -0.083$ ($p = 0.285$)	$r = 0.507$ ($p = 0.012$)	$r = -0.115$ ($p = 0.085$)	$r = -0.054$ ($p = 0.548$)
<i>Attalea phalerata</i>	-	-	$r = -0.086$ ($p = 0.311$)	$r = -0.163$ ($p = 0.076$)	$r = 0.156$ ($p = 0.193$)	$r = 0.175$ ($p = 0.041$)
<i>Attalea speciosa</i>	-	-	-	$r = -0.095$ ($p = 0.430$)	$r = -0.070$ ($p = 0.466$)	$r = -0.032$ ($p = 0.815$)
<i>Astrocaryum aculeatum</i>	-	-	-	-	$r = -0.132$ ($p = 0.205$)	$r = -0.656$ ($p = 0.656$)
<i>Euterpe oleracea</i>	-	-	-	-	-	$r = 0.855$ ($p = 0.004$)

on the idea of specialist, host-specific predators that, inflicting higher mortality probability to seeds or seedling at close distance or high density of conspecific plants, open space for other species. Thereby, it provides an explanation for the maintenance of high tree species diversity in tropical forests (Janzen 1970, Connell 1978). Nevertheless, this is not the case when the colonizing species share enemies with an already established species; then, it just faces a huge numerical disadvantage and no survival benefit from being taken far away from their parents, making population distribution expansion over the areas dominated by indirect competitors much more unlikely.

The dominance of the palm *A. phalerata* along the first 50 m meters beyond the studied floodplain at the Stream Plot, in an area suitable for *A. maripa*, also needs further explanation. The mechanism of apparent competition described above, explains how *A. phalerata* maintains total control of the terra firme area surrounding the floodplain so that no single *A. maripa* palm is found there, but still leaves open the matter of why *A. phalerata* dominated this area in the first place, which is otherwise suitable for *A. maripa*. This may be explained by the migration of large numbers of seeds from the adjacent floodable area, where *A. phalerata* is found in densities up to ten times that of *A. maripa* is found in their distribution range. Such high density of *A. phalerata* in the floodplain can be attributed not only to their relative tolerance to the harsh environmental conditions associated with flooding, but also to the restrictions that such conditions impose to the colonization of many other tree species in this area. These include the severe disturbance regime associated with the unstable soil that contributes to the high light environment suitable for the development of large arborescent palms (Kahn 1986, 1987, Salm 2005). As one goes further and further away from the floodplain, the migration of *A. phalerata* seeds from that highly favorable area for this species diminishes. Therefore, at some point, whatever advantage *A. maripa* has over *A. phalerata* to thrive in the dense terra firme forests of Amazonia, favors the transition from one species to the other. Apparent competition, again, excludes completely one palm species—*A. phalerata*—from the domain of their competitor, *A. maripa*. The same process probably operates around floodplains along the Xingu River margin.

Conclusions

Palm distribution patterns in various scales have been explained by different factors like climate, relief and drainage (Kahn 1987, Kahn & de Granville 1992, Svenning 2001, Eiserhardt et al. 2013). Biological factors, on the other hand, are very rarely considered as key factors to explain species distribution. Here, we demonstrate that the attack of the bruchid beetle, *Speciomerus giganteus*, is an important source of mortality to the seeds of three large arborescent palms, *Attalea maripa*, *A. phalerata* and *A. speciosa*. The beetles, therefore, are the “shared enemies,” the intermediate of the indirect interaction between these palm species, acting to keep the groups of their “victims” apart, similar to the lynx with the snowshoe and the arctic hare, in the classic example of apparent competition (Holt 1977). Because palms are conspicuous and easily identifiable elements of tropical forests, such subtle interspecific relationships may be first detected among them, but in fact, it could be a much more widespread phenomenon among tropical trees.

Acknowledgments

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Corrigendum

In Dransfield, Marcus and Baker's paper *Chrysalidocarpus hankona* (PALMS 67: 89–72. 2023), the holotype of the new species is correctly cited on page 89 as *W.J. Baker 1478*. Later in the same paper, on p. 94, the type is incorrectly cited as *W.J. Baker 1475*.

JOHN DRANSFIELD
Royal Botanic Gardens, Kew

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First Report of *Washingtonia robusta* Naturalized in Louisiana, USA

EMILY K. STAFFORD¹ AND CHRISTOPHER S. REID²

We report *Washingtonia robusta* naturalizing near the community of Grand Isle in coastal southeastern Louisiana, USA. Self-seeded plants occur along roadsides and on elevated ruderal areas near the margins of saline marsh. We recommend additional fieldwork in coastal Louisiana to detect other naturalized populations of this popular ornamental palm.

Washingtonia robusta H. Wendl., often referred to as Mexican fan palm, is native to ground-water-hydrated washes in Baja California Sur and Sonora in northwestern Mexico (Zona 2000). Its only congener, *Washingtonia filifera* (Rafarin) H. Wendl. ex de Barry, is also narrowly distributed with a geographical range contiguous to that of *W. robusta*, extending northward into southern California and Arizona (Zona 2000, Villanueva-Almanza et al. 2018). While these two species have been recognized since Bailey's (1936) monograph, we feel obliged to note that recent studies suggest *Washingtonia* may be represented by

one polymorphic species (Villanueva-Almanza et al. 2018, Zona & Dransfield 2019, POWO 2023).

Although the native range of *Washingtonia* is small, both species have long been established in horticultural trades and have been widely planted in warmer regions of the world. *Washingtonia robusta* has become naturalized in southern California (Cornett 1986) and Florida (Morton 1989, Zona 1997) in the United States. It has also escaped cultivation in the Mediterranean region (Italy, Portugal, Spain, Tunisia), Mauritius and Réunion Islands in the Indian Ocean, South Africa, New Zealand, and Western Australia and New South Wales (Spennemann 2018a,b, Mokni 2021).

The senior author (E.K.S.) first documented *Washingtonia robusta* growing outside of cultivation at Elmer's Island Wildlife Refuge (EIWR) in Jefferson Parish, Louisiana in March 2022. Elmer's Island is located on the southwestern tip of Jefferson Parish along

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1. The senior author (E.K.S.) posing with cultivated material of *Washingtonia robusta* at a residence immediately across Louisiana Highway 1 from Elmer's Island Wildlife Refuge in Jefferson Parish, Louisiana. The larger tree was fruiting heavily, and this tree may be the source of self-seeded plants nearby.

Louisiana Highway 1, just west across Caminada Pass from Grand Isle, a barrier island in the Gulf of Mexico. *Washingtonia robusta* is a frequent ornamental tree in the Grand Isle area, which has numerous homes and fishing camps (Fig. 1). We observed 15–20 self-seeded

plants, mostly juvenile, growing in ruderal areas such as the shoulder of Louisiana Highway 1 (Fig. 2), and elevated areas including a spoil bank and beside the beach access road on EIWR (Figs. 3 & 4). We did not find *Washingtonia robusta* becoming

established in saline marsh, which is the dominant natural community on EIWR. However, one area supporting five seedlings was near the marsh edge and was associated with halophytic marsh plants such as

Sporobolus pumilus (= *Spartina patens*), *Borrchia frutescens*, *Baccharis halimifolia*, *Iva frutescens*, and *Solidago mexicana* (Fig. 4). Close associates of *Washingtonia robusta* on roadsides and spoil banks included *Ilex vomitoria*, *Quercus*

2 (top). A self-seeded *Washingtonia robusta* plant growing beside Louisiana Highway 1 near the entrance to Elmer's Island Wildlife Refuge in Jefferson Parish, Louisiana, just west of Grand Isle. A large cluster of *W. robusta* is evident further west along the highway, in the upper right portion of the image. Saline marsh is extensive to the south of the highway. 3 (bottom). A lone mature tree of *Washingtonia robusta* growing atop a spoil bank adjacent to a canal near the Gulf of Mexico beach at Elmer's Island Wildlife Refuge, Jefferson Parish, Louisiana. We believe this tree established spontaneously since it is far-removed from cultivated trees and no other cultivated plants are evident on the spoil bank.





4. Juvenile *Washingtonia robusta* on Elmer's Island Wildlife Refuge in Jefferson Parish, Louisiana. These plants were growing on elevated ground between an unimproved access road and saline marsh.

virginiana, *Sabal palmetto* (Walter) Lodd. ex Schult. & Schult.f., *Cissus trifoliata*, and *Solidago mexicana*.

Voucher specimen: USA. Louisiana. Jefferson Par.: Grand Isle; Elmer's Island, southwestern tip of Jefferson Parish along Hwy 1. Lat/long: N 29.1882, W -90.0675; isolated young seedling population growing and spreading; surrounding environment included black mangrove (*Avicennia germinans*) and saltwater marsh habitat. 13 March 2022, *Stafford 1* (LSU). (Fig. 5)

Standard references on plant distributions and regional floras (Kartesz 2015; Weakley 2022; POWO 2023; USDA, NRCS 2023) do not list *Washingtonia robusta* as naturalized in Louisiana.

We have clearly documented the spread and persistence of *W. robusta* from cultivation in coastal southeastern Louisiana; therefore, this taxon is admitted into the naturalized flora of Louisiana. While preparing this paper, we were informed of *Washingtonia* escaping cultivation in coastal southwestern Louisiana, specifically in the vicinity of Holly Beach in Cameron

Parish (Rob McElwee, pers. comm.) and in the New Orleans area (Brian Early, pers. comm.). We recommend surveys to document the true extent to which *Washingtonia* is escaping elsewhere in Louisiana, and that an assessment of its potential invasiveness and injuriousness be performed. *Washingtonia* is easily recognized vegetatively by having split petiole bases, filiferous blades, and armed petioles (Zona 2000). *Washingtonia robusta* is a Category II pest plant in Florida (FLEPPC 2019). We tentatively recommend that *W. robusta* be categorized as a Tier III invasive based on criteria set forth by the Louisiana Wildlife Action Plan (Holcombe et al. 2015). Species in Tier III have no known or predicted negative impacts on natural communities. However, further fieldwork may change that designation in the revised Louisiana Wildlife Action Plan, which will be released in 2025.

Acknowledgments

We appreciate Brett Jestrow of Fairchild Tropical Botanic Garden for identifying the voucher specimen cited herein. We appreciate Julia Lightner of Louisiana Department of



5. Image of the specimen documenting *Washingtonia robusta* naturalized in Louisiana for the first time. Image courtesy of Shirley C. Tucker Herbarium (LSU).

Wildlife and Fisheries for providing helpful information regarding EIWR and for her interest in our work. We thank Jennifer Kluse of Shirley C. Tucker Herbarium (LSU) for helping facilitate the identification of the voucher specimen and for providing Fig 5. John Michael Kelley and S. Zona substantially improved the manuscript by providing helpful reviews, for which we are grateful.

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Basselinia

DONALD R. HODEL¹

Basselinia includes at least 14 species of solitary or clustered, small or rarely dwarf to moderate palms with regularly to irregularly pinnate or simple and bifid leaves and a prominent crownshaft restricted to New Caledonia. It is the largest and most diverse and complex genus of palms on the island, and few useful characters exist to distinguish the species. The extremes of habit and foliage are so great that they were once thought to represent three or even four different genera. Not only is the genus unusually diverse, but individual species, such as *B. deplanchei* (Front Cover; Figs. 1 & 2), *B. eriostachys* (Figs. 3–5) and *B. pancheri* (Figs. 6 & 7), are among the most diverse in the palm family.

Basselinia has been divided into two sections or subgenera. Section *Basselinia* comprises variable, generally small, often clustered species with pinnate to simple and bifid leaves and small inflorescences. Crownshafts are unusually colorful, ranging from blackish purple to orange, yellowish or dark red covered with a crusty, blackish indumentum.

Section *Taloua* comprises solitary, mostly stout or robust species with regularly pinnate, often

recurved leaves with more numerous pinnae and large inflorescences. Crownshafts are green to dark green or lilac to gray-red and covered with white to grayish indumentum as in *Basselinia sordida* (Fig. 8).

More recent new additions to *Basselinia* include the new species *B. moorei*; the resurrection of *B. eriostachys* from *B. gracilis*, the former now considered much more common and widely distributed than the latter species; and the inclusion of *Alloschmidia glabrata* (now *B. glabrata*) (Fig. 9).

Look for *Basselinia eriostachys* and *B. pancheri* at the Rivière Bleue Botanical Reserve. One can also see *B. pancheri* at Forêt Nord and Col d'Amieu and *B. eriostachys* at Forêt du Pic du Pin and the Mt. Koghi Botanical Reserve.

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Editors' Note: This is the first of four commissioned articles highlighting the exceptional palm diversity of New Caledonia, the destination for the IPS Biennial in 2024.



1. This form of *Basselinia deplanchei* from Mt. Humboldt has leaves with only a few but large pinnae.



2. Crownshafts of *Basselinia deplanchei* are nearly always colorful, as this individual with an iridescent orange-red one from Mt. Tonta.



3. *Basselinia eriostachys* is also unusually variable in foliage, having leaves with many pinnae, as here at Col d' Amos, or with simple leaves or with only a few, large pinnae.



4. At the cloudy, misty summit of Mt. Panié, the highest point on New Caledonia, a nearly simple-leaved form of *Basselinia eriostachys* occurs.



5. Whatever its form, the common, widespread, and variable *Basselinia eriostachys* typically has a colorful crownshaft, as this individual with a pinkish red one in Rivière Bleue.



6. Like the previous two species, *Basselinia pancheri* is extremely variable, occurring as a small, slender-stemmed, understory palm, as here at Col de Yat  , or as a moderate, emergent species.



7. This *Basselinia pancheri* in Rivière Bleue is a moderate, emergent palm with a more robust stem and dark purplish crownshaft.



8. The gregarious *Basselinia sordida* is an emergent species, as here at Forêt de Saille.



9. *Basselinia glabrata* is famous for carrying numerous inflorescences in various stages of development, as here on Pic Mandjelia.

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CALAMOIDEAE | PIGAFETTINAE

Pigafetta (Blume). Becc.
Synonym: Metropis section Pigafetta (Blume) Martin, Ingo section Pigafetta Blume

Tall – leaf pinnate – no crownshaft – spiny – leaflets pointed

Robust, single-stemmed tree palm, stem shiny green, especially in upper parts, crownshaft absent, dissection. Leaf pinnate, armed with spines and bristles, strongly arching, sheath splitting to the base opposite the petiole, glaucous-white petiole absent, though narrowing upper portion of sheath resembles a petiole; leaflets numerous, with pointed tips, arranged regularly, ascending. Inflorescence between and below the leaves, branched to 2 orders, branches pendulous; primary bracts similar, not dropping off as inflorescence expands; peduncle shorter than inflorescence rachis; rachilla moderately slender, pendulous. Flower in pairs or solitary throughout the length of the rachilla, not developing in pits. Fruit small, creamy white, subglobose, with vertical row of three seeds, stigmatic remains spiral, flesh thin. Seed 1, enclosed in a fleshy coat (sarcotesta), laterally flattened, endosperm homogeneous.

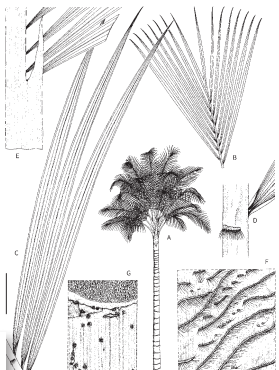
DISTRIBUTION. Two species, one in Sulawesi, the other in Maluku and western New Guinea.

NOTES. Until relatively recently this was a rather poorly known genus, not well represented in herbaria or in cultivation. In the mid 1970s new accessions of seeds were introduced from Indonesia and from New Guinea into cultivation and new herbarium specimens made. It had been considered that there was but one species, *P. flori*, but the distinctions between the two species that had been described long ago became obvious when cultivated plants were compared. *Pigafetta flori* is a palm of Maluku and New Guinea while *P. data* is restricted to Sulawesi (Dransfield 1998).

Pigafetta flori (Günther) Becc.
Synonym: Metropis microcarpa Kunth, Metropis microcarpa Kunth, Metropis flori (Günther) Martin, Pigafetta flori (Günther) Blume, Pigafetta pinnata Blume, Ingo flori (Günther, Ingo microcarpa (Palm) H.B.K., Ingo microcarpa (Palm) H.B.K.

Slender, single-stemmed tree palm to 25 m or more. Stem 30–40 cm diam., shiny green, especially in upper

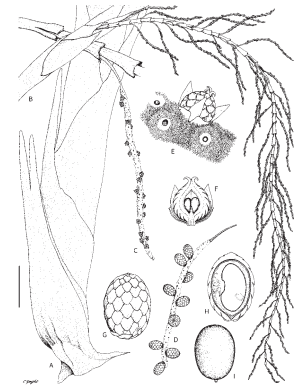
and below the leaves, branched to 2 orders, 250–280 cm long, branches pendulous; primary bracts similar, not dropping off as inflorescence expands; peduncle shorter than inflorescence rachis, ca. 40 cm; rachilla moderately slender, pendulous, 12–15 cm long, 4–6 mm diam., covered in brown tomentum. Flowers crowded throughout the length of the rachilla. Fruit creamy white at maturity, subglobose, 0.8–1 cm x 0.6–0.7 cm, with 1–3, vertical row of three seeds, stigmatic remains spiral, flesh thin.



Pigafetta flori (Plate 2). A. Habit. B. Leaf apex. C. Leaf mid portion. D. Detail of leaf rachis with spines. E. Leaf base with scales. F. Detail of leaf rachis with spines. G. Stem section. Scale bar: A = 2 cm, B, C = 10 cm, D, E, F = 5 cm, G = 1 cm. All from Dransfield, 1973. Drawn by Camille Gagnier.

NOTES. Unmistakable, *Pigafetta flori* is an immensely robust, spreading, single-stemmed tree with gleaming green trunks, arching, shiny leaves and thick, white spiny leaf sheaths. The inflorescence is borne between and below the leaves, reaching 2.5 m long, with long pendulous branches. The fruits are very small (0.8–1 cm) with creamy white scales when ripe. Within its range, *Pigafetta* is a common palm of lowland conditions, including disturbed areas. It can be confused with *Metropis*, which is usually multi-stemmed, with leaf sheaths that are not thickly white, stems that die after flowering, and large fruit (2.5–3.5 cm).

Calamus (Linn.) Becc. is often cited as a synonym of *Pigafetta flori* (Blume). It seems much more likely that the fragmentary fruit material to which the name is based indeed belongs to a species of *Calamus*.



Pigafetta flori (Plate 2). A. Female inflorescence base with prophyll and primary bracts. B. Portion of female inflorescence. C. Detail of leaf rachis with spines. D. Female rachilla with fruit. E. Portion of female rachilla with fruit. F. Female rachilla in longitudinal section. G. H. Fruit whole and in longitudinal section. I. Seed. Scale bar: A = 10 cm, B = 12 cm, C, D = 5 cm, E, F = 4 cm, G = 1 cm, H = 1 mm, I = 1 mm. All from Dransfield, 1973. Drawn by Camille Gagnier.

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