

PALMS

Journal of the International Palm Society

Vol. 70(1) Mar. 2026



THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

Founded in 1956 by Dent Smith

The International Palm Society is a nonprofit corporation engaged in the conservation, preservation, and study of palms. The society is international in scope with worldwide membership, and the formation of regional or local chapters affiliated with the IPS is encouraged. Please address all inquiries regarding membership or information about the society to The International Palm Society Inc., 1401 Lavaca St. #751, Austin, Texas 78701 USA, or to info@palms.org.

Executive Committee:

President: Andy Hurwitz, ashcvts@icloud.com

Vice President: Mary Lock, marylock@sbcglobal.net

Immediate Past President: Robert Blenker, Robert.Blenker@gmail.com

VP Finance: Jeff Brusseau, jbrusseau@newportnational.biz

Treasurer: Tom Jackson, jacksongrantgallery@outlook.com

At Large: Horace Hobbs, horacehobbsjr@gmail.com

Directors:

2022–2026:

Cindy Adair*, Puerto Rico.
William J. Baker*, UK.
Norm Bezona, HI, USA.
Julie Cleaver Malzoni, Brazil.
John Dransfield*, UK.
Glenn Franklin*, NC, USA.
Len Geiger, CA, USA.
Ray Hernandez, FL, USA.
Horace Hobbs*, FL, USA.
Andy Hurwitz*, CA, USA.
Chuck Malloy, TX, USA.
Mary Lock*, HI, USA.
Paco Martí Navarro, Spain.
Jill Menzel*, Brazil.
Fernando Roca, Peru.
Tobias Spanner, Germany.
Andrew Street, FL, USA.
David Tanswell, Australia.

2024–2028:

Robert Blenker, FL, USA.
Juliano Borin, Brazil
Jeff Brusseau*, CA, USA.
Jason Dewees, CA, USA
Anthony Glomski, CA, USA.
Gregg Hamann, CA, USA.
Haresh*, India.
Susan Hubbell*, FL, USA.
Tom Jackson*, CA, USA.
Leland Lai*, CA, USA.
Chuck Malloy, TX, USA.
Boyd Marts*, SD, USA.
Michael Merritt, HI, USA.
Romeo Montalvo, TX, USA.
Lazaro Priegues*, FL, USA.
Grant Stephenson, TX, USA.
Michael Valentine*, CO, USA.
Colin Wilson, Australia.
Scott Zona*, NC, USA.

*Benefactor

Website: www.palms.org. The IPS website includes information on the history and organization of the society, past and future travel, publications and the IPS Bookstore, affiliate chapters, and the link to our popular on-line forum, PalmTalk.

 @InternationalPalmSociety

 @thepalmsociety

 @IPS_PalmSociety

Palms (formerly PRINCIPES)

Journal of The International Palm Society

Publication of PALMS is made possible by a generous gift from Drs. Kathleen Grant and Tom Jackson.

PALMS (ISSN 1523-4495) is an illustrated, peer-reviewed quarterly devoted to information about palms and published in March, June, September and December by The International Palm Society Inc., 1019 S. Central Ave., Glendale, CA 91204 USA.

Periodical postage paid at Glendale, CA and additional mailing offices. Postmaster: Send address changes to PALMS, The International Palm Society Inc., 1401 Lavaca St. #751, Austin, Texas 78701 USA.

Editors: William J. Baker, w.baker@kew.org
Scott Zona, scott.zona@yahoo.com

Associate Editor: John Dransfield, j.dransfield@kew.org

Guidelines for authors are available upon request from the Editors, or on-line at:
<http://palms.org/resources/palms-journal/>

Membership Levels: Sign up or renew on-line at www.palms.org.

Free membership includes the monthly Newsletter delivered via email.

Electronic membership (US\$40 per year or \$100 for three years) includes the Newsletter and our journal, *PALMS*, in digital format.

Full membership (US\$60 per year or US\$150 for three years) includes the above plus a printed copy of *PALMS*. Dues include mailing of the journal by airlift service to addresses outside the USA

Benefactor (US\$5000) memberships are also available. Subscription price is US\$55.00 per year for libraries and institutions.

Change of Address: Send change of address, phone number or e-mail to The International Palm Society Inc., 1401 Lavaca St. #751, Austin, Texas 78701 USA, or to info@palms.org.

Claims for Missing Issues: Claims for issues not received in the USA should be made within three months of the mailing date; claims for issues outside the USA should be made within four months of the mailing date.

Mailed at Hanover, Pennsylvania 16 Mar. 2026
©2026 The International Palm Society

The full text of *PALMS* is available on EBSCO Publishing's database.

This publication is printed on acid-free paper.

8

The Discovery of a New Palm Species in Yunnan Province, China

J.W. QIN

12

Saving the Glorious *Sabinaria magnifica* with the IPSS. VIEIRA-URIBE, S.E.HOYOS-GÓMEZ, N. ECHAVARRÍA,
R. BERNAL & A. HURWITZ

22

Hawaiian *Pritchardia* — Species Delimitation and Genetic Diversity with a Focus on the Ko'olau Mountains of O'ahuV. KELLER, S. FAWCETT, C.P. WEBSTER, S. CHING &
C.D. BACON

37

Dypsis sanctaemariaeW.L. EISERHARDT, P. DE LIMA FERREIRA,
D. PEDERSEN, L. RAJA OVELONA,
M. RAKOTOARINIVO & W.J. BAKER

41

First Record of *Rhynchophorus palmarum* (Coleoptera: Curculionidae) Affecting *Latania lontaroides* in the Acapulco Botanical Garden, Mexico

O.S. GUERRERO-ELOISA & P. CASTRO-SIMÓN

46

***Itaya amicum* near Iquitos, Peru**

W.J. BAKER, M. LOCK & V. VARGAS PAREDES



THE INTERNATIONAL
PALM SOCIETY
Conserve. Learn. Grow.

FRONT COVER

Short-stemmed specimen of *Pritchardia martii* with a broad canopy and notably large leaves. See article by V. Keller et al., p. 22. Photo by V. Keller.

BACK COVER

Itaya amicum in dense, swampy rainforest southwest of Iquitos, Peru. See article by W.J. Baker et al., p. 46. Photo by M. Lock.

Features

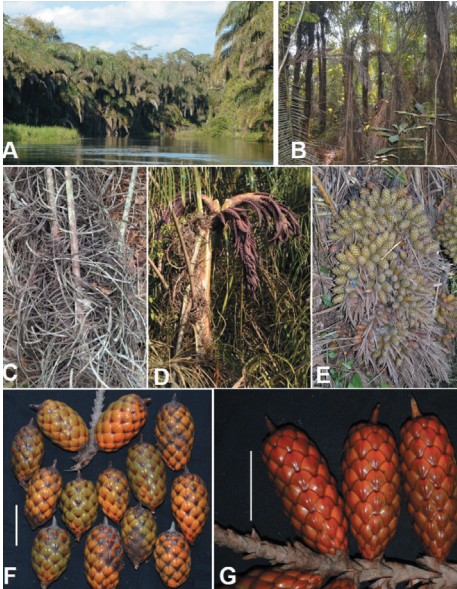
Palm News	4
Palm Profile	18
Patrons of the IPS	51



The contrasting fruit and infructescence axis of *Geonoma camana*. See article by W.J. Baker et al., p. 46. Photo by M. Lock.

PALM NEWS

An international team of botanists, led by J.C. Copete, has published a new species of *Attalea*, *A. taam*, from the Colombian Amazon. The palm, which the Cacua people eat and call “*táam*,” has prominent orange-brown young internodes, distinctive staminate flowers, and endocarps lacking fibers. Remarkably, it is a dominant canopy species in the region and an important food source for the Cacua, but it was heretofore totally unknown to science. The species was published in *Phytotaxa* 739: 83–93. 2026 and is open-access at DOI: 10.11646/phytotaxa.739.1.5.



Ndolo Ebika and colleagues have published a fascinating account of the genus *Raphia* in the Republic of the Congo. The country is home to seven species, all of which are used by local people for construction materials, food, wine, and/or fibers. The account includes expanded morphological descriptions of poorly known species, along with color photos and ethnobotanical data. Conservation assessments are also included. The paper is open access. Ndolo Ebika, S.T. et al. 2026. Synopsis of the genus *Raphia* P. Beauv. (Arecaceae, Calamoideae) in the Republic of the Congo. *PhytoKeys* 271: 37–71. <https://doi.org/10.3897/phytokeys.271.174506>

The Discovery of a New Palm Species in Yunnan Province, China

QIN JIAWEI¹

A new palm species from China, *Lanonia yunnanensis*, has been published recently. The identification process for this species and main differences between it and *L. dasyantha* are described herein.

In September 2023, Mr. Liu Xiangjin, sent me a photo of an understory fan palm growing on limestone from Gulinqing Township, Yunnan Province, China (Fig. 1). The leaf segments were wedge-shaped and the middle segment was unsplit, which led us to identify it as a species of the genus *Licuala*. Since *Licuala fordiana*, the only *Licuala* species in China, is distributed in Hainan and southern Guangdong, we suspected that this palm discovered in Yunnan might be a new species.

It was not until the Spring of 2024 that Dr. Kuang Renping and I visited Maguan County and Hekou County in southeastern Yunnan to investigate our suspected new species. We found two populations in tropical moist forest of Gulinqing Provincial Nature Reserve at the southwesternmost edge of China's karst

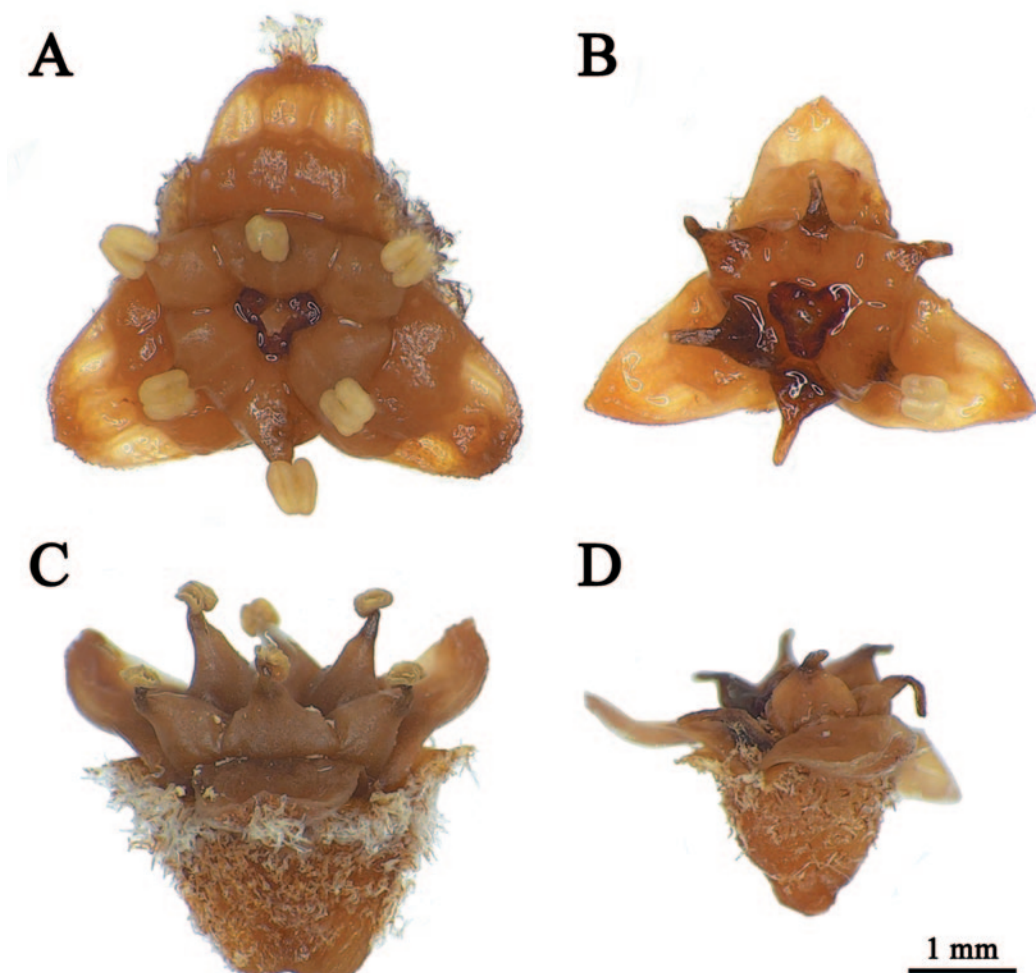
landform, with the help of Mr. Zhang Jinguo, a staff member from the management bureau of the reserve. One population was distributed in the Tropical Mountain Forest Eco-station in Southeast Yunnan, where the rock exposure rate was 44.73% (Liu et al. 2024), and the major tree species included *Parashorea chinensis*, *Pometia pinnata* and *Garcinia paucinervis*. The other population occurred on a limestone mountain named Jinchang, co-occurring with *Caryota monostachya* in a *Parashorea chinensis* and *Pometia pinnata* community. In the subsequent summer, another two populations were found in the karst region of Dawei Mountain National Nature Reserve, near Nanxi River. They occurred in *Burretiodendron tonkinense* forests, along with *Pinanga baviensis* and *Calamus* species. All populations were found on limestone soils and each population included 10 to almost 50 individuals.

On studying the palm in the field, we found that its inflorescences were dimorphic, with male and female inflorescences occurring on

¹Hunan Normal University,
Road Lushan 36#,
Changsha 410006, China
charwayq@hunnu.edu.cn



1 (top). A photo of an understory palm juvenile growing on the limestone. Photo by Liu Xiangjin. 2 (bottom). Pistillate inflorescence of *Lanonia yunnanensis*, showing its two partial inflorescences. Photo by Qin Jiawei.



3. Staminate flowers of *Lanonia dasyantha* (A, C) and *L. yunnanensis* (B, D). Photos by Qin Jiawei.

separate plants. Thus, we realized that the species in fact belonged to the genus *Lanonia*. Its rachillae were densely covered with hairs and the flowers were closely arranged spirally, features that are found in *Lanonia dasyantha*, which is distributed in northern Vietnam and adjacent areas of China, and is known to occur less than 10 km away. However, we noticed that this population had two partial inflorescences in most female plants (Fig. 2) and notably small flowers in male plants (Fig. 3). During previous surveys of *L. dasyantha* populations in Chinese counties along the Sino-Vietnam border, from southwestern Guangxi to southeastern Yunnan, I had never observed individuals or populations with traits like that, which are also not reported in descriptions in the literature (Henderson & Nguyen 2022), which state that *L. dasyantha* has only one partial inflorescence in female

plants and larger male flowers. Moreover, the accounts in *Flora of China* (Pei et al. 2010) and *Palms of Vietnam* (Henderson & Nguyen 2019) state that *L. dasyantha* grows on steep mountain slopes of granite or quartzite rocks, usually on non-limestone soils, just like the nearby populations that we have observed ourselves. In contrast, the unidentified palm grows on limestone soils (Fig. 4). These observations led us to believe that the unidentified palm was probably an undescribed *Lanonia* species.

To find more supporting evidence for the novelty of the palm, we DNA sequenced several genetic markers from four samples and integrated our new data with published data in a phylogenetic analysis. The resulting phylogenetic tree of *Lanonia* showed that our four samples, which came from three different populations, clustered together into a clade.



4. Comparison between *Lanonia yunnanensis* (left) and *L. dasyantha* (right). Top left: the upper side of the leaf of *L. yunnanensis*, with undivided central segment and relatively fixed segment number (5 or 7); top right: the upper side of the leaf of *L. dasyantha*, with split central segments and variable segment number (5–12); center left: the lower side of the leaf of *L. yunnanensis*, showing its continuous costa without pulvinus; center right: the lower side of the leaf of *L. dasyantha*, showing its costa with pulvinus, not continuous to the apex of the blade; bottom left: *L. yunnanensis* grows on limestone soils; bottom right: *L. dasyantha* usually grows on non-limestone soils. Photos by Qin Jiawei.



5 (top). Fruits of *Lanonia yunnanensis*. Photo by Qin Jiawei. 6 (bottom). Two-year seedlings of *Lanonia yunnanensis* (left) and *L. dasyantha* (right). Photo by Wang Chenxing.



7. Leaf comparison between *Lanonia yunnanensis* (left) and a variant individual of *L. dasyantha* that consistently produces leaves with unsplit central leaf segments (right). Photos by Qin Jiawei & Xu Deying.

Despite the numerous morphological similarities between it and *L. dasyantha*, molecular evidence points to a closer relationship with *L. calciphila*, rather than *L. dasyantha* (Chen et al. 2025). Based on this phylogenetic confirmation, we described the species as new-to-science (Chen et al. 2025), naming it *L. yunnanensis*. Since the fruits were not recorded when it was published, we provide additional information here based on fruits collected in November 2025: Fruits 13.2(9.5–20.0) mm long, 11.2(7.0–13.5) mm diameter, irregularly globose to ellipsoid, orange to red, with uneven, ridged surfaces (Fig 5).

In terms of vegetative organs, it is easy to distinguish *L. yunnanensis* and *L. dasyantha* by the shape and width of central segments, even during the seedling stage (Fig. 6). In rare cases, some individuals of *L. dasyantha* produce a leaf with an unsplit central leaf segment, but the next newly grown leaf generally displays a split. Even more rarely, variant individuals of *L. dasyantha* can consistently produce unsplit central leaf segments (Fig. 7), in which the central segments are 20 to 25 cm wide at the apex, i.e. twice as wide as that of typical individuals. The middle segments of *L. yunnanensis* are much wider (Fig 7), 47.5 (10.0–67.0) cm at the apex.

The discovery of this species holds significant meaning as the third *Lanonia* species native

to China. Over the past decade, only two newly described palm species (*Guihaia lancifolia* and *G. heterosquama*) and two newly recorded palm species (*Myrialepis paradoxa* and *Trachycarpus takil*) have been published from China (Luo et al. 2017, Wang 2018, Li et al. 2019, Ding et al. 2022). This latest find inspires us to continue exploring China's remote rainforests and karst regions in the hope of finding more new species.

Acknowledgments

I thank Mr. Liu Xiangjin, Mr. Wang Chenxing and Mr. Xu Deying for making their images available for this article. I would like to express my sincere gratitude to Prof. William Baker for providing insightful suggestions and amendments to the language of this paper.

LITERATURE CITED

- CHEN, S.Y., QIN, J.W., CHEN, Z.S. AND R.P. KUANG. 2025. *Lanonia yunnanensis* (Arecaceae), a new species from Yunnan, China. *Phytotaxa* 718: 123–132.
- DING, H.B., ET AL. 2022. Additions to the seed plant flora in Xizang, China. *Biodiversity Science* 30: 1–9.
- HENDERSON, A. AND BACON, C.D. 2011. *Lanonia* (Arecaceae: Palmae), a new genus from Asia, with a revision of the species. *Systematic Botany* 36: 883–895.

- HENDERSON, A. AND NGUYEN, Q.D. 2019. Palms of Vietnam. New York Botanical Garden, New York, USA.
- HENDERSON, A. AND NGUYEN, Q.D. 2022. A revision of *Lanonia* (Arecaceae, Coryphoideae, Livistoninae). Phytotaxa 532: 209–245.
- LI, X.Y., PENG, H., HE, X., LI, Z.N. AND WU, D. 2019. *Guihaia heterosquama*, a new species of coryphoid palm (Arecaceae) from Chongqing, China. Phytotaxa 405: 248–254.
- LIU, Q., ET AL. 2024. Floristic geography of woody plants in the big plot of Gulinqing karst forest in Yunnan Province. *Guihaia* 44: 1947–1960.
- LUO, K.W., XING, F.W. AND TIAN, J. 2017. Validation of the name *Guihaia lancifolia* (Arecaceae). Phytotaxa 298: 194.
- PEI, S.J., CHEN, S.Y., GUO L.X. AND HENDERSON, A. 2010. Arecaceae. Pp. 148–149, in WU, Z.Y., RAVEN P.H. AND HONG, D.Y. (EDS.) *Flora of China*, Volume 23 (Acoraceae through Cyperaceae). Science Press, Beijing, China.
- WANG, K.L. 2018. *Myrialepis*, a newly recorded genus in China. *Plant Science Journal* 36: 11–16.

Saving the Glorious *Sabinaria magnifica* with the IPS

SEBASTIÁN VIEIRA-URIBE¹, SAÚL E. HOYOS-GÓMEZ^{1,2}, NORMAN ECHAVARRÍA², RODRIGO BERNAL³ AND ANDY HURWITZ⁴

Sabinaria magnifica is a spectacular fan palm that was discovered in 2013 in the jungles of the Darién Gap, the border area between Colombia and Panama. Through the IPS Save the Species fundraising campaign, the Colombian NGO SalvaMontes created a reserve to protect this species and its surrounding forest, including at least 33 other palm species.

In November 2013, the palm world was stunned by the discovery of what some consider to be one of the world's most spectacular palms, *Sabinaria magnifica*. This medium-sized fan palm, the only known member of its own new genus, was found in the dense forests of the Darién Gap, on the

border between Colombia and Panama. For millions of years, this area has been the migration route of plant and animal species between North America and South America. Until recently, it was also a route of migration for thousands of people from many countries around the world, whose destination was the United States.

¹Corporación Salvamontes,
Calle 29 # 79 a 4,
Belén La Palma,
Medellín, Colombia.
sebastian@salvamontes.org

²Universidad de Antioquia, Medellín,
Colombia. saulhoyos@gmail.com,
norman@capurgana.net

³Reserva Natural Guadualito, Montenegro,
Quindío, Colombia.
rgbernal@gmail.com

⁴1019 S. Central Ave.,
Glendale, CA 91204 USA

As narrated by Bernal (2014), the palm was brought to the attention of palm specialists Rodrigo Bernal and Gloria Galeano by botanists Saúl Hoyos and Norman Echavarría. Moved by the exciting discovery and by the amazing beauty and diversity of the forests in the area, the four botanists involved in the discovery and description of the new genus started the process of acquiring a piece of land for establishing a conservation program for *Sabinaria magnifica*, something they intended to do as a private initiative. Eventually, they realized that undertaking such a project as a personal endeavour was unrealistic – if they bought the land, as they were about to do, they would have no resources for having at



1. (top). *Sabinaria magnifica* in its natural habitat. 2 (bottom). Forest inhabited by *Sabinaria magnifica*.



3. Inflorescence of *Sabinaria magnifica* with visiting bees.

least one ranger and for developing conservation activities in the area. Such a project was suitable for a conservation NGO, not just for individuals of goodwill. However, our positive energy gave us the confidence to keep this quixotic goal alive.

Two years later, in February 2016, a non-profit organization, the NGO SalvaMontes, was created by a team of Colombian naturalists and conservationists that included Saúl Hoyos himself. SalvaMontes' major activities were initially focused on the northern Andes, where

4. Map of the Sabinaria Natural Reserve, in northwestern Colombia.





5. New road between Capurganá and Acandí, in northwestern Colombia.

the organization now manages four reserves that protect 1,253 ha (3,096 acres) of cloud forest. Such an NGO was the kind of organization the discoverers of *Sabinaria* had envisioned as appropriate guardians of a reserve for the palm, but the right time had

not yet arrived. They kept dreaming. After several invitations to the board members of SalvaMontes, the team was finally convinced and went to the Darién to visit the *Sabinaria magnifica* habitat. All members were astonished by the forest and the uniqueness

6. El Brillante creek, one of the boundaries of the Sabinaria Natural Reserve.





7. Walter Restrepo (middle), our ally in the project, checking boundaries of the Sabinaria Natural Reserve with Norman Echavarría (left) and Sebastián Vieira (right).

of the place; there was no doubt for all of us that this place needed to be preserved quickly.

Then, in October 2020, Andy Hurwitz, then editor of the IPS Newsletter, contacted Rodrigo Bernal, suggesting the possibility that a Save the Species campaign led by the IPS, as the one just done in Madagascar for protecting *Tahina*, could be launched for *Sabinaria magnifica*. Rodrigo contacted SalvaMontes

through Saúl, and in their next meeting of the board of directors, the idea was unanimously embraced. The stars had aligned!

The Save the Species campaign for *Sabinaria* took place in November and December 2021. Approximately 30 donors supported the initiative, with contributions ranging from US\$25 to \$5,000. In total, \$22,090 were raised. Although this amount was not enough for



8. Recently logged tree surrounded by *Sabinaria magnifica*.

acquiring the 130 ha (321 acres) initially planned, it made an excellent starting point for SalvaMontes to get into the area and commence its conservation activities.

During late 2022 and early 2023, the staff of SalvaMontes reestablished talks with the owners of the properties to define the optimal strategy for investing the resources raised during the Save the Species campaign. The best move appeared to be getting control of the nearby La Paloma property, which has basic facilities, including, three cabins, a kitchen and a bathroom, but the current owners were not able to reach an agreement among themselves, so SalvaMontes moved on to the next best option, dedicating most of the raised funds to the acquisition of a 50 ha parcel of land, completely covered with pristine forests and crystal-clear creeks, and including a good portion of the *Sabinaria* population.

This area belonged to Walter Restrepo, a sawyer from Capurganá, the nearest village, who had expressed his deep interest in getting involved in the conservation project. He offered to sell the 50 ha piece of forest, and to contribute himself to the consortium another 50 ha plot he owns next to this one, thus doubling the size of the protected area.

During October 2023, Norman Echavarría and Sebastián Vieira (director of SalvaMontes) traveled to the Darién and visited the area with Walter. After hiking the area for two days and establishing the boundaries of the 50-ha plot, the agreement was finally sealed, and the Sabinaria Reserve became a reality.

The visit also let Norman and Sebastián witness some of the threats that are currently risking

the future of the forests in the area. A new road between Acandí and Capurganá was finished recently, which makes access to our area of interest increasingly easier; also, loggers are cutting the most valuable trees in some of the areas inhabited by *Sabinaria*. This makes the protection of existing habitat much more urgent and important, and the establishment of nature reserves is the most effective way to achieve this.

By securing these 50 ha and involving Walter in the conservation initiative, the Sabinaria Reserve now protects 100 ha (247 acres) of one of the most diverse forests in the Neotropics, more than 33 species of palms and a significant portion of the population of *Sabinaria magnifica*. This is one more achievement for the International Palm Society. We now expect to raise the necessary funds for hiring a forest guard and building basic infrastructure in the Reserve, so that research and nature tourism can be jointly developed, thus strengthening conservation of these wonderful palms.

Acknowledgments

We thank the International Palm Society for developing the *Sabinaria* Save the Species campaign. We are especially grateful to all who made donations to the campaign. We also thank Walter Restrepo for his positive attitude toward conservation and for his own involvement in the process.

LITERATURE CITED

BERNAL, R. 2014. The discovery of the amazing *Sabinaria magnifica*. *Palms* 58: 5–18.

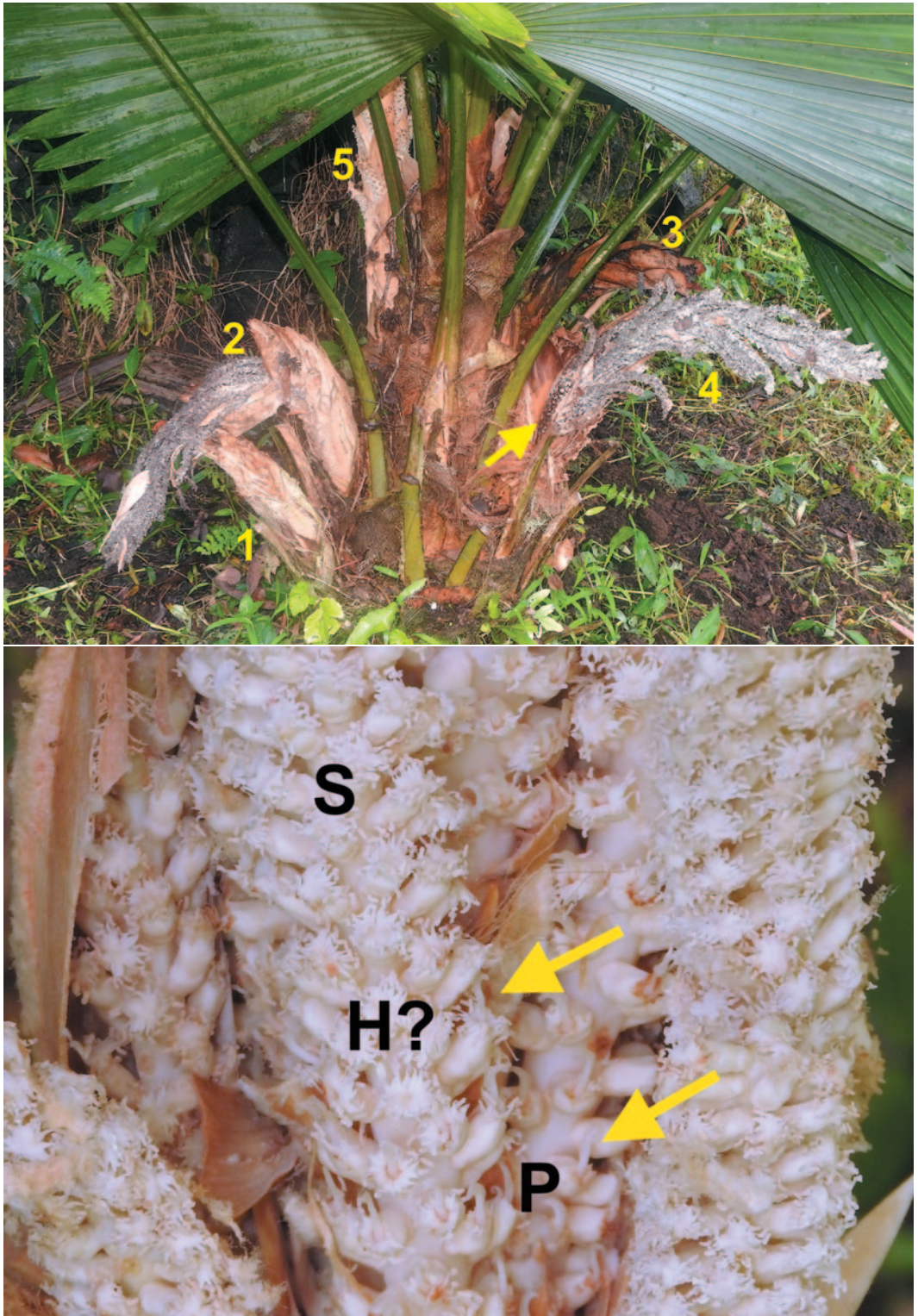
Palm Profile

Cultivated *Sabinaria magnifica* Flowering in Hawaii

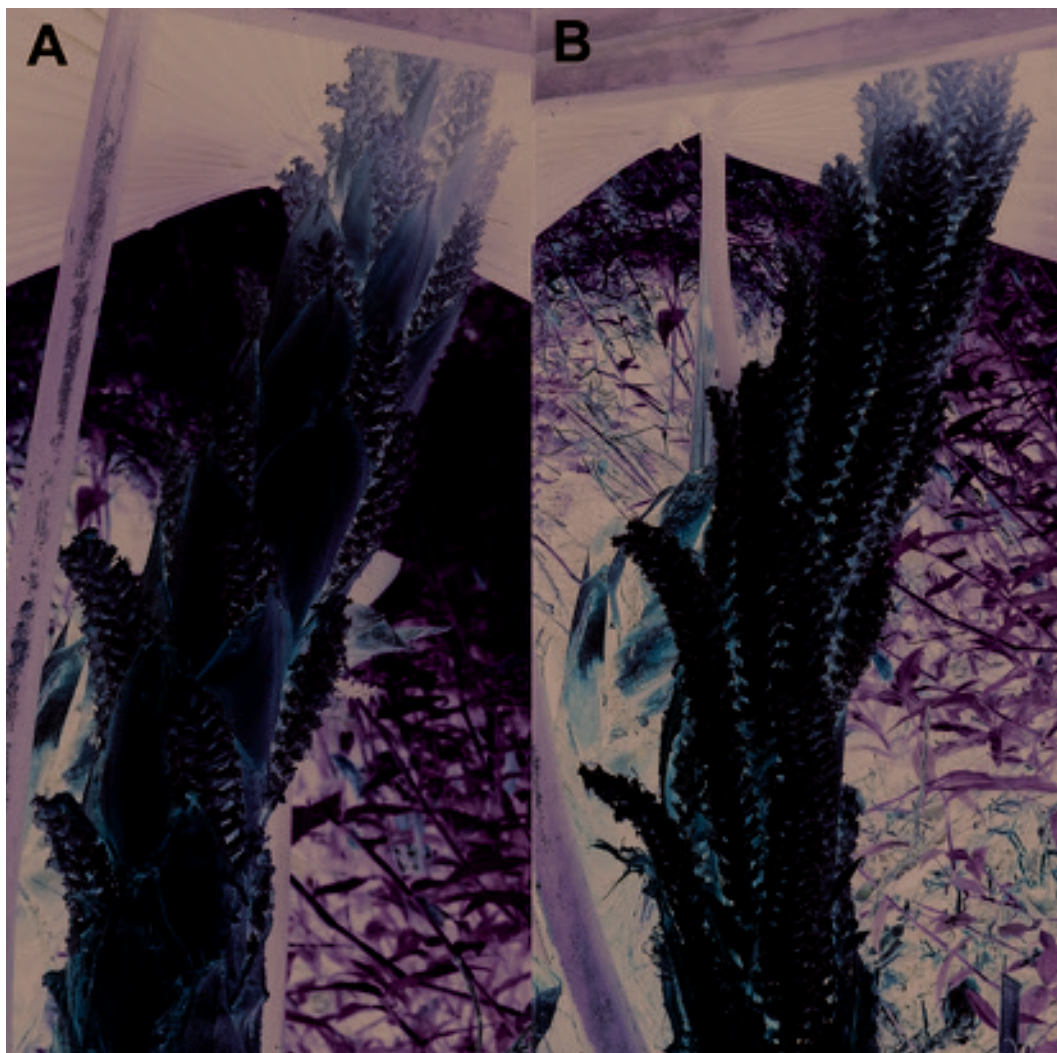
1. Cultivated *Sabinaria magnifica* eight years in the ground from the initial batch of seeds distributed from habitat. Height slightly over 2 m. Lower fronds cut away to expose inflorescences.



The spectacular *Sabinaria magnifica* was first reported growing in the remote Darien Gap in northern Colombia (Galeano & Bernal 2013, Bernal 2014). Seeds were distributed to growers around the world, and now cultivated specimens are flowering in several Hawaiian collections (Fig. 1). The first known inflorescence emerged in January 2025 with additional blooms emerging every few months (Fig. 2). Bernal (2014) reported that he had to examine dozens of individuals in habitat to find one blooming. The apparent tendency for cultivated specimens to bloom frequently might reflect the generous fertilizer that they receive. In the wild, flowers are visited by meliponine bees. However, Bernal (2014) discounted them as pollinators because the pistillate flowers, which are located at the base of the rachillae, are tightly concealed under bracts. Instead, small mystropine beetles able to penetrate the tight flower arrangement were suggested



2 (top). Close-up on inflorescences of *Sabinaria magnifica* that developed in 2025. 1) January 3, 2) January 22, 3) May 15, 4) November 4, 5) November 20. Arrows indicate aborted fruit shown in detail in Figure 5. 3. (bottom). Closeup showing staminate flowers (S) occupying most of each rachilla. Pistillate flowers (P) are found at the base. The central styles of pistillate flowers are visible (arrows). Some flowers found in the middle of rachillae appear to have both styles and anthers (H).



4. Inflorescence of *Sabinaria magnifica* that matured November 4, 2025, showing staminate flowers exposed distally. Basal flowers are covered by bracts (A). After the bracts are removed, pistillate flowers are visible at the base (B).

as more likely pollinators. Densely packed fruits develop deep at the base of leaf petioles (Galeano & Bernal 2013, Bernal 2014).

The photographs presented here (Figs. 3–5) illustrate the flowering habit in cultivation and attempts to artificially pollinate the flowers. Figure 4A shows a mature inflorescence with the distal staminate flowers exposed and bracts covering the lower flowers. Figure 4B shows the same inflorescence with the bracts removed exposing the basal pistillate flowers.

Figure 3 shows a close-up of flowers. Staminate flowers (S) display a ring of paired anthers but no style in the center. The most basal flowers are pistillate (P), lacking anthers, but having a central style resembling a swan's neck. Flowers located midway down the rachillae might have both male and female parts (H) although the anthers are not always visible either because they did not develop or were dislodged when the bracts were removed.

The first three inflorescences from one specimen were left unaltered but failed to produce fruit. Many non-native palms in Hawaii are pollinated by common honey bees, but so far bees have not been observed on cultivated *Sabinaria* flowers. Even if they visited the staminate flowers, it seems unlikely that they could penetrate the covering bracts to reach the pistillate flowers. Swarms of tiny gnats are drawn to the flowers, but again it is not clear if they might carry out



5. Close-up of base of *Sabinaria magnifica* inflorescence 16 days after attempted assisted pollination. Arrows indicate slightly swollen carpels where fruit should develop.

pollination. Assuming Hawaii lacks the natural pollinator, the bracts were removed to expose the pistillate flowers. Pollen was transferred to pistillate flowers using a small paint brush. Figure 5 shows the inflorescence sixteen days later. Although a few slightly swollen bodies were visible (arrows), they were easily dislodged by gentle touch suggesting they are not viable fruit.

At this point it remains unclear if failure to obtain fruit is due to the absence of an appropriate pollinator or the immaturity of the cultivated trees. The overall arrangement of the flowers is similar to *Marojejya*, which only sporadically produces fruit in Hawaii despite blooming profusely. Perhaps cultivated *Sabinaria* plants will also begin to produce fruit as they mature.

Acknowledgments

Rodrigo Bernal provided valuable feedback on an earlier draft of this manuscript.

RICK KELLEY
PO Box 1007 Pahoa,
HI 96778, USA
ricklkelley@att.net

LITERATURE CITED

- BERNAL, R. 2014. The discovery of the amazing *Sabinaria magnifica*. *Palms* 58: 5–18.
- BERNAL, R. AND GALEANO, G. 2013. *Sabinaria*, a new genus of palms (Cryosophileae, Coryphoideae, Arecaceae) from the Colombia-Panama border. *Phytotaxa* 144: 27–44.

Hawaiian *Pritchardia* — Species Delimitation and Genetic Diversity with a Focus on the Ko'olau Mountains of O'ahu

VIKTORIA KELLER^{1,2}, SUSAN FAWCETT³, CARMEN P. WEBSTER⁴,
SUSAN CHING⁵ AND CHRISTINE D. BACON^{1,2}

We report a recent expedition to O'ahu, Hawai'i to collect specimens of *Pritchardia*, the only palm genus native to Hawai'i. To infer species delimitations and gene flow patterns in the genus, leaf material was collected across the Ko'olau mountains. Five sites were visited that varied in environmental conditions and had plants with differing morphology. Additional individuals were sampled from wild-collected material in cultivation, spanning the geographic range of the four species of *Pritchardia* in the Ko'olau. In addition to the sampling efforts, the expedition provided also insights into Hawaiian cultural heritage and ecology.

Remote islands are particularly well suited for studying evolutionary processes as, due to their isolated nature, ecological niches are often filled by diversification of the species present, rather than by continued colonization of new species (Losos & Ricklefs 2009). At the same

time, this geographic isolation causes islands to be especially susceptible to human impacts, including invasions by non-native plant and animal species (Nogué et al. 2017).

Polynesia is a remote island complex located in the Pacific Ocean and encompasses more than 1,000 oceanic islands and island groups. The region harbors exceptional plant endemism and is a hotspot of biodiversity

¹Department of Biological and Environmental Sciences,
University of Gothenburg, Box 461,
SE-405 30 Gothenburg, Sweden

²Gothenburg Global Biodiversity Centre,
Box 461, SE-405 30,
Gothenburg, Sweden

³National Tropical Botanical Garden,
3530 Papalina Road,
Kalāheo, HI 96741 USA

⁴School of Life Sciences,
Arizona State University,
Tempe, Arizona USA

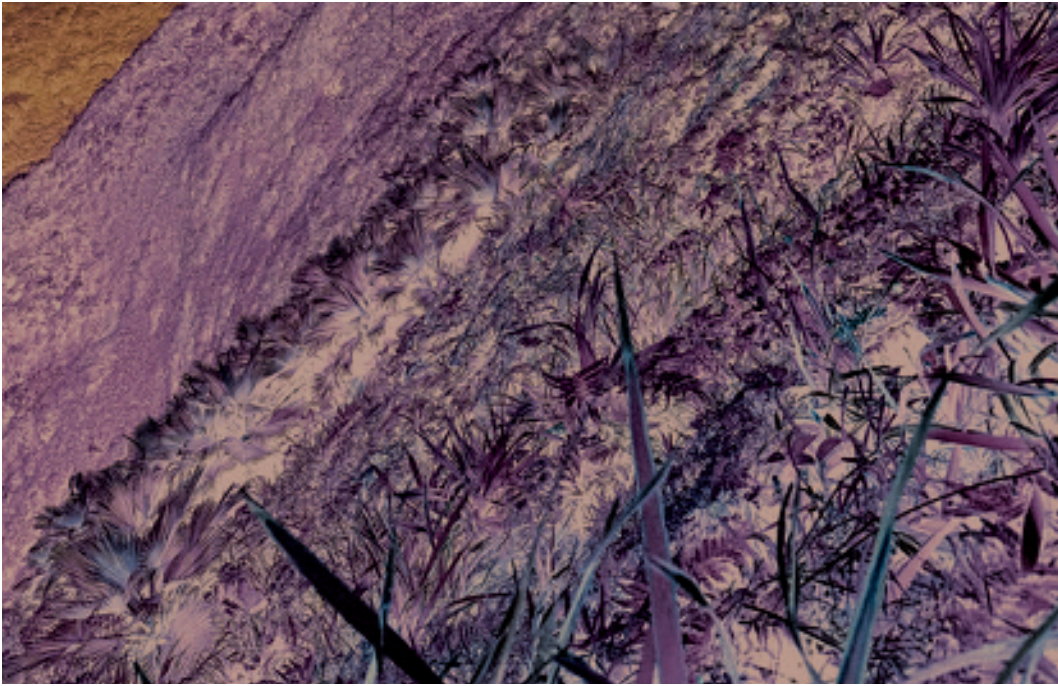
⁵Hawaii Division of Forestry & Wildlife,
Department of Land & Natural Resources,
2551 Waimano Home Road, Room 202,
Pearl City, HI 96782, USA



1. *Pritchardia martii* growing at low altitude, dominated by non-native species. Photo by V. Keller

(Myers et al. 2000). However, following human arrival, Polynesian islands experienced substantial ecological transformation (Burney & Kikuchi 2006).

The first wave of human movement to Polynesia took place approximately 1,000 years ago from Samoa and Tonga west towards the Society Islands (Kirch 2011, Wilmshurst et al.



2. *Pritchardia martii* individuals growing in dense clusters along a steep slope within the Ko'olau Range. Photo by V. Keller.

2011). Forests were cleared for communities and the cultivation of introduced crops, which also led to the establishment of non-native plants and animals (e.g. rats, pigs) that further disrupted native ecosystems (Whistler 2009, Burney & Kikuchi 2006, Prebble & Wilmshurst 2009). In the case of the Hawaiian Islands, western settlement, starting in 1778, led to further forest reductions through increased development, coupled with higher associated land-use change for agricultural purposes and the continued introduction of non-native species such as goats and cattle (Gillespie et al. 2008, Hodel 2012).

The Hawaiian archipelago stands out as the most remote island group in the world (Cowie & Holland 2008) and represents an exceptional model system as its geological origins are well-defined. The islands formed sequentially as the Pacific Plate migrated north-westward over a stationary volcanic hotspot in the Earth's mantle, where persistent upwelling magma created a linear chain of volcanoes that decrease in age in the direction of plate motion (Price & Clague 2002, Macdonald et al. 2021). This unique geological history establishes a natural sequence that provides a proxy for the study of ecosystem development over time starting in the northwestern island of Kaua'i (5.1 Ma), followed by O'ahu (3.7 Ma), Moloka'i (1.9 Ma), Maui (1.32 Ma), Lana'i (1.28 Ma) and

Hawai'i is the youngest island (0.43 Ma) (Cowie & Holland 2008). The native biota further enhances the research value as the islands are characterized by relatively few higher-level lineages that underwent strong diversification into numerous species through adaptive radiation (Barton et al. 2021). This is exemplified by the silversword alliance (Asteraceae), which evolved exceptional morphological variability on the Hawaiian Islands (Landis et al. 2018, Purugganan & Robichaux 2005).

The only native Hawaiian palm genus, *Pritchardia*, is another example of a plant group that radiated across the islands. Originating on the North American continent, the ancestors of *Pritchardia* colonized first the South Pacific islands, then the Hawaiian Islands, likely coeval with the uplift of volcanic settings (Bacon et al. 2012a). *Pritchardia* species exhibit high levels of endemism (Hodel 2012), occupying a broad range of habitats including cliffs, offshore islets and dry to wet forests between sea level and 1,270 m (Chapin et al. 2004, Hodel 2012). Furthermore, many *Pritchardia* species hold significant cultural, economic and historical value (Hodel 2012).

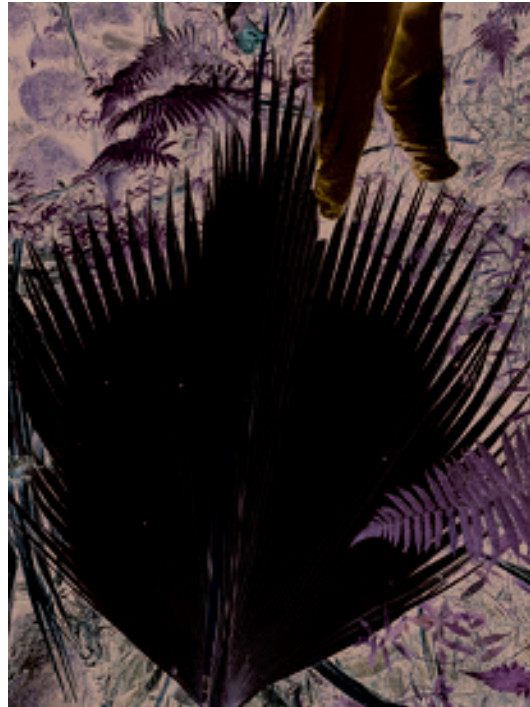
The first Hawaiian flora (Hillebrand 1888) recognized only two species of *Pritchardia*—*P.*



3. A tall *Pritchardia bakeri* individual within the Ko'olau Range. Photo by V. Keller.

gaudichaudii (loulou lelo) and *P. martii* (loulou hiwa). A monograph combining extensive field and herbarium study resulted in the recognition of 38 taxa (Beccari & Rock 1921), many of which are still recognized today. Modern revisions (Read & Hodel 1990, Hodel 2007) followed by a full-color popular guide

resulted in the recognition of 24 species in Hawaii (Hodel 2012, Imada et al. 2025) and five additional species in the Pacific, one recently described from the Marquesas (Butaud & Hodel 2017). Continuing research, especially that resulting from new fieldwork in remote areas combined with morphological



4 (left). An example of a *Pritchardia martii* specimen voucher including a leaf, inflorescence, infructescence and fruits. 5 (right). S. Fawcett measuring a *Pritchardia martii* leaf for morphological data collection. The shown underside of the leaf reveals the dense abaxial lepidia cover characteristic of this species. Photos by V. Keller.

and molecular study may result in even more new discoveries regarding the taxonomy of the genus.

The Hawaiian species are primarily single island endemics—*P. flynnii*, *P. hardyi*, *P. minor*, *P. napaliensis*, *P. perlmanii*, *P. viscosa*, *P. waialealeana* occur only on Kaua'i; *P. bakeri*, *P. kaalae*, *P. kahukuensis* and *P. martii* are restricted to O'ahu; *P. hillebrandii* is the only single island endemic species on Moloka'i; *P. arecina* and *P. woodii* are restricted to Maui and *P. beccariana*, *P. gordonii*, *P. lanigera*, *P. maideniana* and *P. schattaueri* occur exclusively on the island of Hawai'i.

There are five species that are found on multiple islands: *P. forbesiana* co-occurs on Maui and Moloka'i, *P. glabrata* can be found on Lāna'i and Maui, *P. lowreyana* is present on Molokai and O'ahu, *P. munroi* occurs on Maui and Moloka'i, and *P. remota* is present on Nihoa and Ni'ihau (Chapin et al. 2004, Hodel 2012). High levels of island endemism contribute to extinction risk; according to the IUCN Red List of Threatened and Endangered Species, 15 *Pritchardia* species are listed as Critically Endangered and 11 species are considered Endangered (IUCN 2025).

Historical accounts indicate that although the island of Hawai'i was the most populous at the time of European contact, by the early 19th century, Honolulu, on the island of O'ahu, had emerged as the principal port and was claimed by westerners (Jones 1938). Today, O'ahu is the most densely inhabited island and has undergone the greatest degree of human transformation ('Aina of Ka onohi et al. 2023). This extensive alteration of the native landscape provides an important context for studying native taxa such as *Pritchardia*, whose evolutionary history and current distribution may reflect both natural diversification and human impacts.

The Ko'olau Range runs north to south on the eastern side of the island of O'ahu with a continuous ridgeline that reaches an elevation of about 1,000 m. The range is deeply incised with valleys, which likely act as barriers to dispersal for large-fruited *Pritchardia*, contributing to the morphologically distinct and potentially isolated populations we see today. On the western side of the island, the Wai'anae Range hosts the endemic *Pritchardia kaalae*. Presently, four species of *Pritchardia* are known from the Ko'olau. Firstly, *Pritchardia martii*, described by Gaudichaud (1842), is the



6. Fruits of a *Pritchardia martii*. Photo by V. Keller.

most widespread and variable and has six species synonymized within it; until recently it had been considered the only species occurring in the range (Hodel 2007). It is characterized by large leaves with silvery or beige undersides, owing to the dense covering of abaxial scales (lepidia) and often large fruits of variable shape. Secondly, *P. kahukuensis* was originally described from the northern Ko'olaus by Caum (1930) and was resurrected

by Hodel (2007). It is distinct in its great height (25 m or more), large spherical crown and small fruits. Thirdly, *P. bakeri* was described by Hodel (2009) and is distinct in having inflorescences that extend far beyond the crown. It occurs in two widely disjunct populations in the far north and far south of the range. Fourthly, in 2008 Joel Lau and Kenji Suzuki verified the presence of *P. lowreyana* in the central eastern Ko'olaus, a species that is

distinct from the previous three in having green abaxial sides of the leaves, since they lack a dense covering of lepidia (Hodel 2009).

While the majority of *P. martii* plants can be found within the Ko'olau Range, two individuals exist in the southern Wai'anae Range, the mountain range forming the western coast of the island (Hodel 2012). Fossil pollen records identify *Pritchardia* occurrence in the intervening Leilehua Plain, suggesting its distribution may have extended from the Ko'olau to the Wai'anae Range (Hodel 2012). The two populations may then have been separated by forest loss due to either natural events (e.g. flooding) or human activity (e.g. agriculture, movement of seed from wild populations). Similar to other *Pritchardia*

species, *P. martii* is listed as an Endangered species by the IUCN and the main threats to species survival are pigs, rats, goats and severe habitat decimation (IUCN 2025).

Due to their recent diversification (> 5Ma), species boundaries in the Hawaiian *Pritchardia* palms are still, however, unclear (Bacon et al. 2012b, Price & Clague 2002, Wrisberg et al. 2025). Evidence of hybridization and admixture, where distinct populations and even species interbreed and break down species boundaries between them, have been reported in the Ko'olau Range (Bacon et al. 2012b). Species boundaries are also difficult to define due to weak genetic and morphological differentiation, which is potentially complicated by ancient and ongoing

7. J.A. Harmon attaching mesh cages around the maturing infructescence of a *Pritchardia bakeri* palm to protect it from rats. Photo by V. Keller.



movement of plants by people for trade and subsistence (Bacon et al. 2012b). To guide conservation efforts for this highly threatened genus, determining accurate species boundaries is essential, as management strategies depend on taxonomic clarity (Tobias et al. 2010).

The need of conservation and management is clear given the increasing number of biotic threats that Hawaiian palms are facing. The invasive coconut rhinoceros beetle (CRB; *Oryctes rhinoceros*), native to Asia, is a pest that has spread to many different islands in the Pacific. Starting at the beginning of the 20th century, it has been affecting not only the namesake coconut palms, but also a broad range of other cultivated and wild palms (Bedford 2013, Catley 1969). While the introduction of the non-endemic *Oryctes rhinoceros* nudivirus in the 1970s that infects and curtails the lifespan of CRB successfully suppressed beetle populations (Bedford 2013), a new genetic variant haplotype of the CRB escaped biological control and continued to invade Pacific Islands, reaching O'ahu in 2013 (Marshall et al. 2017). By boring into the petiole bases, the beetles feed on the palm crowns, damaging the juvenile leaves and central meristem, which leads to the death of the palm (Catley 1969). Damage is visible by the presence of extensive perforations, mostly affecting the emerging, youngest leaves. The CRB therefore is a rapidly spreading threat to the local vegetation, further reducing the number of remaining *Pritchardia* palms.

Beyond testing taxonomic hypotheses and delimiting species, assessing genetic diversity both within and between populations is also important for the conservation of biodiversity. Genetic diversity describes the variation among individuals of a population and of a species (Ellegren & Galtier 2016). It is a crucial factor for the ability of species to respond to environmental changes and plays an important role in adaptive potential and persistence through time (Peery et al. 2012).

Here, we aim to establish a comprehensive genetic dataset, supported by morphological data, for *Pritchardia* in the Ko'olau Mountains on O'ahu, Hawai'i, in the context of comprehensive taxonomic sampling across the genus. High-throughput DNA sequencing enables genome-wide analyses of diversity and can identify populations with reduced genetic variability or unique genetic composition that should be prioritized for conservation. These data can also guide ongoing propagation

efforts for conservation restoration decisions, where more genetically variable individuals can be prioritized for ex situ and in situ conservation projects, while allowing for the maintenance of genetic diversity on the landscape. Although island populations often exhibit reduced genetic diversity due to factors such as limited dispersal and historic bottlenecks (Frankham 1997), we expect populations consisting of only a few individuals to show particularly low diversity, whereas populations occurring in more intact native forest with many individuals are likely to retain higher genetic variation.

Fieldwork in O'ahu

To achieve conservation prioritization goals, a one-month expedition to O'ahu was conducted in February 2025, during which multiple *Pritchardia* populations were sampled across environmental gradients in the Ko'olau Mountains and supplemented with samples from wild-collected cultivated material at the Waimano Nursery, Lyon Arboretum, the Army Natural Resource Program Nursery and the National Tropical Botanical Garden. Leaf tissue was collected for DNA sequencing, along with herbarium specimens where required. The anticipated dataset will include samples from multiple populations in the Ko'olau Mountains and will help resolve taxonomic uncertainties, patterns of genetic diversity and disentangle species limits within O'ahu and across the Hawaiian Islands, with the ultimate goal of informing conservation measures for this endangered genus.

Northeastern Ko'olau

We first visited Hau'ula, a site on the windward side of O'ahu. Equipped with pole pruners and tabi shoes, which are traditional Japanese footwear that are characterized by a split-toe design, cleats and suction-cups to enhance balance and stability in the field, our colleagues from the Plant Extinction Prevention Program (PEPP) led us to the entrance of a lowland forest that gradually transitioned into a denser, more humid environment as we moved inland and upslope. The area was characterized by a mixture of mostly non-native, exotic plants introduced from various parts of the world, along with ancient stone walls, offering a glimpse into past land use and organization of historical settlements. The presence of mango (*Mangifera indica*) and tangerine (*Citrus* sp.) trees further shows evidence of human influence on the landscape.



8. A tall *Pritchardia martii* individual within the Kalauao Valley. Photo by V. Keller.

Besides the great variety of surrounding vegetation, the first *Pritchardia* palm we came across stood out with its prominent and distinctive presence (Fig. 1). The species found at this site is *Pritchardia martii*, which has a tall growth form and strikingly broad leaves at this location. The occurrence of this specific

specimen, however, took our colleagues from the PEPP by surprise as they had not previously observed one growing at merely 60 m above sea level on O'ahu. According to Hodel (2012), *P. martii* individuals usually occur between 300–800 m elevation. As we continued along the trail, we encountered more individuals of

P. martii, whose impressive height of around 4.5 m made sampling difficult. Given that the species can reach up to 15 m in height, this particular individual was still on the shorter side (Hodel 2012). Unfortunately, multiple individuals showed characteristic symptoms of CRB-related damage.

Southern Ko'olaus

We ascended to the summit of the Southern Ko'olaus for our second field excursion, with the goal of sampling representatives of *P. martii* and *P. bakeri*. The site is particularly interesting due to the apparent slope-associated distribution of the two species: *P. martii* predominantly occurs on the leeward side of the ridge, while *P. bakeri* grows on the opposite windward side. *P. martii* occurred in scattered patches and differed notably from the individuals encountered the previous day - these plants were shorter and grew in dense clusters along the steep cliff faces, making sampling challenging (Fig. 2). This variation in growth form likely represents a form of plasticity or adaptation to the level of exposure individuals experience. In contrast, *P. bakeri* on the opposite slope consisted of taller, more isolated plants (Fig. 3).

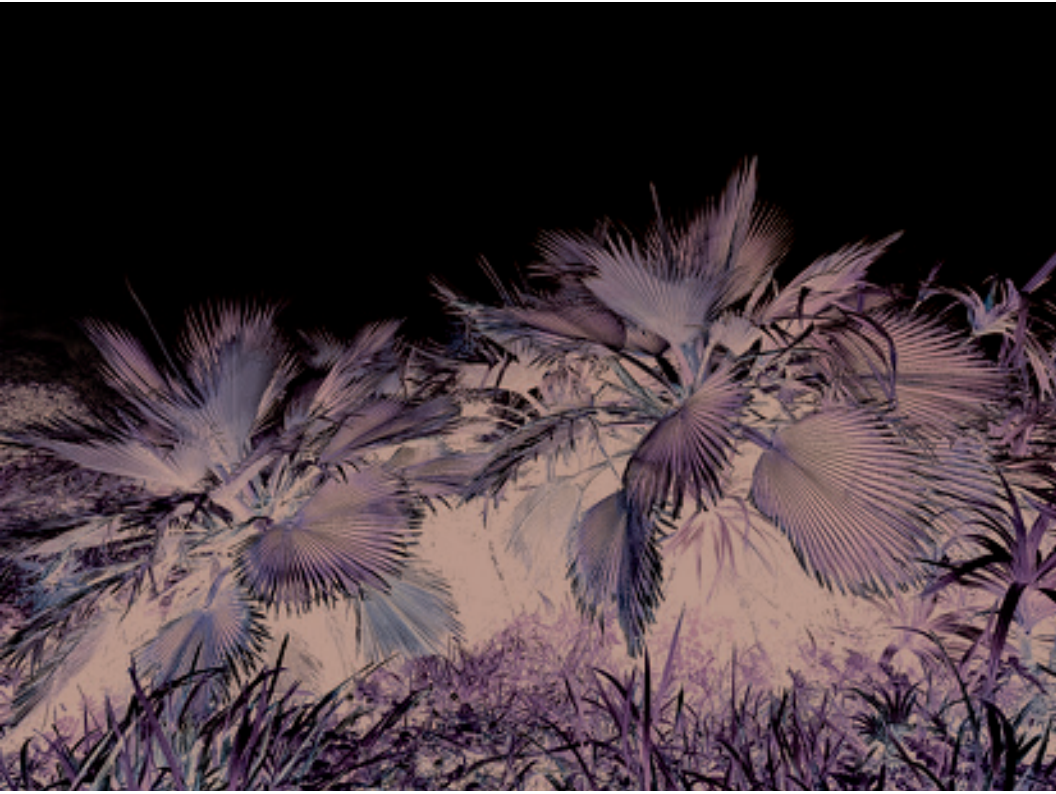
Although *P. martii* and *P. bakeri* co-occur and share several morphological traits, *P. bakeri* can be distinguished by its much longer inflorescences and infructescences, which extend well beyond the crown, a key characteristic that led to its taxonomic recognition as a distinct species in 2009 (Hodel 2012). Previous studies by Bacon et al. (2012b) identified admixture in this area, suggesting hybridization between the two species. To clarify species boundaries, deeper sampling and genomic sequencing is needed. In addition to collecting leaf material for DNA extraction, we also collected herbarium specimens (Fig. 4) and morphological data for at least one individual per population at every site we visited. Morphological data collection included characteristics of the trunk, leaves, inflorescences, infructescences and fruits (Figs. 5 & 6).

Morphological variability is also characteristic of *P. bakeri*. The species varies between small stunted, almost trunkless individuals to tall palms (up to > 9 m). It occurs at low elevation with wet and exposed conditions that are dominated by shrubs and/or grasses as well as steep slopes at elevations of approximately 450–650 m at both the very northern and southern ends of the Ko'olaus (Hodel 2012).

Due to the small population sizes and the restricted range, it is a species that is particularly vulnerable; a single natural disturbance, such as a hurricane, has the potential to eradicate both entire populations. In fact, the highly eroded, unstable steep slopes are subject to periodic mudslides, which may destroy entire groves in an instant (Hodel 2012).

For ex situ conservation, the team collected ripe fruits from the endangered species *P. bakeri*. In addition to this, mesh cages were temporarily attached around the maturing infructescence to protect them from predation (Fig. 7). Introduced mammal species, especially feral pigs and rats, are the primary drivers of seedling recruitment failure (Shiels & Drake 2011, Hodel 2012), clearly seen at this site where there is an absence of juvenile plants. Rats are one of the major drivers of *Pritchardia* palm population declines on contemporary time scales. Experiments have demonstrated that rats remove the majority of *Pritchardia* seeds within weeks of seed placement on the forest floor, well before germination occurs (Shiels & Drake 2015).

On longer time scales, the Hawaiian Archipelago was once home to extensive radiations of endemic finches and flightless ducks, ibises and geese (Steadman 1995). The fruit sizes of the Hawaiian *Pritchardia* species have a width of around 1.5 cm to 6.5 cm (Hodel 2012) and large fruits were dispersed by larger bird species that became extinct long ago. Since human arrival approximately 1,000 years ago (Kirch 2011), about 60 endemic land bird species have gone extinct due to habitat loss, introduced mammals and hunting (Steadman 1995). A second wave of extinctions followed European contact in the 18th century (Boyer 2008), as shown by fossil evidence revealing extensive losses across multiple avian groups (James & Olson 1991, Olson & James 1991). Besides hunting and predation, avian pathogens such as avian malaria (*Plasmodium relictum*) were the main drivers of extinctions (James & Olson 1991, Warner 1968). This has resulted in many remaining native birds being restricted to high-elevation, mosquito-free refugia (Warner 1968). However, with global warming, these refugia are increasingly threatened and with this, the survival of these native birds (LaPointe et al. 2012). The absence of effective seed dispersers restricts the contemporary distribution potential of *Pritchardia* palms. Without animals capable of transporting their large fruits uphill,



9. Clustered occurrence of short-statured *Pritchardia bakeri* palms along the Kuli'ou'ou Trail. Photo by V. Keller.

populations are essentially confined to the same or lower elevations than the parent plant. This limitation not only prevents colonization of higher elevation habitats, but may also increase vulnerability of the palms to human impacts that are more prevalent at lower elevations.

Kalauao Valley (Central Ko'olaus)

To reach our third sampling locality, Kalauao, we first followed a slightly ascending trail through the forest. After a short distance, we left the path to reach the edge of a steep slope. As our sampling targets were located at the bottom of the valley, we descended the slope following small paths created by feral pigs until we reached the bottom of the valley.

During our descent, a member of the team explained that entering the areas above the lowlands traditionally requires a purpose and is usually preceded by *oli* (chants) that serve both as a permission request but also an expression of respect for the significance of the place. In the traditional Hawaiian world, a dichotomy exists through which the land is divided into distinct domains. The lowlands, *wao kanaka*, describes the realm of the people and *wao akua*, the upland forests are regarded

as the spiritual realm, while *wao* generally describes a forest or inland zone (Gon 2014, Coleman 2014).

After continuing along the stream at the foot of the valley, we reached the first palm, a *P. martii* of striking height and remarkable round fruits (Fig. 8). The second individual of the same species located only a few meters away showed, however, a quite distinct appearance. It was much shorter, grew beneath the canopy and produced oblong fruits. The phenotypic plasticity present in *P. martii* is typical for this species and was exemplified well by these two specimens occurring in such proximity and similar habitat.

Northern Ko'olaus

The Poamoho Trail was the destination of our fourth excursion. Located at the northern part of the Ko'olau Range, it is accessed via a restricted, unpaved road. The trail follows a path along a broad valley, providing a great overview of the surrounding forest community. In contrast to other sampling sites, palms were more easily observable here due to their generally higher abundance and the location of the path. We noted vertical lines of *Pritchardia* on the hillsides. As our PEPP

colleague explained, these form when fruits roll downhill and germinate along the slope.

At the initial part of the path *P. kahukuensis* is the most common species, distinguished by a tall growth form and a large, spherical crown (Hodel 2012). Further along the path, the species is gradually replaced by *P. martii*, occurring in close proximity to the trail. In addition to *Pritchardia*, this site harbors a variety of native Hawaiian tree species. Among the most dominant are koa (*Acacia koa*) and 'ohi 'a lehua (*Metrosideros polymorpha*), both of which are endemic and serve as crucial keystone species by holding considerable cultural, ecological and economic significance as their timber was utilized for e.g. canoe construction and their canopies are inhabited by native bird species (Whitesell 1990, Friday & Herbert 2006, Fortini et al. 2019, Hodges 1986).

In the recent years both koa and 'ohi 'a lehua trees have been, however, facing severe threats from pathogenic infections (Camp et al. 2019, Dudley et al. 2015). Following the Poamoho path, we encountered several 'ohi 'a individuals showing symptoms of Rapid 'Ohi'a Death, characterized by foliar browning and subsequent rapid mortality (Hodges 1986, Asner et al. 2018). Managing ungulates (e.g. pigs, goats), mitigating the pathogen spread and avoiding the introduction of distinct, potentially more dangerous biotypes, is essential for preserving native forest integrity (Perroy et al. 2021).

Further along the Poamoho Trail, the density of *P. martii* individuals increased. The phenotypic plasticity was notable at this site as well, in that some palms were tall and erect where others, particularly individuals occurring adjacent to the stream, were markedly shorter and had broader canopies with larger leaves compared to the plants that occurred further away from the stream (Front Cover).

At the Poamoho site, we collected material to develop a reference genome, which will serve as a framework for analyzing the DNA sequence data generated in this study. Establishing this genomic baseline will enable the comparison of genetic variation among populations. Given the relatively high number of individual palms at this location, we hypothesize that this population will exhibit greater genetic diversity. This will be tested through subsequent population genetic and comparative analyses across the different sampling sites.

Southeastern Ko'olau

On the last field excursion in O'ahu, we ascended a trail in Kuli'ou'ou to sample *P. bakeri* palms to reach our last sampling location. The two main palm populations we intended to sample from were located at approximately 700 m elevation and consisted of clusters of short-statured palms, with five to seven individuals per group (Fig. 9). Their morphology closely resembled that of palms found a few hundred meters further along the mountain range. The compact, clustered growth is driven by the extremely exposed conditions at this elevation. The infructescence of the palms were also at this site protected from rats with mesh nets. A notable characteristic of the site was that the two populations were separated by remnants of a World War II airplane wreck, partially embedded in the mountainous landscape.

Next steps and summary

All samples collected throughout the fieldtrip and visits to Waimano Nursery, Lyon Arboretum, the Army Natural Resources Program and the National Tropical Botanical Garden will be used to generate DNA sequencing data that will be leveraged to 1) delimit species boundaries, 2) determine the extent of gene flow between and within populations and taxa in the Ko'olau Range, and 3) identify the magnitude and rate of genetic diversity change through time and space.

This field excursion highlighted the importance of not only focusing on present-day ecosystem composition but also looking at a broader temporal context. By incorporating ecological, cultural and economic knowledge from the present and the past, we can further understand why the present forest composition is structured in this way. Besides the scientific insights, the journey to Hawai'i underscored the importance and great value of fieldwork.

Acknowledgments

This work was supported by the Per Adolf Larsson Scholarship to VK, the Swedish Research Council (2022-03927) to CDB, the Montgomery Botanical Center and the University of Gothenburg Strategic Research Area in Biodiversity and Ecosystem Services in a Changing Climate (BECC). Support to SF was by National Science Foundation grants DEB-2040347, DEB-2040081, DEB-2040097: Collaborative Research: Modeling the Origin

and Evolution of Hawaiian Plants (PIs: M. Landis, F. Zapata and W. Wagner). We are grateful for the Plant Extinction Prevention Program (PEPP) team, James Harmon, Miles Thomas, Kobey Togikawa, Josh Serrano and Kenna Ruis for their invaluable support in the field. We also thank the Harold L. Lyon Arboretum, especially Tim Kroessig and Makoa Elgin, the National Tropical Botanical Garden, especially Tim Flynn, Ken Wood, Tiffany Knight and Seana Walsh, and the United States Army Natural Resources Program, especially Tim Chambers, for their support. This work was supported by the special use permit for rare plants issued by the Department of Land Natural Resources (Endorsement No: 241111134257-PLANT) and the permit for Export/Re-Export/Import/Interstate and Foreign Commerce of Plants under the Convention on International Trade in Endangered Species (CITES) and/or the U.S. Endangered Species Act (ESA) (3-200-36) issued by the Division of Forestry and Wildlife.

LITERATURE CITED

- ‘Aina of Ka Onohipi et al. 2023. Urban ‘Aina: An indigenous, biocultural pathway to transforming urban spaces. *Sustainability* 15: 9937.
- ASNER, G.P. ET AL. 2018. A spectral mapping signature for the Rapid Ohia Death (ROD) pathogen in Hawaiian forests. *Remote Sensing* 10: 404.
- BACON, C.D., BAKER, W.J. AND SIMMONS, M.P. 2012a. Miocene dispersal drives island radiations in the palm tribe Trachycarpeae (Arecaceae). *Systematic Biology* 61: 426–442.
- BACON, C.D., McKENNA, M.J., SIMMONS, M.P. AND WAGNER, W.L. 2012b. Evaluating multiple criteria for species delimitation: an empirical example using Hawaiian palms (Arecaceae: *Pritchardia*). *BMC Evolutionary Biology* 12: 1–18.
- BARTON, K.E. ET AL. 2021. Hawai‘i forest review: Synthesizing the ecology, evolution, and conservation of a model system. *Perspectives in Plant Ecology, Evolution and Systematics* 52: 125631.
- BECCARI, O. AND ROCK, J.F.C. 1921. A monographic study of the genus *Pritchardia* Bishop Museum Press 8.
- BEDFORD, G.O. 2013. Long-term reduction in damage by rhinoceros beetle *Oryctes rhinoceros* (L.) (Coleoptera: Scarabaeidae: Dynastinae) to coconut palms at *Oryctes* Nudivirus release sites on Viti Levu, Fiji. *African Journal of Agricultural Research* 8: 6422–6425.
- BOYER, A.G. 2008. Extinction patterns in the avifauna of the Hawaiian Islands. *Diversity and Distributions* 14: 509–517.
- BURNEY, D.A. AND KIKUCHI, W.K.P. 2006. A millennium of human activity at Makauwahi Cave, Mahauulepu, Kauai. *Human Ecology* 34: 219–247.
- BUTAUD, J.F. AND HODEL, D.R. 2017. A new species of *Pritchardia* from the Marquesas Islands with notes on the genus in French Polynesia. *Palms* 61: 139–154.
- CAMP, R.J., LAPOINTE, D.A., HART, P.J., SEDGWICK, D.E. AND CANALE, L.K. 2019. Large-scale tree mortality from Rapid Ohia Death negatively influences avifauna in lower Puna, Hawaii Island, USA. *The Condor* 121: duz007.
- CAUM, E.L. 1930. New Hawaiian plants. Bishop Museum Occasional Papers 9: 13.
- CATLEY, A. 1969. The coconut rhinoceros beetle *Oryctes rhinoceros* (L.) [Coleoptera: Scarabaeidae: Dynastinae]. *PANS Pest Articles & News Summaries* 15: 18–30.
- CHAPIN, M.H., WOOD, K.R., PERLMAN, S.P. AND MAUNDER, M. 2004. A review of the conservation status of the endemic *Pritchardia* palms of Hawaii. *Oryx* 38: 273–281.
- COLEMAN, H.K. 2014. Wao Kele O Puna. Research division; Land, culture, and history section. Information sheet. Office of Hawaiian Affairs. <https://www.oha.org/wp-content/uploads/Waokeleopuna-Information-Sheet.pdf>.
- COWIE, R.H. AND HOLLAND, B.S. 2008. Molecular biogeography and diversification of the endemic terrestrial fauna of the Hawaiian Islands. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363: 3363–3376.
- DUDLEY, N.S., JONES, T.C., JAMES, R.L., SNIEZKO, R.A., CANNON, P. AND BORTHAKUR, D. 2015. Applied disease screening and selection program for resistance to vascular wilt in Hawaiian *Acacia koa*. *Southern Forests: A Journal of Forest Science* 77: 65–73.
- ELLEGREN, H. AND GALTIER, N. 2016. Determinants of genetic diversity. *Nature Reviews Genetics* 17: 422–433.
- FORTINI, L.B. ET AL. 2019. The evolving threat of Rapid ‘Ohi ‘a Death (ROD) to Hawai‘i’s

- native ecosystems and rare plant species. *Forest Ecology and Management* 448: 376–385.
- FRANKHAM, R. 1997. Do island populations have less genetic variation than mainland populations? *Heredity* 78: 311–327.
- FRIDAY, J.B. AND HERBERT, D.A. 2006. *Metrosideros polymorpha* ('ohi 'a lehua). *Species Profiles for Pacific Island Agroforestry* 3: 2.
- GAUDICHAUD-BEAUPRÉ, C. 1842. Botanique, in Freycinet, L. de (ed.). *Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la corvette La Bonite*. Arthus Bertrand, Paris, France.
- GILLESPIE, T.W., CHU, J. AND PAU, S. 2008. Non-native plant invasion of the Hawaiian Islands. *Geography Compass* 2: 1241–1265.
- GON, S.'O. 2014. Lessons from a thousand years of island sustainability [Video]. TEDx Talks. YouTube. https://www.youtube.com/watch?v=l9fv_2XIJBk.
- HILLEBRAND, W. 1888. *Flora of the Hawaiian Islands*. Pp. 673. William & Norgate, London, UK.
- HODEL, D.R. 2007. A review of the genus *Pritchardia*. *Palms* 51 (Suppl.): 1–52.
- HODEL, D.R. 2009. A new species of *Pritchardia* and the rediscovery of *P. lowreyana* on Oahu, Hawaii. *Palms* 53: 173–179.
- HODEL, D.R. 2012. *Loulu: The Hawaiian Palm*. University of Hawaii Press.
- HODGES, C.S. 1986. Decline of Ohia (*Metrosideros polymorpha*) in Hawaii: a review. *General technical reports*: 1–22.
- IMADA, C.T., FACCENDA, K., THOMAS, M.K., GALLAHER T., OPPENHEIMER, H., KENNEDY, B. AND ARTHUR, K. 2025. *Hawaiian Native & Naturalized Vascular Plants Checklist*. Bishop Museum Technical Report 25.
- INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN). 2025. The IUCN Red List of Threatened Species. <https://www.iucnredlist.org>
- JAMES, H.F. AND OLSON, S.L. 1991. Descriptions of thirty-two new species of birds from the Hawaiian Islands: Part II. Passeriformes. *Ornithological Monographs* 46: 1–88.
- JONES, S.B. 1938. Geography and politics in the Hawaiian Islands. *Geographical Review* 28: 193–213.
- KIRCH, P.V. 2011. When did the Polynesians settle Hawai'i? A review of 150 years of scholarly inquiry and a tentative answer. *Hawaiian Archaeology* 12: 3–27.
- LANDIS, M.J., FREYMAN, W.A. AND BALDWIN, B.G. 2018. Retracing the Hawaiian silversword radiation despite phylogenetic, biogeographic, and paleogeographic uncertainty. *Evolution* 72: 2343–2359.
- LAPOINTE, D.A., ATKINSON, C.T. AND SAMUEL, M.D. 2012. Ecology and conservation biology of avian malaria. *Annals of the New York Academy of Sciences* 1249: 211–226.
- LOSOS, J.B. AND RICKLEFS, R.E. 2009. Adaptation and diversification on islands. *Nature* 457: 830–836.
- MARSHALL, S.D., MOORE, A., VAQALO, M., NOBLE, A. AND JACKSON, T.A. 2017. A new haplotype of the coconut rhinoceros beetle, *Oryctes rhinoceros*, has escaped biological control by *Oryctes rhinoceros* nudivirus and is invading Pacific Islands. *Journal of Invertebrate Pathology* 149: 127–134.
- MACDONALD, G.A., ABBOTT, A. AND PETERSON, F.L. 2021. *Volcanoes in the Sea: the Geology of Hawaii*. University of Hawaii Press.
- MEILLEUR, B.A. 2022. Ancient Hawaiian house lots and their flora: a review of Great Mahele plant claims with a special focus on *Pritchardia* (loulu) palms. *Revue d'Ethno-écologie* 21.
- MYERS, N., MITTERMEIER, R.A., MITTERMEIER, C.G., DA FONSECA, G.A. AND KENT, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.
- NOGUÉ, S. ET AL. 2017. Island biodiversity conservation needs palaeoecology. *Nature Ecology & Evolution* 1: 0181.
- OLSON, S.L. AND JAMES, H.F. 1991. Descriptions of thirty-two new species of birds from the Hawaiian Islands: Part I. Non-Passeriformes. *Ornithological Monographs* 45: 1–88.
- PEERY ET AL. 2012. Reliability of genetic bottleneck tests for detecting recent population declines. *Molecular Ecology* 21: 3403–3418.
- PERROY, R.L. ET AL. 2021. Spatial patterns of 'ohi'a mortality associated with rapid 'ohi'a death and ungulate presence. *Forests* 12: 1035.
- PREBBLE, M. AND WILMSHURST, J.M. 2009. Detecting the initial impact of humans and

- introduced species on island environments in Remote Oceania using palaeoecology. *Biological Invasions* 11: 1529–1556.
- PRICE, J.P. AND CLAGUE, D.A. 2002. How old is the Hawaiian biota? Geology and phylogeny suggest recent divergence. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 269: 2429–2435.
- PURUGGANAN, M.D. AND ROBICHAUX, R.H. 2005. Adaptive radiation and regulatory gene evolution in the Hawaiian silversword alliance (Asteraceae). *Annals of the Missouri Botanical Garden* 92: 28–35.
- READ, R. AND HODEL, D.R. 1990. Arecaceae. Palm Family. Pp. 1360–1375, in WAGNER, W.L., HERBST, D.R. AND SOHMER, S.H. (eds.) . *Manual of the Flowering Plants of Hawai'i*. Bishop Museum Special Publication 83. University of Hawai'i Press and Bishop Museum Press, Honolulu, USA.
- SHIELS, A.B. AND DRAKE, D.R. 2011. Are introduced rats (*Rattus rattus*) both seed predators and dispersers in Hawaii? *Biological Invasions* 13: 883–894.
- SHIELS, A.B. AND DRAKE, D.R. 2015. Barriers to seed and seedling survival of once-common Hawaiian palms: the role of invasive rats and ungulates. *AoB Plants* 7.
- STEADMAN, D.W. 1995. Prehistoric extinctions of Pacific island birds: biodiversity meets zooarchaeology. *Science* 267: 1123–1131.
- TOBIAS, J.A., SEDDON, N., SPOTTISWOODE, C.N., PILGRIM, J.D., FISHPOOL, L.D. AND COLLAR, N.J. 2010. Quantitative criteria for species delimitation. *Ibis* 152: 724–746.
- WARNER, R.E. 1968. The role of introduced diseases in the extinction of the endemic Hawaiian avifauna. *The Condor* 70: 101–120.
- WHITESELL, C.D. 1990. *Acacia koa* Gray. Pp. 17–24, in BURNS, R.M. AND HONKALA, B.H. (eds). *Silvics of North America 2. Hardwoods. Agriculture Handbook 654*, USDA, Washington DC.
- WHISTLER, W.A. 2009. *Plants of the Canoe People*. National Tropical Botanical Garden, Lawai, Kaua'i, Hawai'i, USA.
- WILMSHURST, J.M., HUNT, T.L., LIPO, C.P. AND ANDERSON, A.J. 2011. High-precision radiocarbon dating shows recent and rapid initial human colonization of East Polynesia. *Proceedings of the National Academy of Sciences U.S.A.* 108: 1815–1820.
- WRISBERG ET AL. 2025. A densely sampled nuclear phylogenomic analysis of the coryphoid palms (Arecaceae: Coryphoideae). *Taxon* 74: 1372–1392.

Dypsis sanctaemariae

WOLF L. EISERHARDT^{1,2}, PAOLA DE LIMA FERREIRA¹,
JOHN DRANSFIELD², DENNIS PEDERSEN¹, LANDY RAJAOVELONA^{2,3},
MIJORO RAKOTOARINIVO⁴ and WILLIAM J. BAKER^{1,2}

Following fieldwork in Madagascar and new genomic analyses, the transfer of *Dypsis sanctaemariae* to *Chrysalidocarpus* is reconsidered.

In 2022, many Malagasy palm species were transferred from the genus *Dypsis* to the genera *Chrysalidocarpus* and *Vonitra* based on new genomic evidence (Eiserhardt et al., 2022). Among those species was *Dypsis sanctaemariae* J. Dransf (Fig. 1). This handsome medium-sized understory palm is currently only known from the island Nosy Boraha (Sainte-Marie) off the east coast of Madagascar, although occurrences close by on mainland Madagascar are rumoured and seem credible considering that the islands were connected during the Last Glacial Maximum (ca. 20,000 years ago). Based on the single DNA sample that was available at the time, the genomic data firmly placed this species within the genus *Chrysalidocarpus*, prompting the publication of a new name, *C. sanctaemariae* (J. Dransf.) Eiserhardt & W.J.Baker. Morphologically, this placement seemed to make little sense: the palm is unusually small and slender for a

Chrysalidocarpus and would be the only species in the genus with entire leaves. Its inflorescence morphology is also atypical for the genus, being rather small and slender. Nevertheless, the genomic evidence seemed too strong to keep the species in *Dypsis*, and the new name in *Chrysalidocarpus* was thus coined, while noting that the species is a morphological outlier in the genus (Eiserhardt et al., 2022).

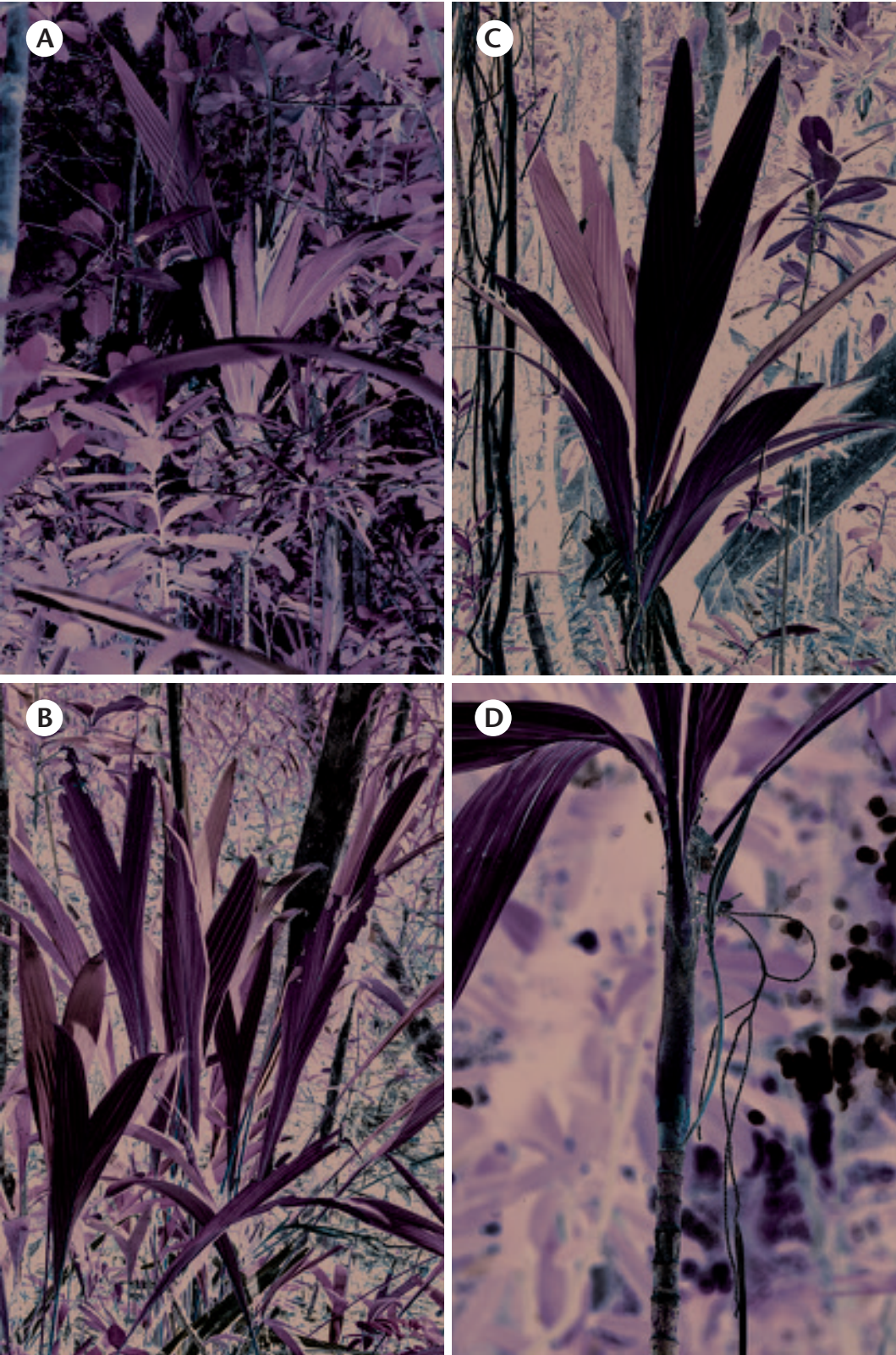
The specimen used in the analysis had impeccable credentials; it had been collected by John Dransfield and Mijoro Rakotoarinivo in November 2015 during an International Palm Society meeting on Nosy Boraha. However, despite the seemingly clear genomic evidence and credibility of the material, nagging doubts about the transfer to *Chrysalidocarpus* remained. Although the specimen had been analysed twice to rule out any errors in the lab, the conclusion was still only based on a single specimen. Would additional specimens confirm the placement of the species in *Chrysalidocarpus*? To put this issue to rest, we applied for funding from the International Palm Society to visit Nosy Boraha and collect additional material. With support from the Society, the first author visited the island in May 2024, accompanied by WJB, DP and LR. We were able to locate the species in the same area where the original sample had been collected. The palm occurs in wet, low-lying areas in the coastal white sand forest (Fig. 2) of Ambohidena on the east coast of Nosy Boraha, where we found the species in

¹Department of Biology,
Aarhus University,
Aarhus, Denmark
wolf.eiserhardt@bio.au.dk

²Royal Botanic Gardens, Kew,
Richmond, Surrey, UK

³Kew Madagascar Conservation Centre,
Antananarivo, Madagascar

⁴Department of Plant Biology and Ecology,
Faculty of Sciences,
University of Antananarivo,
Antananarivo, Madagascar



1 *Dypsis sanctaemariae* in Ambohidena, Nosy Boraha. Photos by Dennis Pedersen (A & D) and William J. Baker (B & C).



2. The collecting team on its way from the first to the second collecting locality, trekking through coastal white sand forest in Ambohidena on the eastern side of Nosy Boraha. Photo by William J. Baker.

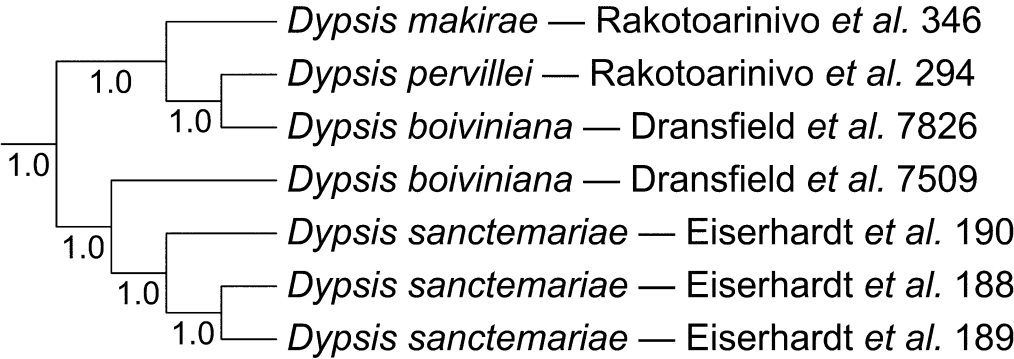
two places, 2.7 km apart. We were able to collect herbarium specimens and leaf samples for genomic analysis of three individuals (specimens Eiserhardt et al. 188, 189 & 190 at TAN, K & AAU). Despite visiting other white sand forests, we were unable to locate the species anywhere else on the island.

The new specimens have now been placed phylogenetically using 3430 nuclear genes that were captured using the target regions of Loiseau et al. (2019). The results clearly show that the species does not belong to the genus *Chrysalidocarpus*. Instead, it is firmly embedded in the genus *Dypsis* (Fig. 3), as expected based on its morphology, and should thus be referred to as *Dypsis sanctaemariae* J. Dransf.

The genomic data strongly suggest that *D. sanctaemariae* is related to three other slender, medium-sized understory palms of NE Madagascar, namely *Dypsis boiviniana*, *D. pervillei* and *D. makirae* (Fig. 3). The relationship with *D. boiviniana* and *D. pervillei* was predicted based on morphology already by Dransfield and Beentje (1995) (*D. makirae* was described later, Rakotoarinivo et al. 2009). *Dypsis sanctaemariae* differs from the three other species in having entire or sparsely divided leaves. It further differs from *D. pervillei* and *D. makirae* in inflorescence architecture

(branched to one order as opposed to spicate and branched to two orders, respectively) and from *D. makirae* in being clustering. However, the fact that the two analysed individuals of *D. boiviniana* do not group together suggests that species limits may be complicated. All species occur in the same broad area of Madagascar between the Maroantsetra and Toamasina, and introgression among the species is thus a possibility, perhaps in the distant past. Alternatively, it is conceivable that *D. boiviniana*, the most common and widespread of the four species, represents an ancestral species that has given rise to the other three (budding speciation) in various parts of its distributions. Further studies to clarify speciation mechanisms in *Dypsis* are on the way.

Why, then, did Eiserhardt et al. (2022) obtain a misleading result for the placement of *Dypsis sanctaemariae*? Both misidentification at the time of collection and a confusion of samples in the lab or during data analysis can be firmly ruled out. This leaves only the possibility that the sample has been switched or mislabelled, somehow, between the time of collection on Nosy Boraha and the time when its DNA was extracted in the laboratory at Aarhus University in Denmark. This is a healthy reminder of the many steps involved in a



3. Phylogenetic relationships of *Dypsis sanctaemariae*, inferred from 3430 nuclear genes using a coalescent-based approach (Zhang & Mirarab, 2022). Specimens sequenced are indicated behind the species name. Values below branches indicate phylogenetic support (local posterior probability), ranging from zero (no support) to one (maximum support).

phylogenetic analysis, and the fact that errors can creep in at each step. To guard against such issues, multiple individuals per species should ideally be included in phylogenetic studies. The declining cost of genomic lab work means that such an approach is coming within reach.

Taxonomic treatment

Dypsis sanctaemariae J.Dransf. in J.Dransfield & H.Beentje, *Palms Madagascar*: 264.1995. *Chrysalidocarpus sanctaemariae* (J.Dransf.) Eiserhardt & W.J.Baker, *Taxon* 71: 1185. 2022. **synon. nov.**

Acknowledgments

This work was funded by grants from the International Palm Society Endowment Fund and VILLUM FONDEN (grant 00025354) to W.L.E. We thank the Direction des Aires Protégées, des Ressources Naturelles Renouvelables et des Écosystèmes (DAPRNE) of the Ministère de l’Environnement et du Développement Durable (MEDD) of Madagascar for issuing collection permit No. 076/24 to W.J.B. and the necessary export permits, which made this work possible. We are also grateful to the Regional Directorates of the Environment and Sustainable Development (DREDD) of Analanjirofo and Alaotra-Mangoro, as well as the Canton Forest offices in Sainte Marie and Moramanga, for their valuable assistance with administrative procedures related to the transport of specimens from the field to Antananarivo. We sincerely thank Hermann Francesco Randriamahafehy, Augustin Massou, Donato Botovazaha, and Anselme Kintsy for their

invaluable help in the field. Our warmest thanks go to the teams at the University of Antananarivo and Kew Madagascar for their support in sorting and preparing specimens for shipment, and to Katherin Restrepo-Sulez and Alexandre Zuntini for their help in the laboratory. The computing for this project was performed on the GenomeDK cluster, and we would like to thank GenomeDK and Aarhus University for providing computational resources and support.

LITERATURE CITED

DRANSFIELD, J. AND BEENTJE, H. 1995. The Palms of Madagascar. The Royal Botanic Gardens Kew and the International Palm Society, HMSO, Norwich.

EISERHARDT, W.L. ET AL. 2022. Phylogenomics and generic limits of Dypsidinae (Arecaceae), the largest palm radiation in Madagascar. *Taxon* 71: 1170–1195.

LOISEAU, O. ET AL. 2019. Targeted capture of hundreds of nuclear genes unravels phylogenetic relationships of the diverse neotropical palm tribe Geonomateae. *Frontiers in Plant Science* 10: 864.

RAKOTOARINIVO, O., TRUDGEN, M.S. AND BAKER, W.J. 2009. The palms of the Makira protected area, Madagascar. *Palms* 53: 125–146.

ZHANG, C. AND MIRARAB, S. 2022. Weighting by gene tree uncertainty improves accuracy of quartet-based species trees, *Molecular Biology and Evolution* 39: msac215.

First Record of *Rhynchophorus palmarum* (Coleoptera: Curculionidae) Affecting *Latania lontaroides* in the Acapulco Botanical Garden, Mexico

OSCAR SANDINO GUERRERO-ELOISA¹ AND POLICARPIO CASTRO-SIMÓN²

The palm weevil *Rhynchophorus palmarum* has attacked the endangered palm *Latania lontaroides* (Gaertn.) H.E. Moore, endemic to Réunion Island, in a tropical botanical garden in México. This is the first documented record of the weevil affecting *L. lontaroides*, adding a new palm species as a host for this insect pest.

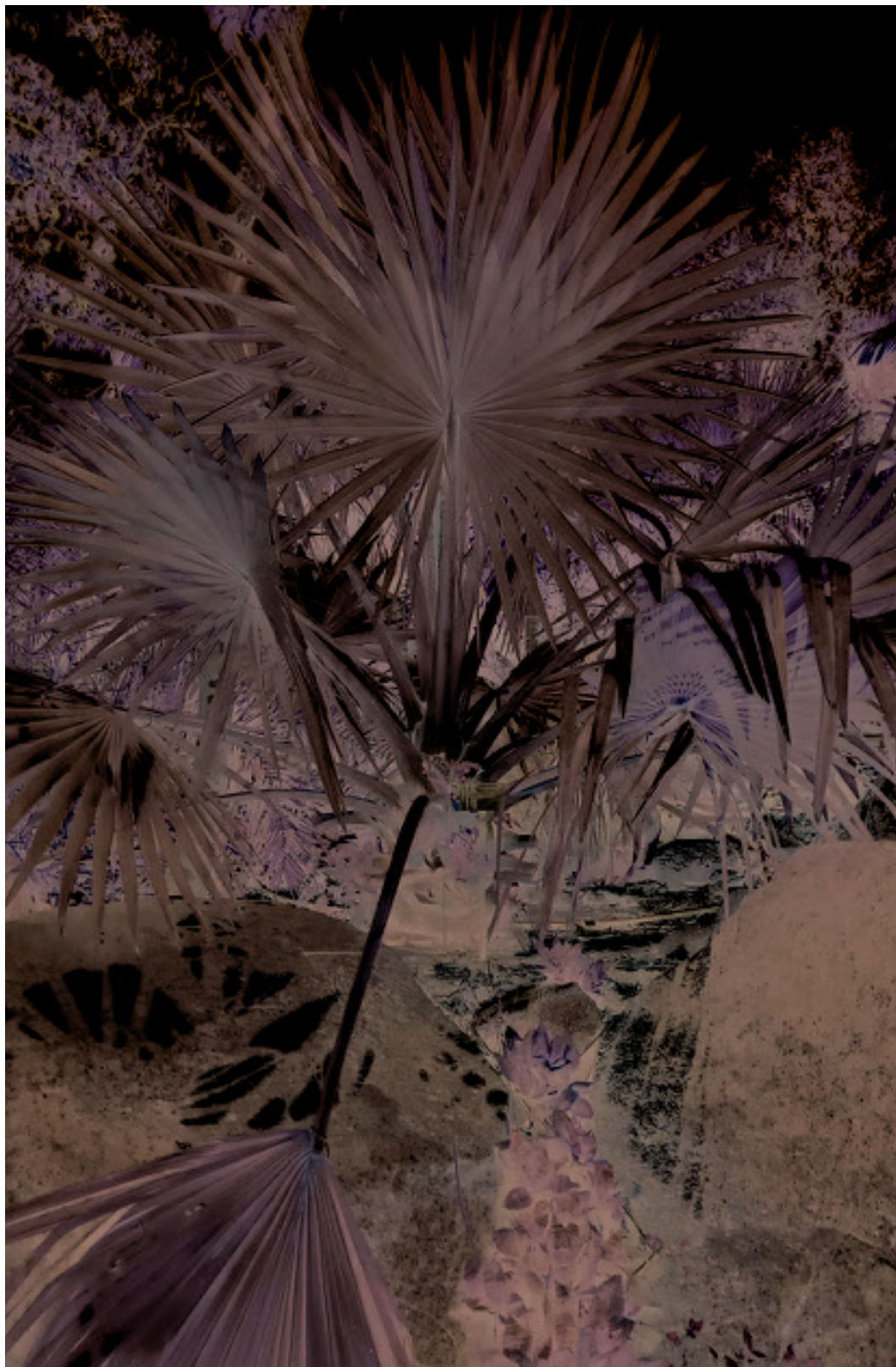
The genus *Rhynchophorus* has a wide global distribution, primarily concentrated in the tropics, with ten recognized species (Wattanapongsiri 1966). *Rhynchophorus ferrugineus* (red palm weevil) and *R. palmarum* (black palm weevil) are two major pests that cause severe damage to palms, with significant economic and ecological implications (Jacas 2011, SIVICOFF 2018).

The Acapulco Botanical Garden “Esther Pliego de Salinas” (Guerrero, Mexico) — hereafter ABG — hosts a significant collection of over 30 palm species, representing a characteristic assemblage within a tropical botanical garden.

Latania lontaroides (Gaertn.) H.E. Moore (Red Latan) is a popular ornamental palm endemic to Réunion Island and is listed as Endangered (EN) on the IUCN Red List. It was once believed to be nearly extinct in its native habitat, but a wild population was rediscovered nearly 20 years ago (Lavargne et al. 2004). Red Latan has since been introduced into numerous gardens worldwide (Merklinger 2016, Pagaza Calderón et al. 2019, Diez-Carretas & Asensi 2020). Since the ABG’s inauguration in March 2002, eleven individuals of Red Latan have been introduced into two sections of the garden. This palm is considered one of the iconic members of the collection and is particularly attractive to

¹Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Liga Periférico-Insurgentes Sur 4903, Parques del Pedregal, Tlalpan C.P 14010, México.
sguerrero@conabio.gob.mx .

²Jardín Botánico de Acapulco A.C. “Esther Pliego de Salinas”. Avenida Heroico Colegio Militar s/n, Frac, Cumbres de Llano Largo, C.P. 39820 Acapulco de Juárez, Guerrero. México.



1. *Latania lontaroides* individual located in the palm collection of the Acapulco Botanical Garden, Guerrero, Mexico. Photo by P. Castro-Simón.



2. Adult male of *Rhynchophorus palmarum* collected near the first deceased *Latania lontaroides*. Photo by S. Guerrero-Eloisa.

visitors for its distinctive red, fan-shaped leaves (Fig. 1).

Rhynchophorus palmarum is a weevil with a Neotropical distribution in the Americas, ranging from southern USA (Texas and California) to South America (Argentina; Wattanapongsiri 1966). Thirty-seven palm species have been identified as hosts of *R. palmarum* (EPPO 2025). External symptoms in infested palms progress gradually, beginning with yellowing of the leaves. The apical leaf bends and eventually drops, while the emerging leaves begin to dry in ascending order. Internally, galleries and damage to the petioles caused by the larvae are readily observed in heavily infested plants. Pupae and older larvae are frequently found when inspecting the canopy of affected palms. Infested tissues emit a strong, foul odor (EPPO 2005).

In Mexico, *R. palmarum* was first recorded in Baja California Sur on the native palm *Washingtonia robusta* (García-Hernández et al. 2003). It has also been reported on ornamental palm crops in Veracruz, associated with several native species (*Chamaedorea elegans*, *Roystonea regia*, *W. robusta*) and exotic species (*Chrysalidocarpus decaryi*, *Chrysalidocarpus lutescens*, *Howea forsteriana*, *Hyophorbe lagenicaulis*, *Livistona australis*, *Phoenix canariensis*, *P. roebelenii*, *Rhapis*

excelsa, *Syagrus romanzoffiana*) (Landero-Torres et al. 2015).

Attack and Control

In June 2024, an adult individual of *Rhynchophorus palmarum* was observed and collected in the palmetto section of the ABG (Fig. 2). The palm weevil was identified following the taxonomic description by Durán et al. (1998). The palms in the collection (over 150 individuals from 37 species) were examined, and an apical leaf bend and drying were observed in a specimen of *Latania lontaroides*. Upon closer inspection, individuals of the palm weevil were found at the base of the palm, which emitted a fetid odor from the apical part, indicating tissue death (Fig. 3).

The ABG environmental advisor recommended the removal and incineration of the palm as a mitigation measure. In addition, two systemic insecticides effective against sucking insects — Murralla Max (Imidacloprid + Beta-cyfluthrin; 1.5 ml per liter of water) and Podium (Abamectin; 1.5 ml per liter of water) — were applied alternately for eight weeks (four weeks per insecticide) to palms adjacent to the infected palm and others throughout the botanical garden.

Four specimens of *L. lontaroides* were identified as showing signs of infestation, such as



3 Damage in *Latania lontaroides* associated with *Rhynchophorus palmarum* infestation. Photo by S. Guerrero-Eloisa.

discoloration of the apical leaf. Of the four individuals suspected of being affected by *R. palmarum*, three died within a three-week period, and one survived. The same extraction and incineration protocol was applied to the affected palms, in which dead palm weevil individuals were observed.

During the mitigation process, ten *R. palmarum*-susceptible palms distributed throughout the ABG were treated and protected against further infestation. The ABG hosts palms such as *Cocos nucifera*, *Hyophorbe lagenicaulis*, *Phoenix roebelenii* and *Roystonea regia*, which are known hosts of *R. palmarum*

(EPPO, 2005). The presence of other resources such as *Latania lontaroides* presents an opportunity for larval establishment and expansion into new host ranges.

Acknowledgments

The environmental advisor of the Botanical Garden Eng. Rosendo Galeana provided valuable information on the identification and control measures of infected palms. We thank Cinthia Hernández Cortes for logistical support.

LITERATURE CITED

- DIEZ-GARRETAS, B. AND ASEÑSI, A. 2020. La colección de palmeras del parque de Málaga. Boletín de la Academia Malagueña de Ciencias 22: 63–67.
- DURÁN, J., YELA, J., BEITIA, F. AND JIMÉNEZ-ÁLVAREZ, A. 1998. Curculionidos exóticos susceptibles de ser introducidos en España y otros países de la Unión Europea a través de vegetales importados (Coleoptera: Curculionidae: Rhynchophorinae). Boletín Sanidad Vegetal 24: 23–40.
- EPPO, EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION. 2005. Bulletin 35. *Rhynchophorus palmarum*. 468–471. <https://doi.org/10.1111/j.1365-2338.2005.00883.x>
- EPPO, EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION. 2025. *Rhynchophorus palmarum*. EPPO datasheets on pests recommended for regulation. <https://gd.eppo.int/taxon/RHYCPA> (accessed 2025-03-27)
- GARCÍA-HERNÁNDEZ, J.L., BELTRÁN-MORALES, F., TROYO-DIÉGUEZ, E., LOYA-RAMÍREZ, G., MORALES-CORTA, J.R. AND BELTRÁN-MORALES, F.A. 2003. First record of *Rhynchophorus palmarum* (Coleoptera: Dryophthoridae) in Baja California Sur. Folia Entomológica Mexicana. 42: 415–417.
- JACAS, J.A. 2011. El picudo rojo está causando graves pérdidas económicas. Universitat Jaume I. Unitat Associada d'Entomologia Agrícola UJI-IV-IA-Castellón. http://www.guiaverde.com/noticias/el_picudo_rojo_esta_causando_graves_perdidas_economicas_312
- LAVERGNE, C., DURET, C. AND GIGROD, L. 2004. The last wild Red Latan population in the Mascarene Archipelago. Plant Talk 36: 32–33.
- LANDERO-TORRES, I., PRESA-PARRA, E., GALINDO-TOVAR, M.E., LEYVA-OVALLE, O.R., MURGUÍA-GONZÁLEZ, J., VELENZUELA-GONZÁLEZ, J.E. AND GARCÍA-MARTÍNEZ, M.A. 2015 Variación temporal y espacial de la abundancia del picudo negro (*Rhynchophorus palmarum* L., Coleoptera: Curculionidae) en cultivos de palmas ornamentales del centro de Veracruz, México. Southwestern Entomologist 40: 179–188. <https://doi.org/10.3958/059.040.0116>
- MERKLINGER, F.F. 2016. The Singapore Botanic Gardens palm collection – historical, perspective representation conservation and direction. Palms 60: 5–24.
- PAGAZA CALDERÓN, E., COLIN, F., CORTÉS, C., EQUIHUA, C., CODINA, V., AND ZONA, S. 2019. Palms and art in the Jardín Botánico Culiacán. PALMS 63: 81–88.
- SIVICOFF, SISTEMA INTEGRAL DE VIGILANCIA Y CONTROL FITOSANITARIO FORESTAL. 2018. *Rhynchophorus palmarum* (Linnaeus, 1758). https://sivicoff.cnf.gob.mx/ContenidoPublico/08%20Gu%C3%ADas%20de%20s%C3%ADntomas%20y%20da%C3%B1os/Gu%C3%ADas%20de%20s%C3%ADntomas%20y%20da%C3%B1os%20nativas/Rhynchophorus%20palmarum_Version%20Larga.pdf
- WATTANAPONGSIRI, A. 1966. A revision of the genera *Rhynchophorus* and *Dynamis*. Department of Agricultural Science Bulletin, Bangkok, Thailand 1: 1–185.

Itaya amicornum near Iquitos, Peru

WILLIAM J. BAKER¹, MICHAEL LOCK² AND VICTOR VARGAS PAREDES³

A chance meeting by a roadside in Peru led a group of lucky palm travelers to an unforgettable encounter with a near-mythical Amazonian fan palm, *Itaya amicornum*.

Prior to the IPS midterm board meeting and excursion in Peru in September 2025, a small group of participants assembled for a few days of palm exploration in the Allpahuayo-Mishana National Reserve. This spectacular protected forest lies about 30 km southwest of Iquitos in the Amazon lowlands of northeast Peru and can be accessed easily by day trips from the city. Allpahuayo-Mishana is an extremely rich palm locality, home to at least 41 species in 17 genera (Vargas Paredes et al. 2012), but as yet the most celebrated palm of the region, *Itaya amicornum*, has not been reported within the reserve.

Itaya was first described by Harold E. Moore, Jr. from specimens collected in the 1960s from forest close to the Río Itaya south of Iquitos and less than 20 km from Allpahuayo-Mishana (Moore 1972). It is one of only two coryphoid genera known from Peru (the other being *Chelyocarpus*), its closest relative being *Sabinaria*

from the Serranía del Darién on the border of Colombia and Panama. *Itaya* has a patchy distribution in the Amazon lowlands of eastern Peru and bordering provinces of Brazil and Colombia (Henderson et al. 1995, Castaño et al. 2011). Nowhere is it common. *Itaya* has also been reported (e.g., in Dransfield et al. 2008) to occur farther afield in Ecuador, but we could find no occurrence records to support this. Furthermore, two experts on American palms – Henrik Balslev of the University of Aarhus, Denmark and Andrew Henderson of the New York Botanical Garden – dispute the occurrence of *Itaya* in Ecuador (Balslev & Henderson, pers. comm.) We note that several specimens of *Itaya* have been collected in Brazil near the village of Estirão do Ecuador and speculate that a misinterpretation of the locality may have led to a spurious report for the country of Ecuador.

The palms of Allpahuayo-Mishana—towering *Mauritia carana*, graceful *Euterpe catinga*, several paddle-leaved species of *Geonoma*—were varied and often spectacular and did not disappoint. Still, our hearts were set on finding *Itaya*. With the help of Prof. Balslev, we identified a potential site a few kilometers further southwest of Allpahuayo-Mishana along one of the many dirt roads cut into the forest to promote agricultural development. Despite our

¹Royal Botanic Gardens, Kew,
Richmond, Surrey, TW9 3AE, United Kingdom

²The Merwin Conservancy, Haiku, HI, USA

³Universidad Nacional de la Amazonía
Peruana, Iquitos, Loreto, Peru



1. *Itaya amicornum* has long, arching petioles and deeply divided, Licuala-like leaves. Photo by W.J. Baker.

best efforts, access to our intended search site proved impossible due to dense secondary vegetation that had grown up where the forest had been cleared. After a few sweaty hours, we abandoned our search and retraced our steps to the main road where our vehicle was waiting. As we recovered in the shade to take

stock and make new plans for the rest of the day, we struck up a conversation with a local man and showed him photos of *Itaya*. He responded quite casually that it grows behind his house, less than 2 km back along the very same dirt road. Excited and a little skeptical, we agreed to meet him the following morning.



2 (left). The underside of an *Itaya* leaf (foreground) displays a lustrous silver color in contrast to the glossy green of the upper surface (background). 3 (right). A close-up of the silvery underside of the tip of an *Itaya* leaf. Photos by W.J. Baker.

The morning broke, overcast and cool, and we made good time on the hike to our new friend's house, which sat on the edge of a *Mauritia flexuosa* swamp across a log bridge flanked by vegetable ivory palms (likely *Phytelephas tenuicaulis*). Immediately, he led us into the forest next to the house as if it were his backyard garden and within moments showed us our first *Itaya*. It was rather short, but soon we came upon many more, some with stems to around 2 m (Fig. 1). (Moore reported that *Itaya* can reach up to 5 m.) All were growing in swampy ground next to a narrow stream with other interesting palms growing nearby, such as *Geonoma camana* and *Wendlandiella gracilis*. These plants resembled large *Licuala* palms, with long, unarmed, arching petioles and gracefully flopping deeply cut leaf segments. In contrast to *Licuala*, however, the undersides of the leaves had a lustrous silver color (Figs. 2 & 3). The center of the crown was untidy, due to a mess of detritus that had accumulated around the leaf bases, obscuring the characteristic split leaf sheaths that help distinguish *Itaya* from *Chelyocarpus* (Fig. 4). Inflorescences emerged from the crowns of a handful of the palms, highly branched and bearing yellow-green, egg-shaped fruit (Fig. 5). In some of the most

mature fruits, the epicarp (skin of the fruit) cracked and flaked off, exposing white mesocarp (flesh) beneath (Fig. 6).

Not long after midday, we were back at our vehicle, amazed at how fortunate we had been to have tracked down *Itaya* in the wild (Fig. 7). As far back as 2009, *Itaya* was already considered "a relatively difficult palm to observe" near the ever-expanding city of Iquitos (Castaño et al. 2011). We certainly found this to be the case and were especially gratified to have found a thriving, albeit small, population of *Itaya* composed of individuals of every age including mature, reproducing adults and seedlings. While still difficult to observe, our find suggests that there may be other similarly charmed pockets of *Itaya* scattered throughout the forests in the Peruvian Amazon near Iquitos.

Acknowledgments

WJB and ML owe a great debt to Víctor Vargas Paredes for accompanying us for three days in the rainforest, seeking out and identifying palms of all kinds, and having the good sense to ask everyone we encountered whether they had ever seen an *Itaya*. We also thank Fred Stauffer for his excellent advice on planning our explorations and Henrik Balslev for



4. A close look at the crown of an *Itaya* shows how it captures leaf litter from other trees among its numerous inflorescences and leaf bases. Photo by M. Lock.

persuading us off the beaten track. Special thanks are also due to our travelling companions, Mary Lock, Jeff Marcus and Sujin Marcus, for logistical support and good company.

LITERATURE CITED

CASTAÑO, F., SPICHIGER, R. & STAUFFER, F.W. 2011. Revisiting the Neotropical genera *Chelyocarpus*, *Cryosophila* and *Itaya*

(Coryphoideae: Cryosophileae). *Palms* 55: 72–83.

DRANSFIELD J., UHL N.W., ASMUSSEN C.B., BAKER W.J., HARLEY, M.M. AND LEWIS C.E. 2008. *Genera Palmarum: The Evolution and Classification of Palms*. Kew Publishing, Royal Botanic Gardens, Kew, UK.

HENDERSON, A., GALEANO, G. AND BERNAL, R. 1995. *Field Guide to the Palms of the*



5 (left). Ripening fruit on *Itaya amicornum*. The younger fruit at top is light yellow-green while the more mature fruit at bottom is yellow and brown with the skin beginning to crack and flake. 6 (right). A ripe *Itaya* fruit with the skin mostly flaked away reveals the fleshy, white mesocarp underneath. Photos by W.J. Baker.

Americas. Princeton University Press, New Jersey, USA.

MOORE, H.E. 1972. *Chelyocarpus* and its allies *Cryosophila* and *Itaya* (Palmae). Principes 16: 67–88.

VARGAS PAREDES, V., STAUFFER, F.W. AND PINTAUD, J.-C. 2012. Riqueza, usos y conversación de palmas (Arecaceae) en la Reserva Nacional Allpahuayo-Mishana (Perú). Acta Botánica Venezolánica 35: 53–70.

7. The group poses for a celebratory photo after tracking down a grove of *Itaya amicornum*. From left: William Baker, Juan Peña Ramirez, Jeff Marcus, Víctor Vargas Paredes, Michael Lock, Sujin Marcus, Mary Lock and local landowner Segundo. Photo by W.J. Baker.



The IPS is grateful for the support of the following patrons

2025

Platinum (\$15,000 and up)

Dr. Kathy Grant & Dr. Thomas Jackson, California, USA,
in support of the publication of PALMS

Gold (\$5,000 to \$14,999)

Mrs. Faith Bishock, Florida, USA
Ms. Glenn Franklin, North Carolina, USA

Silver (\$1,000 to \$4,999)

Mr. Jeffry Brusseau, California, USA
Ms. Jan Elliott, Hawaii, USA
Mr. Gregg Hamann, California, USA
Hawaii Island Palm Society
Dr. Andy Hurwitz, California, USA
Mr. Leland Lai, California, USA
Mr. & Mrs. Michael & Mary Lock, Hawaii, USA
Dr. Boyd Marts, South Dakota, USA
Ms. Tracy Sutherland, Florida, USA
Mr. & Mrs. Stan & Jane Walkley, Queensland, Australia

If you would like to make a gift, however large or small, please contact IPS
President Andy Hurwitz, ashcvs@yahoo.com or any IPS Board member.
To give on-line, visit www.palms.org.

