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Palms (formerly PRINCIPES)

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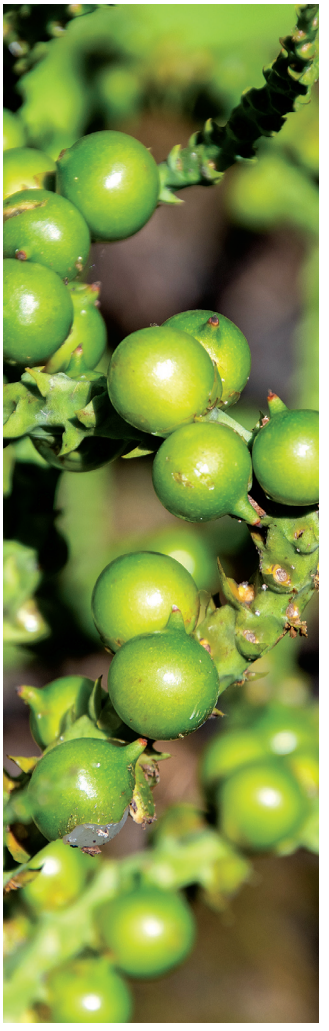
Features

FRONT COVER

Cyrtostachys renda growing in a garden pond at The Retreat, Nassau, Bahamas. See article by L. Noblick and A. Street, p. 65. Photo by L. Noblick and A. Street.

BACK COVER

Chrysalidocarpus titan in the garden of Jerry Welch, Haiku, Maui, Hawai'i. See article by J. Dransfield et al., p. 79. Photo by W.J. Baker.



The unusual beaked and bracteate fruits (here, immature) of a new species of *Chysalidocarpus*. See article by Dransfield et al., p. 89. Photo by W.J. Baker.

PALM NEWS


Horace Hobbs

In late May, coinciding with the RHS Chelsea Flower Show, **the IPS Board of Directors, guests and other IPS members gathered in London, UK, for their annual business meeting**. The day-long meeting addressed the society's business, finances and plans for future activities, including the 2024 Biennial meeting in New Caledonia. When not in meetings, the group enjoyed outstanding tours of the Royal Botanic Gardens, Kew, from Drs. Bill Baker and John Dransfield, along with Dave Cook, curator of the Temperate House, and Will Spoelstra, the curator of the Palm House. They also were treated to tours of the Palm Room and Library by Drs. Sidonie Bellot and Ben Kuhnhäuser and botanical illustrator Lucy T. Smith. Visits to the Chelsea Flower Show and the Millennium Seed Bank were also on the itinerary. The highlight of the week was a banquet at which John Dransfield was awarded the highest honor from the IPS, the Dent Smith Memorial Award. The award is recognition for John's years of outstanding service to the IPS. John is only the fourth person to receive this award. Previous awardees are Natalie Uhl, Jim Cain and Libby Besse. A full account of the award was given in a special edition of the IPS Newsletter.

A recent review of the cultivation of the date palm (*Phoenix dactylifera*) addressed the status of date palm horticulture, environmental factors affecting its growth and productivity and future challenges to date palm cultivation brought on by climate change, increasing salinity and emerging pests and diseases. Sustainable practices in terms of soil and water management and fertilization were given special attention. The paper, by K.D. Alotaibi and coauthors, was published in the May issue of the journal *Land Degradation and Development* 34: 2431–2444. 2023. https://doi.org/10.1002/ldr.4619


Jean-Yve Jamin

The evolutionary tree of life of the palm family remains a major research frontier, despite many years of foundational studies. In March, a team led from South China Botanical Garden produced **the first complete tree of life for all palm genera based on plastid genomes**. The plastid, a structure within the plant cell responsible for photosynthesis, contains its own ring-like genome, in addition to the vastly larger genome found in the cell nucleus. The plastid genome of palms is up to 160,000 base pairs long and can be especially informative in the determination of deep relationships among palms, as this study has demonstrated. After years of studying the plastid genome, we now look forward to a time when vast datasets from both the plastid and nuclear genomes will be combined to obtain a fully rounded picture of the evolution of palms. The publication is G. Yao et al. A plastid phylogenomic framework for the palm family (Arecaceae). *BMC Biology* 21: 50. 2023. https://doi.org/10.1186/s12915-023-01544-y

Pinanga subterranea, a New Arecoid Palm from Borneo that Flowers Underground

Agusti Randi[1,2], Peter Petoe[3,4], Benedikt G. Kuhnhäuser[4], Paul P.K. Chai[5], Sidone Bellot[4] and William J. Baker[4]

A new acaulescent species of *Pinanga* (Arecoideae: Areceae: Arecinae) is described and illustrated here. This remarkable new species is the first palm described as flowering and fruiting underground, highlighting Borneo as a hotspot for palm diversity.

The palm genus *Pinanga* Blume has radiated extensively in Borneo, where it is represented by 40 species (POWO 2023). However, several Bornean species are known only from their types, and little is known of their range of variation (Dransfield 1980). *Pinanga* diversity in Borneo has not received much attention recently. So far only three species have been described during the 21st century, namely *P. jambusana* C.K.Lim (Lim 2005), P. *limbangensis* C.K.Lim (Lim 2005) and *P. schwanerensis* Randi, Hikmat & Heatubun (Randi et al. 2019), although several undescribed taxa are known.

In Borneo, *Pinanga* displays great variation in size, form and ecology (Dransfield 1991). Almost all Bornean species are small understorey palms with slender stems, but some are acaulescent. Here, we describe a new acaulescent *Pinanga* from Borneo in which the stem, crownshaft and inflorescence are buried below ground level. Following initial observations in Sarawak, where we had recorded the species under the preliminary name *P.* aff. *brevipes* (Petoe et al. 2020), we have made extensive direct observations in the wild in multiple localities across Borneo of its extraordinary habit of flowering and fruiting underground. The presentation of inflorescences and infructescences below the soil surface (a form of geocarpy) has not been reported previously in any other palm species (Kuhnhäuser et al. 2023). All characters and measurements presented below are based on

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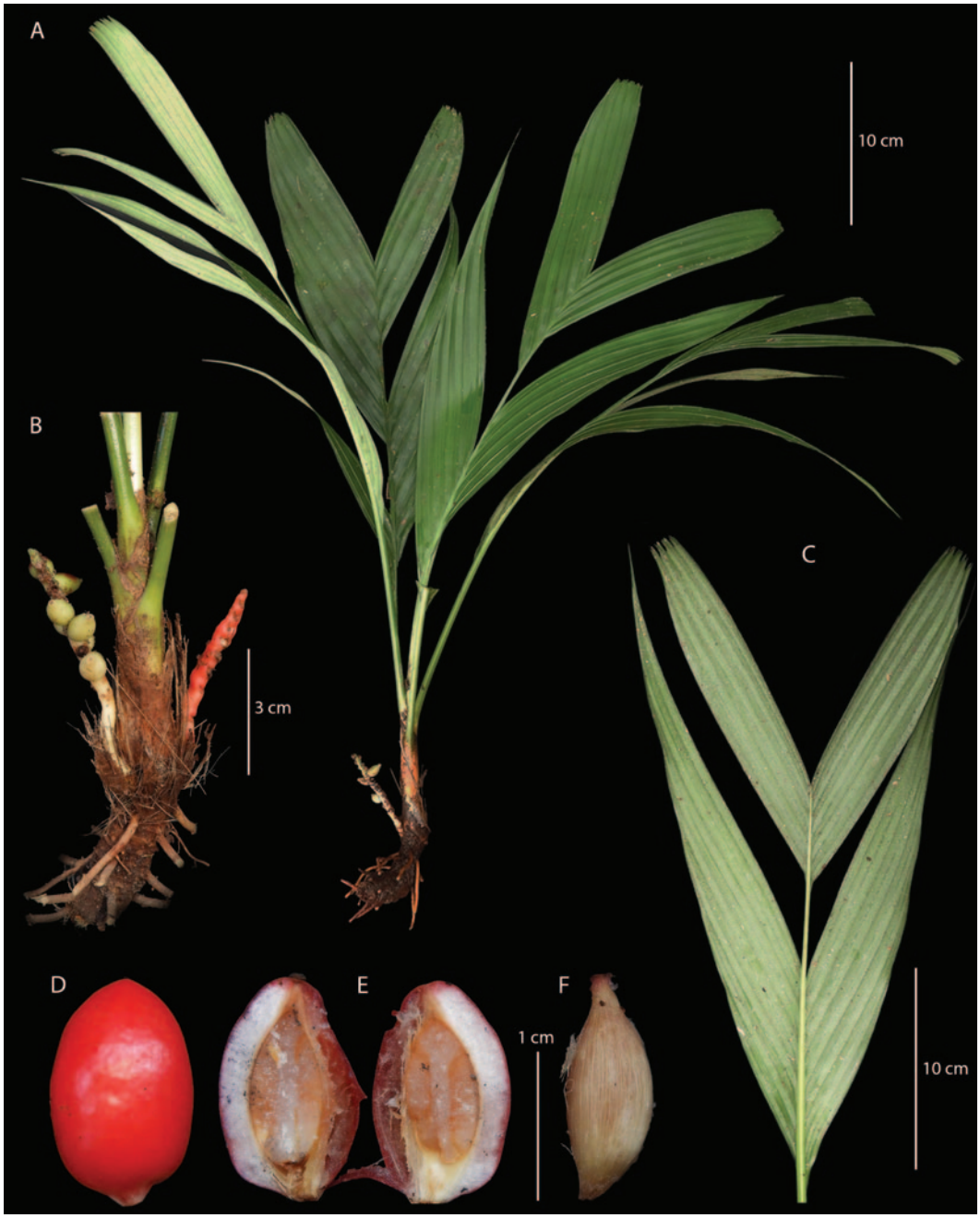
observations of both fresh and dried specimens, and terminology follows Beentje (2010).

Pinanga subterranea *Randi & W.J.Baker*, **sp. nov.** (Figs. 1–4). Type: MALAYSIA. Sarawak: Sri Aman Division, Lanjak Entimau Wildlife Sanctuary, ridge path ca. 400 m SSW of Lanjak Field Station, 359 m elev., 1°24′41″N, 112°0′13″E, 2 Nov. 2018, Petoe et al. 32 (holotype K!; isotype SAR).

Diagnosis: This species is superficially similar to *P. tenacinervis* J.Dransf. (1980) but can be easily distinguished by its solitary habit (vs. clustering in *P. tenacinervis*), stem, crownshaft and inflorescence that are usually subterranean (vs. all above ground), and erect, usually

1. *Pinanga subterranea*. **A**. Entire plant; **B**. Stem, crownshaft and infructescences; **C**. Leaf blade abaxial surface; **D**. Ripe fruit (side view); **E**. Longitudinal section of ripe fruit showing inside of the seed; **F**. Fibrous endocarp that encloses the seed. All photos by A. Randi, from West Kalimantan.



2. *Pinanga subterranea*. **A**. Wild population; **B**. A mature individual; **C**. Buried infructescence excavated with unripe white fruits. All photos by W.J. Baker, from Lanjak Entimau Sarawak.

subterranean infructescence (vs. pendulous, aerial).

Solitary, understorey, geocarpic palm, with a very short stem, with 4–6 leaves in crown; stem buried underground, up to 6 cm long, 1.2–1.8 cm diameter; internodes very closely spaced, 2–4 mm apart, scars conspicuous and slightly thickened; crownshaft often completely subterranean, or only partially rising above ground level, 7–12 × 1.4–2.2 cm., tubular, swollen at base. Leaf sheath 6–10 cm long, 4.5–7 cm wide at the widest point, pale to deep yellow or green when not buried, covered with dense reddish-brown scales; ligule drying early, only visible on the very young leaf, ca. 1 cm long. Leaf 25–85 cm long including 9–25 cm long petiole; petiole plain green to yellowish at base, with sparse indumentum, flat to slightly channeled adaxially and rounded abaxially; rachis weakly impressed, with adaxial longitudinal ridge, rounded abaxially; blade 16–60 cm long, 14–30 cm wide at the widest point in the middle, pinnate or sometimes undivided, base attenuate into petiole, symmetrical or slightly asymmetric, adaxial surface light to dark green and shiny when fresh, with sparse and scattered white scales, glaucescent abaxially, with dense scales; leaflets 2–4 on each side of the rachis, alternate or subopposite, connected or with short intervals between them (usually less than the width of one segment), somewhat sigmoid to linear lanceolate or linear oblong, 18–32 × 2.5–5.8 cm, with long tapering tip, surface flat to folded or slightly undulate, with 4–8 folds and prominent adaxial ribs; apical leaflet pair joined, each lobe 8–20 cm long on the longest side, 2–7 cm wide, tip dentate, with 5–10 folds. Inflorescence infrafoliar, usually presented underground, or partially exposed above surface of soil or leaf litter, erect, comprising two or rarely one rachilla, white to yellowish or green when young then turning red, swollen and fleshy when the fruit are ripe, glabrescent; peduncle 1.2–3.5 cm long; rachilla 4.2–9.2 cm long, slightly zig-zag when young and becoming straight with age, tapering at the end, each rachilla bearing up to 30 triads on each side, arranged distichously along its length. Pistillate flower: calyx with 3 incurved sepals, free at base, each sepal 2.1–3.2 × 2.5–4.5 mm, keeled and with sparse scales abaxially, base thickened, apex rounded or nearly flat, margins membranous; corolla with 3 petals, smaller than sepals, each petal 1.8–

3. *Pinanga subterranea*. Stem, crownshaft, and infructescences are buried in the ground. Inset showing fruits. Photos by A. Randi from West Kalimantan.

2.5 × 2.0–3.1 mm, base thickened, apex obtuse to nearly flat, glabrous on both sides, margins membranous. Fruits ovoid when ripe, 1.5–1.9 × 1.3–1.5 cm, white to green then purplish brown to bright red when ripe; base usually pale white, apex with dark brown persistent stigmatic remains; epicarp glabrous, thin and shiny; mesocarp ca. 2 mm thick, white, fleshy and juicy; endocarp fibrous, extending from base to apex. Seeds narrowly ovoid, 8–13 × 4–6 mm; endosperm ruminate, with irregular orange intrusions; embryo basal.

Distribution: Endemic to Borneo. This species occurs at the type locality in Sarawak, Malaysia, and in West and Central Kalimantan, Indonesia (Fig. 5).

Habitat: Mainly recorded from lowland mixed dipterocarp forest valleys and on slopes near streams. On clay soils on chalk, red clay soils, or sandy clay soils, up to 650 m elevation.

Vernacular name: *Pinang Tanah* (Malay, West Kalimantan). *Pinang Pipit*, *Muring Pelandok* (Kendorih language, Central Kalimantan). *Tudong Pelandok* (Iban language, Sarawak).

Uses: In Central Kalimantan, the ripe fruit flesh is often eaten raw; it has a soft and juicy texture and a predominantly sweet taste.

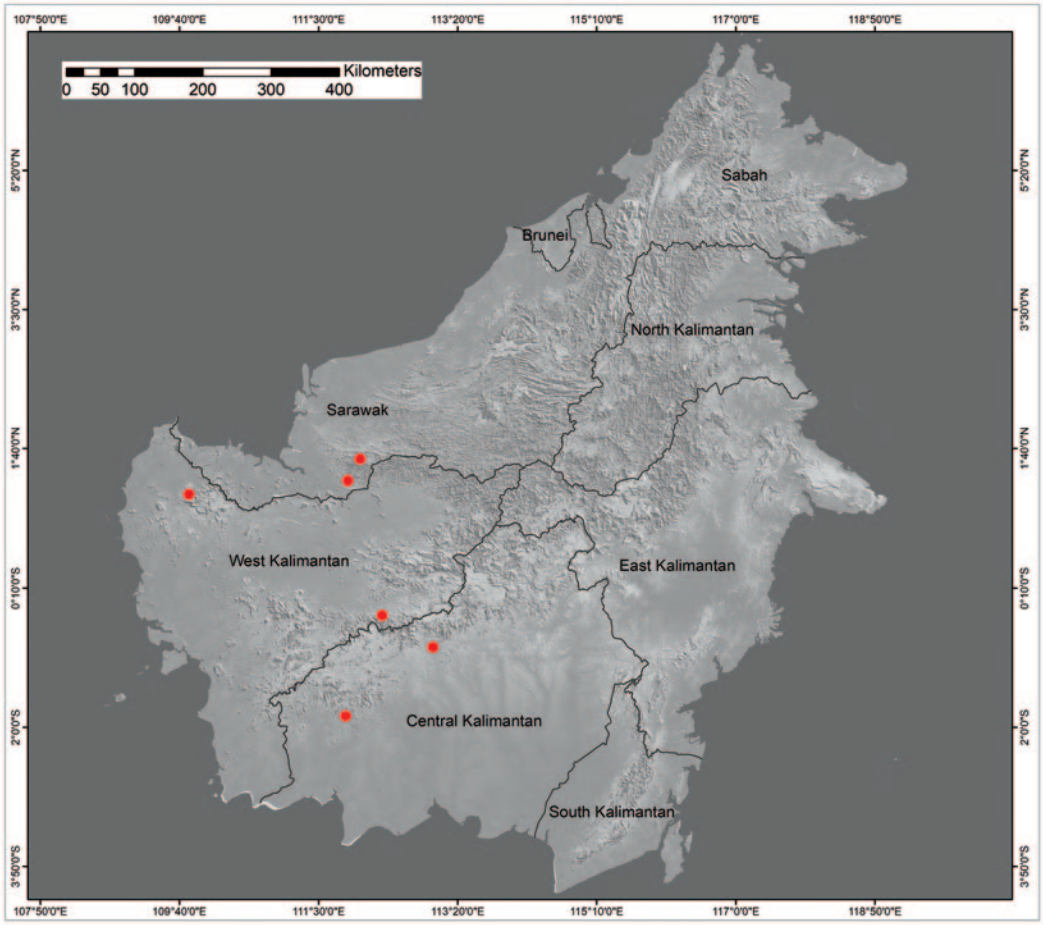
Etymology: The specific epithet "subterranea" is derived from the Latin word subterraneus, meaning "underground." This reflects the position of the stem, inflorescences and crownshaft below ground level.

Preliminary conservation status assessment: Least Concern (IUCN 2022). *Pinanga subterranea* is widespread throughout primary forests in Borneo and populations often have numerous individuals. Based on the Extent of Occurrence (EOO) this species also qualifies for the category Least Concern (EOO = 63,979.667 km^2). We used the EOO because the Area of Occupancy (AOO) is thought often to be a gross underestimate due to low collecting effort (AOO = 24 km^2) (Bachman et al. 2011). *Pinanga subterranea* is known at present in at least four protected areas in Borneo, which are Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park in Sarawak, and then in Gunung Niut Natural Reserve and Bukit Baka Bukit Raya National Park in Kalimantan. An ex-situ conservation initiative has been undertaken since 2017 being cultivated at the Arboretum Sylva UNTAN Pontianak.

Additional examined specimens: MALAYSIA. Sarawak: Sri Aman Division, outside the

4. *Pinanga subterranea*. Stem excavated by erosion. Note 'saxophone growth' of the stem. Photos by A. Randi from West Kalimantan.

boundary of Lanjak Entimau Wildlife Sanctuary, Lanjak Field Station, on other side of bridge, 278 m elev., 1°24'50"N, 112°0'18"E, 3 Nov. 2018, Petoe et al. 34 (K!, SAR); Sarawak: Mamau, Ulu Sg. Engkari, Batang Ai, Lubok Antu, 500 m elev., 14 Dec. 1994, Lai Shak Teck et al., S.68192 (K!, SAR). INDONESIA. West Kalimantan: Sintang Regency, HPH Km 70, NE of camp along main logging road and environs, 100 m elev., 0°51'53.6"S,



5. Distribution map of *Pinanga subterranea* (red dots indicate known occurrences).

112°13′29.9″E, 7 Apr. 1994, Church et al. 716 (BO, K!); West Kalimantan: Bengkayang Regency, Umbo Village in Gunung Niut Natural Reserve, 650 m elev., 1°3'12.55"N, 109°53'31.97"E, 6 Jun. 2017, Randi TCF 49 (WAN!, BO!); Central Kalimantan: Katingan Regency, Tumbang Habangoi Village, 340 m elev., 0°45'46.46"S, 112°58'34.16"E, 26 Nov. 2022, Randi 1093 (WAN!, BO!).

Discussion: Other than differences with *P. tenacinervis* as the most similar species mentioned in the diagnosis above, this species also differs from other acaulescent *Pinanga* species from Borneo, namely *Pinanga brevipes* Becc. (1886) in the unique combination of characters. *Pinanga subterranea* has a shorter petiole than the rachis, its stem, crownshaft and inflorescences are often completely subterranean, its leaflets are connected or separated by very short intervals, and its fruit are bright red when ripe, whereas *P. brevipes* has a petiole that is much longer than the rachis, its stem, crownshaft and inflorescences are aerial, the leaflets are distantly separated, and the fruits are black when ripe.

Pinanga subterranea also resembles *Pinanga acaulis* Ridl. (1905), an endemic of the Malay Peninsula. Both species are small, solitary, acaulescent, and have leaves that are entire or pinnate with few leaflets. However, *P. acaulis* has an unbranched inflorescence that is suberect to horizontal, whereas the inflorescence of *P. subterranea* is very rarely unbranched and entirely erect. Furthermore, *P. acaulis* has a short stem covered by old leaf sheaths that only appears to be buried; it is in fact aerial, with the whole of the inflorescence being clearly visible above ground.

Having observed populations of *P. subterranea* in the wild, we now understand why the stem, crownshaft and inflorescence are underground. Excavated plants show "saxophone growth" (Tomlinson 1990), with the stem growing initially downwards to a depth of 20–

30 cm and then upwards (Fig. 4). Internodes are highly condensed, so the stem remains buried entirely below the ground even in mature plants. Inflorescences are short and infrafoliar, and thus usually do not emerge above ground. In addition, organic litter accumulates around the stem by the widely spreading petioles and leaves. The litter then rots and is invaded by roots (which grow upwards into it), building up around the stem and crownshaft. Rain, which splashes sand and soil around, also plays a role. Together, these factors create the impression of the plant burying itself underground (Figs. 2 & 3). The inflorescence emerges within the soil and humus layer trapped around the stem and crownshaft, as if hiding the flowers and fruits that might reach the surface. We estimate the rate of accumulation of organic litter around plants is much faster than the growth of the plant itself. This mechanism may protect the inflorescence from predators. The pollination mechanism is still not known with certainty and requires further study. Besides that, a field observation from West Kalimantan found that wild bearded pigs dig up and eat the underground fruits. We have been able to grow *P. subterranea* from seeds retrieved from their faeces, demonstrating that they are effective seed dispersers (A. Randi, pers. obs. in 2017).

Acknowledgments

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Photo Feature

Kerriodoxa elegans is a dioecious species. Just occasionally, the neat separation of the sexes into male and female individuals seems to break down. In my garden in Puerto Rico one predominantly staminate individual also produces fruit. The inflorescence in right foreground is at anthesis while on the left an older one shows a few developing fruits. It has not determined if the fruits, which have been proven to be viable, result from female flowers mixed with the males, or if there are hermaphroditic flowers – flowers containing both gynoecium and pollen-bearing stamens.

Mike Dahme
Puerto Rico

The Retreat

Larry Noblick[1] and Andrew Street[1]

The Retreat (Figs. 1 & 2) is the former private residence and palm collection of Arthur C. Langlois. He and his wife, Margaret, loved palms and at one point, they were known for having one of the largest private palm collections in the world. Arthur also authored Supplement to Palms of the World with Margaret, a book that was preeminent at the time.

Arthur Langlois was born in 1902 in the Channel Islands, a British territory off the west coast of France. In 1922, he stopped off in the Bahamas on his way to British Guiana (Guyana), liked what he saw and decided to make his home there (Moore 1977). He first worked as a wireless operator in the Outer Islands but eventually joined the Public Works on New Providence Island. He was associated with the Water Department until his retirement in 1965 after 40 years of service (Gape 2017a, Moore 1977). He did such a fine job of supplying water to Nassau during World War II that he was honored by being made a Member of the British Empire (MBE) (Moore 1977).

Arthur married his wife Margaret in 1925 and the honey-moon couple settled into their new home and property, The Retreat, in August that same year. They worked diligently to fix up their 11-acre garden, when on June 25, 1926, they experienced their first hurricane with winds that exceeded 120 miles per hour. Margaret kept a diary and after the storm she wrote: "For three days I could not eat, then we set to work to see what we could save out of the ruins. With a sad heart, I watched them pull up what trees they could, the rest they destroyed." Barely had they begun to recover when another hurricane struck just a few months later on September 17th. Margaret writes: "Once more the garden was desolate. Once more heartache and pain. Again we worked. The same trees were hoisted back up. The props could not hold them against that wind." Just about a month had passed, when as they were rejoicing at the sight of a new green shoot on their royal palm, a third hurricane struck on October 20th. This storm was not as strong as the first two and they rushed out into the battering winds to save their plants from falling a third time.

That was not the last hurricane for the couple. The property was again left in ruins by a potent September 1928 hurricane (Gape 2017b). In Florida, that hurricane was named the Okeechobee Hurricane because it was responsible for a huge storm surge on Lake Okeechobee that caused the lake to slosh in tsunami-fashion out over its south side and drown more than 2,500 people under 20 feet of water.

With all that said, the Langlois's most destructive hurricane struck in 1929. It was a powerful, slow-moving hurricane with wind gusts of an estimated velocity of 180 miles per hour that passed directly over New Providence

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and Abacos Islands and lasted for three days (Gape 2017b). There was an hour of calm as the eye moved in slow motion over the small island, and then the damaging winds returned more powerful than before, reversing direction and ripping away a large portion of their home. After a terrifying three days, Margaret wrote (Gape 2017b): "On Thursday morning we woke to find no roof left on the bedroom, the library, and the small room adjoining the library. The drawing room rug was swimming in a foot of water and still it blew. We had nothing to eat as the pantry door had blown off and everything in it was wet. I remember Arthur trying to make a cup of tea over a candle and I begging him to let us sell and move away from such a terrible place." But the couple, now determined as ever, decided not to move. In spite of the property being hammered multiple times over the years, they managed to build and assemble one of the finest palm collections in the Caribbean (Figs. 3–5).

Arthur's interest in palms began as a hobby, but quickly grew into a passion. One of the few popular palm books available at that time was Palms of the World by James McCurrach (1957). Arthur corresponded with McCurrach, along with many other palm specialists of his day, and he and McCurrach planned on co-authoring a second book to include those genera not included in McCurrach's original Palms of the World. Arthur and Margaret personally met many famous botanists during their palm explorations and became charter members of the International Palm Society. In fact, Margaret Langlois (1957) was one of the first authors to publish in the very first volume of the Society's journal, Principes.

So it was that, during their free vacation time, Arthur and Margaret set out to find all the genera missing from McCurrach's book; they planned trips to many exotic and remote locations to collect and photograph these rare palms in their native habitats. Margaret was a great photographer. She composed and developed many of the photos herself (Gape 2017a). Their passion took them to British Honduras (Langlois 1957), Costa Rica, Madagascar, New Hebrides (Vanuatu), New Caledonia, Fiji, Western Samoa, and Trinidad. Several specimens were collected and sent to L.H. Baily and later to H.E. Moore at the L.H. Bailey Hortorium at Cornell University, where they are still preserved in the herbarium.

1. The Langlois's home, which now functions as The Retreat visitor's Centre.

2. The Langlois's home complex as seen through a portion of the palm collection.

Dr. David Fairchild was so impressed with the couple that he shared rare palms from his voyage on the Cheng Ho with Mr. and Mrs. Langlois, and they helped to grow many of these handsome palms to maturity – the beautiful *Areca langloisiana* (= *Areca vestiaria*) was among them. *Euterpe langloisii* (= *Euterpe precatoria* var. *precatoria*) from Trinidad also honors Arthur Langlois. He was also recognized as being the first to introduce *Schippia concolor* into cultivation (Moore 1977).

After years of documenting rare palm genera, Arthur was ready to write the final chapter to The Palms of the World, but in the interim McCurrach had passed away. Nevertheless, Arthur's friends encouraged and reassured him of his ability to write the book on his own, and so he did, bringing the final chapter to Palms of the World with the publication of Supplement to Palms of the World (Langlois 1975) just shortly before his death in 1977.

Today, the land is now part of the National Park System under the care of the Bahamas National Trust (BNT) and became a national park in 1985, upon the death of Margaret Langlois. It was the first national park established on New Providence Island. The Retreat was originally on the outskirts of the city of Nassau, but the popular tourist city has now surrounded it, resulting in a green paradise favored by migrating birds and other native and non-native wildlife. The 11-acre garden consists of natural upland vegetation referred to as coppice, a highly diverse woodland in the Bahamas including native trees and shrubs of Gum elemi, Poisonwood, Silk Cotton, Logwood, Lignum vitae, Five Finger, Cancer Bush, Sage, Brasiletto, Horseflesh, Sapodilla, Mahogany and Red Cedar (Gape 2017a). The garden also includes a few other exotic trees and an exceptional collection of palm species.

In order to preserve The Retreat and its valuable living palm collection from developers, Arthur and Margaret Langlois donated one half of the property value of their property to the Bahamas National Trust (BNT) in 1975, and a rich philanthropist, Sir Jack Hayword with other donors, donated the rest of the property to the BNT in the early 1980's (Gape 2017a). Upon Margaret's death in 1985, their 150 year old wooden home became the headquarters for the BNT (Figs. 1 & 2), and

3. Andrew regarding an impressive *Copernicia baileyana* and a *C. macroglossa* palm

4. The beautifully ringed stems of *Chrysalidocarpus cabadae*.

5. One of the green spaces at The Retreat surrounded by original palm plantings.

later became the Visitor's Centre for The Retreat. The BNT headquarters was officially opened in 1985 by Prince Philip, Royal Patron of the Bahamas National Trust (Lynn Gape, pers. comm.).

Lynn Gape (2017a), Deputy Executive Director, reported that over 170 rare and exotic palms representing more than half of the known palm genera were known to have flourished at The Retreat. Many of these palms are planted in natural solution holes in the limestone coral rock (Figs. 6–8), which are continuously enriched by nutrients from fallen leaves, shaded by the surrounding coppice trees.

6. A typical solution hole in the coral rock ready to receive a palm.

For Montgomery Botanical Center (MBC), our involvement with The Retreat started with a dying palm. In 2022, Lynn Gape emailed to us an image of a dying *Phoenicophorium borsigianum*, known as the Thief Palm, originally collected from the Seychelles and a featured palm in the garden. After noting the missing spear leaf and sad state of the palm, Andrew and I sadly determined that it was too late to save the palm. We had already planted out the last of our wild-collected *Phoenicophorium borsigianum* specimens at MBC and had no more to share, but we offered them some other Seychelle palms that we were happy to be able to share, mainly *Deckenia nobilis* and *Nephrosperma vanhoutteanum*. They

7. *Licuala grandis* occupying a shallow solution hole.

8. *Arenga undulatifolia* occupying a deep solution hole.

9. An idyllic trail through the palms and coppice forest.

10. A peaceful stream flowing through the forest.

11. The vine pergola and other plantings bordering the Pergola Lawn at The Retreat.

12. A juvenile *Deckenia nobilis*, donated by MBC, finding a new home at The Retreat.

made arrangements to ship the donated specimens from Florida to The Retreat and invited us to come to The Retreat for a ceremonial planting of the six donated palm specimens and to give a talk on palms to celebrate Earth day in April 2023.

The garden is quite natural looking with its native flora and has a number of trails (Fig. 9) that loop through the native coppice trees and palm specimens. The trails circle through the forest passing water features (Fig. 10) with planted palms flourishing in naturally formed

solution holes and occasionally the trails lead into small exposed green spaces and lawns with attractive plantings, such as the vine pergola (Fig. 11), all very artistically designed by the Langlois's and currently preserved by the BNT. We were glad to have been able to make our small palm donation to The Retreat, where the palms have found a new home (Fig. 12).

Acknowledgments

We extend our thanks to Lynn Gape of the Bahamas National Trust for providing us with additional historical information on Arthur and Margaret Langlois, to her and Chantal Curtis for arranging our accommodations in the Bahamas and to our driver, Mr. Gregory Rolle, who hauled us back and forth between the airport, hotel and The Retreat. We would also acknowledge Dr. Joanna Tucker-Lima for her valuable edits and suggestions.

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Chrysalidocarpus canaliculatus and its Relatives

JOHN DRANSFIELD[1], WOLF L. EISERHARDT[2], JEFF MARCUS[3] AND WILLIAM J. BAKER[1]

The three species of *Chrysalidocarpus* discussed in this paper are among the largest species of palm in Madagascar and perhaps not surprisingly are poorly represented in herbarium collections.

These *Chrysalidocarpus* species share a highly distinctive seed type. The seed is black and marked with deep, sinuous grooves except at the rounded hilum. In one species, *C. bejofo* (Beentje) Eiserhardt & W.J.Baker, cross section of the seed displays almost regular deep grooves penetrating the otherwise homogeneous endosperm. In the other two species, not only is the endosperm regularly penetrated by the grooves in the black seed coat, but it is also irregularly ruminate. In the recent phylogenetic analysis of the Dypsidinae (Eiserhardt et al. 2022), the three taxa form a well-supported, monophyletic group that is most closely related to a group comprising *C. lastellianus* (Baill.) Eiserhardt & W.J.Baker, *C. leptocheilos* (Hodel) Eiserhardt & W.J.Baker, *C. mijoroanus* (Eiserhardt & W.J.Baker) Eiserhardt & W.J.Baker and *C. nauseosus* (Jum. & H. Perrier) Eiserhardt & W.J.Baker. The distinctive seed type, not known elsewhere in the genus appears thus to be a phylogenetically robust character. According to the phylogenetic analysis, all *Chrysalidocarpus* with deeply grooved seeds could in principle be viewed as a single morphologically variable species, *C. canaliculatus* (Jum.) Eiserhardt & W.J.Baker. However, we argue that there are three distinct morphological entities within this group, which we recognize as separate species including one which is newly described in this paper.

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Deeply grooved seeds imported from various sources have entered cultivation mostly under the name of *Dypsis bejofo*, but also as *Dypsis aff. bejofo* and *Dypsis* "bejoufa" and *Dypsis* "bejouf." Now that collections have reached maturity it has been possible to assess their identity. Many cultivated specimens do indeed seem to match *Chrysalidocarpus bejofo* (as *D. bejofo* is now correctly known), a species that is becoming better understood now that more collections have been made from the wild. Of

1. Soejatmi Dransfield beneath a mature tree of *Chrysalidocarpus titan* outside the property of Jerry and Cindy Andersen, Lelani Estates, Hawai'i (Photo: J. Dransfield).

2. *Chrysalidocarpus titan* at Floribunda Palms and Exotics, Hawai'i (Photo: W.J. Baker).

3 (top). *Chrysalidocarpus titan*, detail of basal part of leaf . 4 (bottom). Detail of mid part of leaf (Photos: W.J. Baker).

C. canaliculatus, we still have only three verified herbarium collections, and the palm has not been seen recently in the wild. It is unknown in cultivation. A third taxon, known under the moniker *Dypsis* "bejoufa," is represented by several individuals in cultivation in Hawai'i (Back Cover; Figs. 1 & 2) and it has become apparent that it is distinct from *C. bejofo* and *C. canaliculatus* in a number of characters that have provided justification for the description of a new taxon, *C. titan*.

Chrysalidocarpus titan *J.Dransf., Marcus & W.J.Baker,* **sp. nov.**

Massive palm with black deeply sinuously grooved seeds, differing from the other species in the genus with such seeds (*C. canaliculatus* and *C. bejofo*) in the subregular moderately

5. *Chrysalidocarpus titan*, crown with mature infructescence (Photo: W.J. Baker).

plumose leaflets (rather than strongly grouped highly plumose leaflets), ramenta on the abaxial midrib surface very sparse or absent, the midleaf leaflets up to 8 cm wide (rather than to 4 cm) and the staminate flowers with 12 rather than six stamens (stamen number

6. JM struggles to hold a complete infructescence of *Chrysalidocarpus titan* with ripe fruit (Photo: W.J. Baker).

not known for *C. canaliculatus*). Type: USA. Hawai'i, Island of Hawai'i, Mountain View, Floribunda Palms, Jan 2023, *W.J. Baker with J. Marcus and S. Marcus WB1475* (Holotype K).

Massive single-stemmed palm to 15 m tall in cultivation (so far). Stem 35–40 cm diam., internodes 15–25 cm, green in lower part of stem, covered in dense white wax distally. Crown of 8–12 leaves, held ± porrect, not drooping; crownshaft massive, 2–2.5 m long, ca. 60–70 cm diam., densely white-waxy over a buff surface; leaf sheath to 2 m long, abaxially white waxy and with scattered brown scales in exposed parts, shiny bright red brown at the base and adaxially; petiole 30–60 cm long, 10 cm wide, deeply channeled and with very sharp margins, abaxially covered in brown indumentum and white wax; leaf rachis 6.0–6.9 m long, deeply channeled in lower third, ridged distally, the margins sharp, distally rachis surface glabrescent; leaflets ca. 140–188 on each side of the rachis, irregularly arranged and plumose towards the base (Fig. 3), in distal 60% of blade ± regularly arranged (Fig. 4) and not plumose but held in different planes, acute, mid-leaf leaflets 104 × 8 cm, concolorous, glabrous adaxially and abaxially, with very few inconspicuous brown ramenta towards the base, absent on some leaflets, short inconspicuous sinuous transverse veinlets visible adaxially. Inflorescence infrafoliar (Figs. 5 & 6), spreading and somewhat hippuriform, ca. 110–220 cm long and with a spread of 90 cm, branched to two orders with ca. 40 first order branches, orange-yellow when newly emerged, basal-most first order branch the longest, to 120 cm long; peduncular bract 150 × 36 cm when open, fibrous, woody to 20 mm thick, with a prominent beak to 20 cm long; rachillae to 10 cm long, 4–5 mm diam. bearing triads throughout except towards the tips where bearing paired or solitary staminate flowers. Staminate flowers cream-colored at anthesis, 8 × 5 mm; calyx with 3, distinct imbricate sepals 4 × 5 mm, irregularly keeled, thick; petals 3, 3 × 1.5 mm, coriaceous; stamens 12, filaments 0.6 mm long, 0.2 mm wide at base tapering to very slender connective, fleshy, connective dark-colored in preserved material, anthers versatile 1 × 0.4 mm; pistillode columnar 1.3 × 0.3 mm. Pistillate flower globular ca. 5 × 5 mm; sepals 4 × 4 mm; petals ca. 4 × 4 mm; staminodes minute, irregular, ± triangular or toothlike, 9–12. Fruit ovoid (Fig. 7), 30–35 × 26–30 mm; epicarp greenish orange at maturity, ± smooth or slightly pebbled, splitting to expose the mesocarp (Fig. 7), mesocarp ca. 2–5 mm thick, slightly spongy with longitudinal fibers. Seed

7. Chrysalidocarpus titan, close-up of ripe fruit showing splitting pericarp (Photo: W.J. Baker)

8. Fruits and seeds of the holotype of *Neodypsis canaliculata* in the carpological collections in the Paris Herbarium. (https://mediaphoto.mnhn.fr/media/16534712311028sEwLxcTbeK3JyWQ). Cross section (9A) and vertical section (9B) of seed of *Chrysalidocarpus titan* (*Baker et al. WB1475*). 10a. Cross section (10A) and vertical section (10B) of seed of *Chrysalidocarpus bejofo* (*Dransfield JD6405*).

26 × 23 mm, black, ovoid with a short apical beak, the seed surface deeply and sinuously grooved, apart from at the circular hilum; endosperm deeply, irregularly ruminate; embryo sub-basal.

Specimens examined: USA. Hawai'i, Island of Hawai'i, Mountain View, Floribunda Palms, Jan 2023, *W.J. Baker with J. Marcus and S. Marcus WB1475* (Holotype K); 15 Feb 2015, *J. Dransfield with J. Marcus and S. Dransfield JD7801* (K). Pahoa, near Hilo, Andersen Garden, 16 Feb. 2015, *J. Dransfield and S. Dransfield JD7844* (K).

This enormous palm, one of the most robust in the genus, has been traded as *Dypsis* aff. "bejoufa." Individuals in cultivation have begun to flower and fruit, and the differences between it and *Chrysalidocarpus bejofo* and *C. canaliculatus* can now be more clearly appreciated.

The seed of *C. titan* is black and deeply channeled with sinuous grooves apart from at the rounded hilum. As mentioned above this unusual seed form occurs in *C. bejofo* and, we now know, also in *C. canaliculatus*. These are the only species in the genus to display such an unusual seed type. When P*alms of Madagascar* was published in 1995, the palm now known as *Chrysalidocarpus canaliculatus* was known from just three specimens, none of which apparently had fruit. Recently images of carpological specimens in the Paris

11. Mature individual of *Chrysalidocarpus bejofo* showing the highly plumose leaves with narrow leaflets, Analalava, eastern Madagascar (Photo: J.Dransfield).

Herbarium have become available online, including fruit of the type of *Neodypsis canaliculata* (= *C. canaliculatus*) (https://mediaphoto.mnhn.fr/media/16534712311028sEwLxcTbeK3JyWQ) (Fig. 8). The black seeds with sinuous grooves are clearly shown and it seems highly likely that Jumelle was referring to the grooved seed when he coined the species epithet rather than the deeply channeled petiole as was suggested in *Palms of Madagascar*

(Dransfield & Beentje 1995). These seeds are, measured from the image, globose, about 21 mm diam. and the endosperm appears to be deeply penetrated by the grooves but also ruminate. The endosperm of all three taxa is deeply penetrated by the grooves in the surface of the black seed coat (Figs. 8–10).

Chrysalidocarpus canaliculatus remains very poorly known and based on very imperfect herbarium specimens. Nevertheless, it can be separated from *C. bejofo* by vegetative characters. *Chrysalidocarpus titan* also has distinctive vegetative features which allow easy separation, but in addition the 12, rather than six, stamens are unique among all species of the genus where we have data on stamen number.

Thus, we believe we have ample evidence for recognizing *C. titan* as undescribed. The species epithet obviously refers to the very large size of this magnificent palm.

These three species of *Chrysalidocarpus* with black, deeply grooved seeds can be keyed out as follows:

1. Abaxial surface of the leaflet midrib with an almost uninterrupted row of conspicuous ramenta. Petiole lacking . . . . . *C. canaliculatus*

1. Abaxial surface of leaflet midrib with sparse ramenta or ramenta lacking. Petiole present. . . . . 2.

2. Leaflets strongly plumose in arrangement throughout the leaf, arranged in groups, in mid leaf up to 4 cm wide. Inflorescences at anthesis greenish white. Stamens 6. Seed 17–23 × 15–21 mm, the endosperm deeply grooved, slightly ruminate . . . *C. bejofo* (Fig. 11).

2. Leaflets irregularly arranged near the leaf base, ± regularly arranged in mid leaf, not conspicuously plumose, in mid leaf 5–8 cm wide. Inflorescences at anthesis golden yellow. Stamens 12. Seed to 26 × 23 mm, the endosperm deeply grooved and also irregularly ruminate . . . . . *C. titan*

Seeds of *C. titan* were originally bought by JM from the late Australian nurseryman Rolf Kyburz under the name of *Neodypsis* sp "Bejoufa." Kyburz's main contact in Madagascar was the seed merchant Gunther Gottlieb. JM bought a further 75 plants from Australian nurseryman Stan Walkley in 1995 and 1996, legally imported into Hawai'i. These plants were sold and distributed in Hawai'i and represent the source of all mature *C. titan* in cultivation in Hawai'i.

Chrysalidocarpus titan grows much faster than *C. bejofo*. The eophyll of *C. titan* is bifid whereas that of *C. bejofo* is pinnate.

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WJB thanks the Merwin Conservancy and the Hawaii Island Palm Society for funding and facilitating his travel to Hawaii (especially Sonnet Coggins, Sara Tekula and Mary and Michael Lock) during which key observations and specimens were made.

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Chrysalidocarpus hankona

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Among the many Madagascar palms in the extraordinary collection at Floribunda Palms and Exotics at Mountain View in Hawai'i is a species of *Chrysalidocarpus* with the moniker *Dypsis* "hankona," long recognised by JM as being distinct (Figs. 1 & 2) We have been unable to match this with any described species and describe it here as new.

Chrysalidocarpus hankona *J.Dransf, Marcus & W.J.Baker* **sp. nov.**

In the sheaths and leaflet arrangement somewhat reminiscent of *Chrysalidocarpus hovomantsina* (Beentje) Eiserhardt & W.J.Baker but differing in the conspicuous triangular rachilla bracts unlike those of any other species in the genus; fruit spherical, the stigmatic remains forming a lateral narrow rigid beak not seen elsewhere. Type: USA. Hawai'i, Island of Hawai'i, Mountain View, Floribunda Palms, Jan 2023, *W.J.Baker with J. Marcus and S. Marcus WB1478* (Holotype K).

Robust solitary tree palm ca. 8 m tall. Stem 21 cm diam., internodes brown, closely spaced. Crownshaft swollen, ca. 1.75 m long, gray white. Leaves 11 in crown, somewhat arching, to 370 cm long, including the petiole to 70 cm long; leaf sheath c. 1.5 m long, abaxially densely covered in thick waxy grey-white indumentum and scattered black hairs; rachis densely covered with indumentum as the sheath; leaflets 151 on each side of the rachis, stiff, tending to bend at about 3/4 their length, irregularly arranged in close groups of 2 to 8, diverging at an acute angle from the rachis and held in many planes giving the whole leaf a strongly plumose appearance (Figs. 3 & 4); basal-most leaflets ca. 80 × 2.5 cm; midleaf leaflets ca. 82 × 4 cm; apical leaflets ca. 48 × 1.5 cm; leaflets somewhat discolorous, mid green adaxially, abaxially with thin white wax, both leaflet surfaces with abundant punctiform brown scale along all main veins, ramenta absent, grey floccose caducous indumentum present along main ribs and leaflet margins. Inflorescence (Figs. 5 & 6) infrafoliar, 140 cm long including peduncle 30 cm long, branched to 2 orders; prophyll leathery, 24 × 11 cm, strongly 2-keeled and with a rounded triangular beak, the surface covered in dense

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1. *Chrysalidocarpus hankona*, growing at Floribunda Palms and Exotics, Hawai'i (Photo: W.J. Baker).

2. *Chrysalidocarpus hankona,* crown with inflorescences (Photo: W.J. Baker).

3. *Chrysalidocarpus hankona*, crown with leaves (Photo: W.J. Baker).

4. *Chrysalidocarpus hankona*, leaf to show leaflet arrangement (Photo: W.J. Baker).

5. *Chrysalidocarpus hankona*, young infructescence (Photo: W.J. Baker).

dark scales and white wax; peduncular bract 50 × 25 cm, leathery, with a beak ca. 6 × 2 cm, the abaxial surface with abundant scattered dark brown scales and abundant white wax; rachis oval in cross section, near the base 6 × 2.5 cm, with ca. 50 primary branches, the branches somewhat distorted, the longest (at the base) to 85 cm long; rachillae 5–31 cm long, 1–5 mm diam., glabrous, green, with thin white wax, bearing very conspicuous, thick, rigid, narrow triangular acuminate rachilla bracts (Fig. 7), those at the base of the largest rachillae 25 × 2 mm but most bracts ca. 5 × 2 mm or smaller, the bracts somewhat curved, adaxially channelled, glabrous. Staminate flower with sepals 3, 2 × 1 mm; petals 3, 4.5 × 1.5 mm; stamens 6, filaments 2 × 0.1 mm, anthers sagittate 1.2 × 0.5 mm; pistillode narrow pyramidal, 1.5 × 1 mm. Pistillate sepals in fruiting stage 4 × 2.5 mm; pistillate petals in fruiting stage 7 × 6 mm, young developing ovary with a pronounced lateral beak bearing stigmatic remains. Fruit spherical, shiny green to brown, 15 mm diam., the stigmatic remains lateral to subbasal, ± prominent in a conspicuous beak to 3.5 × 1 mm (Figs. 7 & 8); epicarp smooth, glabrous; mesocarp ca. 1 mm thick; endocarp thin. Seed spherical, 11 mm diam.; endosperm homogeneous; embryo lateral.

Specimens examined: Type: USA. Hawai'i, Island of Hawai'i, Mountain View, Floribunda Palms, Jan 2023, *W.J.Baker with J. Marcus and S. Marcus WB1475* (Holotype K); 15 Feb 2015, *J. Dransfield with J. Marcus and S. Dransfield JD7804* (K).

It has not been possible to match this palm with any described species (Dransfield & Beentje 1995). The rigid, persistent triangular rachilla bracts diverging at right angles from the rachillae give a very distinctive appearance to the rachillae, unlike any other species of *Chrysalidocarpus* (but note that the illustration in *Flore de Madagascar* of *Neodypsis compactus* [= *Chrysalidocarpus baronii*] shows somewhat similar conspicuous bracts) (Jumelle & Perrier 1945). Furthermore, the stigmatic remains on the fruit form a slender rigid lateral beak, unlike that of any other species in the genus.

Seed of *Chrysalidocarpus hankona* was acquired by JM in the 1990s from the late Inge Hoffmann, who operated a small commercial palm seed bank. She dealt exclusively with the late Alfred Razafindrasira in Madagascar. *Chrysalidocarpus hankona* is a rather slow-growing palm when cultivated in pots but once in the ground develops rapidly.

6. *Chrysalidocarpus hankona*, JM holds whole inflorescence (Photo: Suchin Marcus).

7 (top). *Chrysalidocarpus hankona*, detail of rachilla showing conspicuous pointed rachilla bracts and developing fruit with prominent stigmatic beaks. 8 (bottom). Close-up of immature fruit showing prominent beaks (Photos: W.J. Baker)

Acknowledgments

WJB thanks the Merwin Conservancy and the Hawaii Island Palm Society for funding and facilitating his travel to Hawaii (especially Sonnet Coggins, Sara Tekula and Mary and Michael Lock) during which key observations and specimens were made.

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Photo Feature

1. *Brahea brandegeei* in Cañon Tabor. The islands in the background are Isla Danzante and Isla Carmen in the Gulf of California (or Sea of Cortez).

The canyons of the Baja California Peninsula are harsh but beautiful habitats for palms. *Brahea brandegeei* was photographed in Cañon Tabor, near Bahia Puerto Escondido (Figs. 1–3). *Washingtonia robusta* was photographed in Arroyo de las Parras on the road to Mission San Javier (Figs. 4 & 5). Both locations are within twenty miles of Loreto, Baja California Sur, Mexico. Curiously, there was no species overlap between these two canyons – in other words, Arroyo de las Parras was pure *Washingtonia robusta* and Cañon Tabor was pure *Brahea brandegeei*. There is another canyon farther to the south (Cañon Mesquite) that has both species. That canyon had few mature palms but showed extensive seedling recruitment. I think that it had been scoured by a tropical storm or hurricane a few years ago, so that the only mature palms were well up on the canyon walls and starved for water.

Gregg Hamann
San Diego, California

2. *Brahea brandegeei,* Cañon Tabor.

3. *Brahea brandegeei*, Cañon Tabor.

4. *Brahea brandegeei,* Cañon Tabor.

5. *Washingtonia robusta* in Arroyo de las Parras.

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