Palms

Journal of the International Palm Society Vol. 51(1) Mar. 2007

THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

FRONT COVER

Clinostigma warburgii, Sopo'aga Falls, Lotofaga, 'Upolu, Western Samoa. See article by D.R. Hodel, p. 11.

Palms (formerly PRINCIPES)

Journal of The International Palm Society

An illustrated, peer-reviewed quarterly devoted to information about palms and published in March, June, September and December by The International Palm Society, 810 East 10th St., P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

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Manuscripts for PALMS, including legends for figures and photographs, should be typed double-spaced and submitted as hard-copy and on a 3.5" diskette (or e-mailed as an attached file) to John Dransfield, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom. Further guidelines for authors are available on request from the Editors.

Annual membership dues of US$35.00 for Individuals and US$45.00 for Families include a subscription to the Journal. Subscription price is US$40.00 per year to libraries and institutions. Dues include mailing of the Journal by airlift service to addresses outside the USA. Single copies are US$10.00 postpaid to anywhere in the world.

Change of Address: Send change of address, phone number or e-mail to The International Palm Society, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA, or by e-mail to palms@allenpress.com

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 six months of the mailing date.

Periodical postage paid at Lawrence, KS, USA. Postmaster: Send address changes to The International Palm Society, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

PALMS (ISSN 1523-4495)

Mailed at Lawrence, Kansas March 27, 2007

This publication is printed on acid-free paper.

CONTENTS

BACK COVER

Pseudophoenix vinifera is one of the many palms that left a lasting impression on the attendees of the 2006 IPS Biennial in the Dominican Republic. Photo by Ryan Gallivan.

Features

Can the attendees of the 2006 IPS Biennial in the Dominican Republic identify this palm? Photo by Ryan D. Gallivan. For the answer, see page 50.

NEWS FROM THE WORLD OF PALMS

The IPS Board of Directors thanks Dial Dunkin, Allan Crockett and Tad Dyer for volunteering to store and distribute our 20,000+ back issues of Principes and PALMS. Storage costs at the Allen Press warehouse in Kansas have been an on-going expense for the IPS. The Board could no longer justify spending the society's funds to keep these issues in storage when all the volumes have been digitized. The Board, however, did not wish to have them destroyed. Dial, Allan and Tad generously offered to store the back issues and make them available in bulk to our affiliates, members and associates in the near future. Stay tuned for announcements on how to obtain these back issues. Again, to Dial, Allan and Tad, on behalf of the IPS, THANK YOU! At some point in the near future the entire run of Principes/PALMS will be available on-line to IPS members via the website. The run will be accompanied by an index to articles that will allow easy search and retrieval of any of the articles published in Principes/PALMS.

Christine Bacon, a Ph.D. student at Colorado State University's Molecular Plant Biology program, has been awarded the first of a newly established McBryde Graduate Student Fellowship at the National Tropical Botanic Garden for her research on the genus *Pritchardia*. Her research will answer some of the long-standing questions in *Pritchardia* phylogeny and taxonomy, as well as address the new challenges of conservation genetics. During the two years of her project, she will also collaborate with researchers at the Smithsonian Institution and Fairchild Tropical Botanic Garden.

In international news, we learned that ministers from Brunei Darussalam, Indonesia and Malaysia have signed an important declaration to protect the forested Heart of Borneo. The agreement records the intent to conserve one of the most important centers of palm diversity in the world and will end plans to create the world's largest palm oil plantation. Since 1996, deforestation across Indonesia has averaged two million hectares (7722 square miles) per year and, today, only half of Borneo's original forest cover remains. The world's largest oil palm plantation, supported by Chinese investments, was planned to cover an area of 1.8 million hectares (6949 square miles) and would have had damaging consequences to the Heart of Borneo. A pledge of US$100,000 from the US government will be disbursed through the World Wildlife Fund and the International Tropical Timber Organization. The Heart of Borneo Declaration is a tremendous victory for Borneo's rainforest palms.

It is more than little ironic that one of the greatest threats to the palms of Borneo is another palm, the African oil palm. Conservation organizations have raised concerns that the demand for bio-diesel and other bio-fuels would lead to an increase in African oil palm plantations and result in the destruction of forests throughout the tropics. Beyond the problem of deforestation is the issue of waste and pollution. The conservation advocacy group Mongabay.com reported that in 2001 Malaysia's production of 7 million tons of crude palm oil generated 9.9 million tons of solid oil wastes, palm fiber and shells, and 10 million tons of palm oil mill effluent, a mix of crushed shells, water and oil residues that has been shown to have a negative impact on aquatic ecosystems. While no one is arguing for a cessation of palm oil production, the economic growth of a region needs to be balanced by its conservation needs.

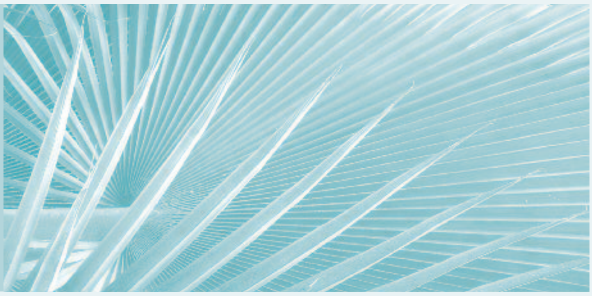
THE EDITORS

GROWING PALMS

Horticultural and practical advice for the enthusiast

Edited by Randy Moore

Contents



Leaning Crown Syndrome

A serious yet unexplained malady of palms is gaining wider attention in California and elsewhere. First recognized at least 25 years ago, I call it Leaning Crown Syndrome (LCS) because affected palms lose their geotropic response, their crowns of leaves leaning and growing horizontally before, in severe cases, actually growing back down toward the ground. Such abnormal and bizarre growth detracts greatly from the palm's esthetic and commercial value and, in the most severe cases, results in death. There is no documented cause or remedy for this condition.

Although first seen on *Howea forsteriana* (kentia palm), I have observed LCS or similar symptoms on *Archontophoenix cunninghamiana* (king palm), *Phoenix dactylifera* (date palm), *P. reclinata* (Senegal date palm), *Syagrus romanzoffiana* (queen palm), and *Trachycarpus fortunei* (Chinese windmill palm). Others have reported observing it on additional species.

1. *Howea forsteriana* showing moderate to severe symptoms of LCS.

The first symptoms of LCS are abnormal petioles, which tend to bend or curve in the same direction, pushing the leaf blades toward one side of the palm (Figs. 1, 2). If the condition persists, the center growing point (center bud or apical meristem) will gradually change orientation from a near vertical to horizontal and eventually downward alignment. The process can takes months or even years.

In LCS-afflicted kentia palms, at least, pinnae are set much more closely on the rachis and are a darker green than those of unaffected palms. In LCS-afflicted king palms, nodes or leaf scars tend to be slanted rather than horizontal, as if one side of the trunk is growing vertically faster than the adjacent opposite side, thus forcing the palm to bend or lean. In kentia palms, however, slanted leaf scars are probably not a reliable indicator of LCS because even normal palms have leaf scars in a variety of alignments. In some instances with LCS-afflicted kentia palms the apical growth appears to have expanded upwards very quickly, giving the impression it might be unusually weak and thus prone to bending (Fig. 2).

Twice, in 1985 and 2001, I cut down LCS-afflicted kentia palms and took the center bud and adjacent tissues to the University of California at Riverside for analysis by the soil and plant tissue lab and the departments of entomology and plant pathology. Analyses showed that there were no abnormal levels of any elements in the palm tissue, and there were no diseases or insect or mite pests present.

Chapin and Ooka reported LCS or a similar condition on *Pritchardia pacifica* in Hawaii; although they were unable to identify a causal agent (*Palms* 47:107–109. 2003.). The same or a similar condition in Florida has been attributed to boron deficiency (T. Broschat and A. Meerow, *Ornamental Palm Horticulture*. 2000.), yet soils in California typically have more than adequate levels of this element. Also, with kentia palms in California, which are commonly found in the landscape as multiples because they were grown as such in the nursery, it is only one plant out of a group of several that is affected by LCS even though it is obvious that the roots of all individuals in the group are intertwined.

Darley and co-workers reported that a condition similar to LCS affected *Phoenix dactylifera* 'Barhee' (now known as "Barhee Bending"), although they also were unable to determine its cause (Date Growers' Inst. Ann. Rep 37: 10–11. 1960; Date Growers' Inst. Ann. Rep. 41: 15. 1964). Yost, a date grower in California, later reported that he corrected Barhee Bending by rearranging the heavy infructescences to hang on the opposite side of the trunk from the bend (Date Growers' Inst. Ann. Rep. 45: 2. 1968.).

Several collectors have purportedly "cured" their LCS-afflicted kentia palms by drenching the center bud with a copper-based fungicide or by removing all the leaves and cutting down horizontally through the crown area to expose the center bud. However, these undocumented and unverified procedures are not the result of a controlled, replicated study so their efficacy is somewhat dubious. Indeed, in some instances, LCS-afflicted palms have, after a while, resumed normal growth.

2. *Howea forsteriana* showing the bending and leaning of the apical bud area typical of LCS.

According to kentia palm seed producers on Lord Howe Island, where the palm is endemic, LCS has not been observed or recorded. Strangely, though, kentia palms seed producers not too far away on Norfolk Island, where kentia palms have been planted by the 1000s for seed production, have reported that LCS occasionally occurs. On Norfolk Island, seed producers treat LCS-afflicted palms by applying direct, opposing, physical pressure or tension to the bud area. Typically, they attach a strong rope to the leaning or bending crown or center bud area of a LCS-afflicted palm, pull the rope taut to apply sufficient pressure to the crown or bud, and tie the rope off to secure object, such as a building, sturdy post, or other palm. They retie or readjust the rope periodically to maintain fairly strong pressure or tension on the leaning crown or bud.

On kentia palms I have observed a bud rot, perhaps pink rot caused by the fungus *Gliocladium*, followed by an insect infestation distorting the new emerging growth in such a manner that it began to lean very slightly to one side in a way somewhat similar to LCS. I arrested this condition, though, by applying a fungicide and an insecticide and, perhaps most importantly, providing proper culture, such as irrigation, nutrition and mulching.

Multiple causes for LCS are a distinct possibility. Perhaps viruses or virus-like agents or even genetic instability should be considered. I urge anyone observing or having experience with LCS or similar conditions to contact me. I would like to devise an appropriate research strategy to determine the cause of and solution for this serious malady. – *Donald R. Hodel, University of California, Cooperative Extension, 4800 E. Cesar Chavez Ave., Los Angeles, CA 90022, USA, drhodel@ucdavis.edu.*

Palm Horticulture in the Rose Hills Foundation Conservatory for Botanical Science, Part I

In a strict sense, the conceptual beginnings of the Rose Hills Foundation Conservatory for Botanical Science at the Huntington Botanical Gardens in San Marino, California date to the early 1990s. However, the historical impetus for this ambitious project goes back to the early part of the 20th Century. At that time, Henry E. Huntington built a grand lath house whose design inspired the current modern-yet-classical building (Fig. 1). This precursor was located very near the site of the present structure but was demolished about 50 years ago. With ties to the past and a view toward the future, the Conservatory complements the institution's many historic buildings.

The Conservatory belongs to an inclusive Botanical Center that encompasses the Children's Garden, Nursery and Botanical offices. Combined with the new Chinese Garden, these works represent over 20 years of planning and the cultivation of generous support from a wide range of donors. They are the first major Botanical Division building projects at The Huntington in over 60 years.

1. The south façade of the recently constructed Rose Hills Foundation Conservatory for Botanical Science at the Huntington Botanical Gardens.

With three distinct environments – tropical rainforest, cloud forest and carnivorous plant bog, as well as a living plant science lab – this unique resource functions as an interactive science center for children and families. Exhibits are designed to engage youngsters (emphasis on ages 9–12) in hands-on experiments using scientific instruments and living plants to explore the natural world around them. The facility serves to support a program of botanical science education and helps develop and sustain the living collections. Beyond this core mission, many visitors simply enjoy observing beautiful and unfamiliar plants in a rarified setting and leaving with fond memories.

The overall area of this steel and glass building is 1,500 sq. meters. Of this area, only one-third is devoted to planting space. At first this seems like a generous allowance for walkways and other hardscape features, but this ratio has worked out well. Palms are concentrated in the Rotunda (tropical rainforest) section (Fig. 2). This room features relatively small beds along the upper deck, too small for most palms, while the main section is sunken below this level and houses most of our larger specimens. Varying topography is one of the best features of this area. From the lowest point to the roof of the dome is about 13 m.

Climate

Climate control for the Conservatory is concentrated in a circular plenum running beneath the main walkway of the Rotunda section. In our mild Mediterranean climate, heating is not a significant challenge and is handled by two 1-million BTU units, one acting as back-up. Cooling is more complex and depends primarily on a system of underground tunnels that carry air cooled by armatures of fog nozzles inside the tunnels (i.e., cooling by evaporative transpiration). In addition, overhead manifolds generate large quantities of fog in all galleries and help both to cool and humidify. The cooling system is well suited to our warm, dry climate but loses much of its effectiveness during occasional hot, humid weather.

Almost all of the palms in the Conservatory are planted in the Rotunda, and the following figures relate to this gallery only (the remaining three galleries all experience cooler night temperatures). In winter, the nighttime low temperature (heating set-point) is about 18ºC/65ºF, with a high of about 24ºC/75ºF by day. This daytime high figure for winter reflects ambient solar input during fair weather; daytime heating set-point is 20ºC/68ºF. Humidity in winter is 70–75% by day and around 80% at night. Over the summer, the night-time low temperature gradually increases to about 21ºC/70ºF, usually without any supplemental heating, even though outdoor temps in our area stay below 21ºC/70ºF except for the few very hot and humid days of the year. During

2. The interior of the Rotunda section of the Conservatory that exhibits a tropical rainforest environment with an emphasis on palms.

the daytime in summer, highs are kept to about 27–29ºC/80–85ºF but can climb to around 32ºC/90ºF during hot spells, when outdoors it may be over 43ºC/110ºF. Humidity at night in the summer is about 90% and dips to about 80% during the day. With set-points agreeing closely between winter and summer there is no great need for autumn and spring climate templates, and these may be omitted eventually. Since the building was planted in late summer 2005, we have made constant, incremental adjustments every few weeks or months, and the frequency of these has diminished over time.

In general, it may be that the climate conditions outlined above are slightly too cool on average for some tropical plants, including certain palms (to be covered in Part II: "The Palms"). Obviously slower growth results from cooler conditions, and whether some palms can maintain healthy and vigorous slower growth is as yet unknown. While warmer, muggy nights would doubtless be a boon to many low elevation tropical species in the Rotunda, such conditions would also encourage most insect pests and some diseases. This effect is consistently demonstrated in our two tropical greenhouses, one kept under intermediate conditions and the other under warm conditions (as per orchid culture).

Soil Mix

Some of the considerations in developing our soil mix were as follows: longevity, porosity (drainage), neutral to slightly acid pH, and aesthetics. Some aspects of choosing a planting mix that in hindsight should have received more attention were settling (solution: a lower % of fir bark and/or fuller beds), cation exchange capacity (solution: addition of some clay and/or silt) and hydrophobic properties (solution: add a wetting agent). The mix used throughout the Conservatory for all terrestrial plants is as follows:

40% 0-1/4 inch (1 cm) fir bark
20% #20 silica sand
10% 5/16 inch (0.8 cm) scoria
10% 3/16 inch (0.5 cm) scoria
8% charcoal (from coconut shell)
7% coarse peat
5% Turface®

Incorporated into each cubic yard (765 liters or 0.76 cubic meters) of this mix were the following additives:

0.9 kg (2 lbs) Micro-Max
2.7 kg (6 lbs) Nutricote® 16-6-8
1.8 kg (4 lbs) dolomite
1.8 kg (4 lbs) Nitriform
0.9 kg (2 lbs) triple super phosphate
0.5 kg (1 lb) potassium nitrate
0.2 kg (0.5 lb) iron sulfate

All of these ingredients were gathered together and mixed by A1 Soils in San Diego, a division of Hanson Aggregates. Price varied between US$135.00 and $180.00 per cubic yard, depending on the load size.

Irrigation

Aspects of water quality and application of water to planted areas are among our greatest ongoing challenges. Upon its implementation we realized that the cooling system described above would use essentially all of the reverse osmosis (RO) water produced and stored, at least during hot weather. The actual constraint is RO water storage rather than production, making the solution fairly simple conceptually. In the meantime we are using city water, which normally varies from 250 to 350 ppm tds (higher in summer), the main salts being sodium and calcium.

The application of water is limited by a system that is similarly undersized for the scope of the project. A network of twin quick-couplers throughout the Conservatory, each pair consisting of one city water connection and one RO water connection, is used to attach hoses and hand-water, or set-up hose-end sprinklers. As it is not possible or desirable to water all plantings throughout the building at once, calculating frequency of watering is only approximate. Most areas are watered once every three or four days in winter and every two or three days in summer. Ideally, all watering is performed in the early evening or late afternoon, but schedule considerations and public hours dictate that most watering occurs during mid-morning. (Incidentally, in the greenhouses, plants are routinely left wet overnight and this "natural" condition has not caused any disease problems). Plans are underway to develop a simple irrigation system that will run manually or automatically and employ various "mini sprinkler" technologies. This system would operate in conjunction with continued hand-watering in certain areas.

Problems under this arrangement are what might be expected, including inadequate saturation (especially where the medium has dried out and become hydrophobic), water spotting on foliage and eventual cumulative salt build-up in the root zone. A few palms have exhibited salt tip burn but most have adapted well to current conditions. A further issue that is very important, even in our mild climate, is tempered or warmed water. Ground temperature of our city water ranges from about 16ºC/60ºF in winter to 21ºC/69ºF in summer. Warming this range up by about 10ºC/20ºF would doubtless have a positive and noticeable impact on most plants, especially palms.

Fertilization

The initial mix of additives detailed above was depleted after about ten months. Supplemental fertilizing has consisted mainly of top dressings of Nutricote® 18-6-8 and liquid injector feeding with GrowMore® hydroponic 5-11-26 with micronutrients, at about 160 ppm N. Most irrigation occurs without fertilizer, however, due to time constraints and the difficulties of having our volunteers fertilize. Much of the Conservatory watering chores are performed by our volunteer corps. A good incentive for us to use the hydroponic formula frequently at the recommended application rate is that this fertilizer drops the pH of our city water from around 8 to around 7. Occasional applications of Mycor Palm Saver™ (6-3-6 with endomycorrhizal package and micronutrients) and calcium nitrate (CaN) have also been used. Rates used for all of these products were toward the low end of manufacturers' recommendations and probably too low for heavy feeders, including many of the palms. It is worth experimenting with different formulations and methods of application, and we are continuing this process on an informal basis. In particular, the use of fertilizers with N mostly in the form of nitrate nitrogen (with only a small percentage of ammoniacal or urea nitrogen) makes a notable difference in growth and flowering in certain plants (amaryllids, orchids, etc.) and presumably provides better nitrogen nutrition for many other plants also. A comprehensive baseline analysis (structural, chemical, microbial) of our in situ planting mix after continued use of this fertilization program is currently under way.

We have used top dressing fertilizers high in nitrogen to supplement our usual low nitrogen liquid fertilizer (5-11-26). The latter is effective in producing more compact, disease-resistant growth that never looks lush, but for palms and some other plants the top dressing fertilizers and occasional feeding with CaN are helpful in maintaining vigor and good color. A few years ago I learned from an agricultural advisor that most plants (except turf and bedding annuals) benefit from a formulation with potassium and phosphorus *twice* the level of nitrogen, with potassium even a little higher. In effect this means that common formulations with, say, a 20-20-20 ratio may provide proportionately excess nitrogen. This approach has worked well for almost all of our tropical plants, though some commercial growers will probably want to accelerate growth with different ratios. – *Dylan P. Hannon, Curator of Conservatory and Tropical Collections, Huntington Botanical Gardens, San Marino, California USA*

Unraveling *Clinostigma* in Samoa

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Field work has revealed that Samoa is home to three species of *Clinostigma*, the handsome, highly ornamental, quintessential palms of the South and West Pacific. Two species, *C. samoense* and *C. warburgii*, occur on 'Upolu while the third one, *C. savaiiense*, is found on Savai'i.

Samoa includes nine inhabited islands and two political regions in the Pacific Ocean between 13 to 15° south and 168 to 173° west, about 4200 kms south of Hawaii, 2200 kms west of Tahiti, and 2900 kms northeast of New Zealand. The two largest islands, Savai'i and 'Upolu, comprise the independent state of Samoa (formerly Western Samoa) while Tutuila and several smaller islands in the eastern part of the archipelago comprise the U. S. territory of American Samoa. Polynesians settled and inhabit the islands and enjoy a year-round, wet, tropical climate. Centuries of human activity and a series of strong tropical cyclones in the last 20 years devastated much of Samoa's fragile forests. Undisturbed, closed-canopy primary forest is uncommon while highly disturbed and altered primary and secondary forests, typically with many exotic, invasive weed species, predominate.

Six genera of palms are recorded for Samoa: *Balaka* (2–4 species); *Clinostigma* (3 species); *Cocos nucifera* (coconut); the mysterious and enigmatic *Drymophloeus whitmeeanus*; *Metroxylon* (1 or 2 species); and the rather shy *Solfia samoensis*. All genera and species occur in Samoa while only the coconut occurs in American Samoa (*Clinostigma* and *Metroxylon* have been recorded from Tutuila although it is thought that they are cultivated and were brought from Samoa).

The focus of this paper is on *Clinostigma*, which includes about 11 or so species native in a great, sweeping arc from the Ogasawara and Caroline Islands in the west Pacific Ocean to New Ireland, Solomon Islands, Vanuatu, Fiji, and Samoa in the south Pacific. While unusual, this vast, insular distribution is not unique among the palms. The coconut, *Heterospathe*, *Metroxylon*, and *Pritchardia*, among others, have a similar distribution. *Clinostigma* are highly ornamental and typically have a handsome, smooth, waxy-white, ringed trunk topped with a conspicuous, lime-green crownshaft and splendid crown of spreading leaves with elegantly pendulous pinnae.

Samoan *Clinostigma* differ from other members of the genus on nearby island groups, such as *C. exorrhizum* (Fiji) and *C. harlandii* (Vanuatu), in the lack of prominent stilt roots at the base of the trunk and black rather than red fruits.

In Samoa *Clinostigma* has had a long and somewhat tortured and complex taxonomic history comprising up to six taxa and eight names. In December 1978 I visited Samoa and made four collections of seeds of *Clinostigma* from 'Upolu, two each of what I called *C. samoense* and *C. onchorhynchum*, and distributed them to several botanical gardens in Hawaii and palm growers in Hawaii, California and Florida. At the time, I based these species determinations entirely on fruit shape and size and position of the stigmatic remains because the most current information in the literature at that time (Moore and Fosberg 1956, Moore 1969) and personal communication with the late Dr. Harold E. Moore, Jr. suggested that these were the most important and reliable characters for distinguishing species of *Clinostigma*.

Near sea level along the northern and southern coasts of ‘Upolu I made collections in two localities where the fruits were rounded, 7–10 mm diam., and with the stigmatic remains about midway between the top and bottom. I referred to these two collections as *Clinostigma samoense*. In the central highlands of ‘Upolu I made collections in two localities where the fruits were markedly longer than broad, 15–18 mm long, and with the stigmatic remains near the top. I referred to these two collections as *C. onchorhynchum*.

At least one each of my *Clinostigma onchorhynchum* and *C. samoense* collections from ‘Upolu have been flowering and fruiting for several years at Ho’omaluhia Botanical Garden of the Honolulu Botanical Gardens system in Hawaii. While visiting Ho’omaluhia in 2004, I examined these collections carefully and was able to distinguish the two taxa based solely on fruit size and shape, as I had done more than 25 years earlier on ‘Upolu in Samoa. However, I was surprised to notice that the branching pattern or architecture of the inflorescences of the two taxa was markedly different as well, a character to which I and others had given little, if any, attention. The *C. onchorhynchum*, with larger fruits longer than broad, had broom-like inflorescences branched to two orders and thick, coarse, narrowly diverging rachillae. The *C. samoense*, with smaller, rounded fruits, had diffuse inflorescences branched to three orders and slender, widely spreading rachillae.

My surprise at the differences in inflorescence architecture between what I and others had referred to as *Clinostigma samoense* and *C. onchorhynchum* was due in part to the fact that Cox and Moore (1986) had thoroughly discounted fruit shape and size as reliable characters for distinguishing these two species. Indeed, in their paper, they relegated *C. onchorhynchum* to a synonym of *C. samoense*, a fact to which I was aware during visits to Hawaii in 1998 and 2000. At those times I informed the staff at Ho’omaluhia Botanic Garden about this nomenclatural change and, based on my recommendation, they adjusted the labels accordingly.

The rather dramatic differences in inflorescence architecture I had noticed between the two taxa in 2004 at Ho’omaluhia Botanical Garden, and a subsequent visit in 2005, though, prompted me to investigate further *Clinostigma* on ‘Upolu. Based on inflorescence architecture alone, there are clearly at least two taxa, but the appropriate application of names to these taxa remained elusive.

In October 2005 I again visited Samoa and other islands in the southwestern Pacific to gather information and take photographs as part of a project I am leading that will result in a publication on the palms of Pacific Islands. This paper summarizes the findings about *Clinostigma* in Samoa from that trip as well as information gleaned from the cultivated plants in Hawaii that were grown from seeds I collected in Samoa in 1978, examination of specimens in several herbaria, and a review of the literature.

History of *Clinostigma* in Samoa

The tortured and complex taxonomic and nomenclatural history of *Clinostigma* in Samoa begins and is centered on the island of ‘Upolu (Table 1). Hermann Wendland (1862) established *Clinostigma* when he named and described *C. samoense* from material that Pickering (*Pickering s. n.*) had collected on ‘Upolu during the United States South Pacific Exploring Expedition of 1833–1842. Asa Gray of Harvard University, who was preparing the botanical account of the Expedition, had forwarded Pickering’s material to Wendland, one of the leading palm botanists of the time.

According to Christophersen (1935) and Moore and Fosberg (1956), Wendland had commented that the material upon which he based the new genus and species was incomplete and contained fragments from Savai’i. Wendland’s specimen consisted of part of a leaf, one of the main branches of an inflorescence with fertilized pistillate flowers, and the tips of some rachillae with immature fruits, the latter labeled “Savai’i” and with the stigmatic remains midway between the base and apex (Christophersen 1935). Although Wendland’s material was incomplete and perhaps mixed, Moore and Fosberg (1956) felt that “the major part of the description corresponds with what appears to be a duplicate specimen at the Gray Herbarium” (GH).

The specimen at GH consists of part of a leaf, a branch of the inflorescence, and loose immature and rounded, nearly mature fruits, all labeled as being from ‘Upolu and annotated

Table 1. Summary of names of *Clinostigma* in Western Samoa and their status, 1862 to 2006.

Name	Status	Author & Date	Collection cited	Location
Clinostigma samoense	new species	Wendland (1862)	*Pickering s. n.*	‘Upolu
	syn. of *Cyphokentia samoensis*	Rechinger (1907, 1910)		
	as *Clinostigma onchorhynchum*	Langlois (1976); Whistler (1992)		
Cyphokentia samoensis	new name (combination) based on *Clinostigma samoense*	Warburg (1898)		
	syn. of *Clinostigma samoense*	Beccari (1910)		
	syn. of *Clinostigma onchorhynchum*	Burret (1928)		
Clinostigma warburgii	new species	Beccari (1934)	*Reinecke 322*	Lake Lanoto’o, Upolu
	as *Clinostigma samoense*	Langlois (1976); Whistler (1992)		
	syn. of *Clinostigma samoense*	Whistler (1992); Hodel (1999)		
	as *Clinostigma* sp. “Eastern ‘Upolu”	Hodel (2006)		
Clinostigma onchorhynchum	new species	Beccari (1913)	*Whitmee s. n.*	Lake Lanoto’o, Upolu
	syn. of *Clinostigma samoense*	Cox and Moore (1986); Hodel (2006)		
Clinostigma powellianum	new species	Beccari (1913)	*Powell 246*	Western Samoa (no locality cited)
	synonym of *Clinostigma samoense*	Martelli (1935); Whistler (1992); Hodel (2006)		
Clinostigma savaiiense	new species	Christophersen (1935)	*Christophersen 2267*	Matavanu, Savai’i
Exorrhiza vaupelii	new species	Burret (1935)	*Vaupel ???*	Maugaloa, Savai’i
Clinostigma vaupelii	new name (combination) based on *Exorrhiza vaupelii*	Burret (1935)		
	synonym of *Clinostigma savaiiense*	Whistler (1992); Hodel (1999, 2006)		

1. Holotype of *Clinostigma samoense* (GH).

with an unpublished name in Wendland's handwriting (Moore and Fosberg 1956). The name "Savai'i" does not appear on the specimen. The inflorescence is distinctive in its broom-like appearance with thick, coarse, narrowly diverging rachillae (Fig. 1).

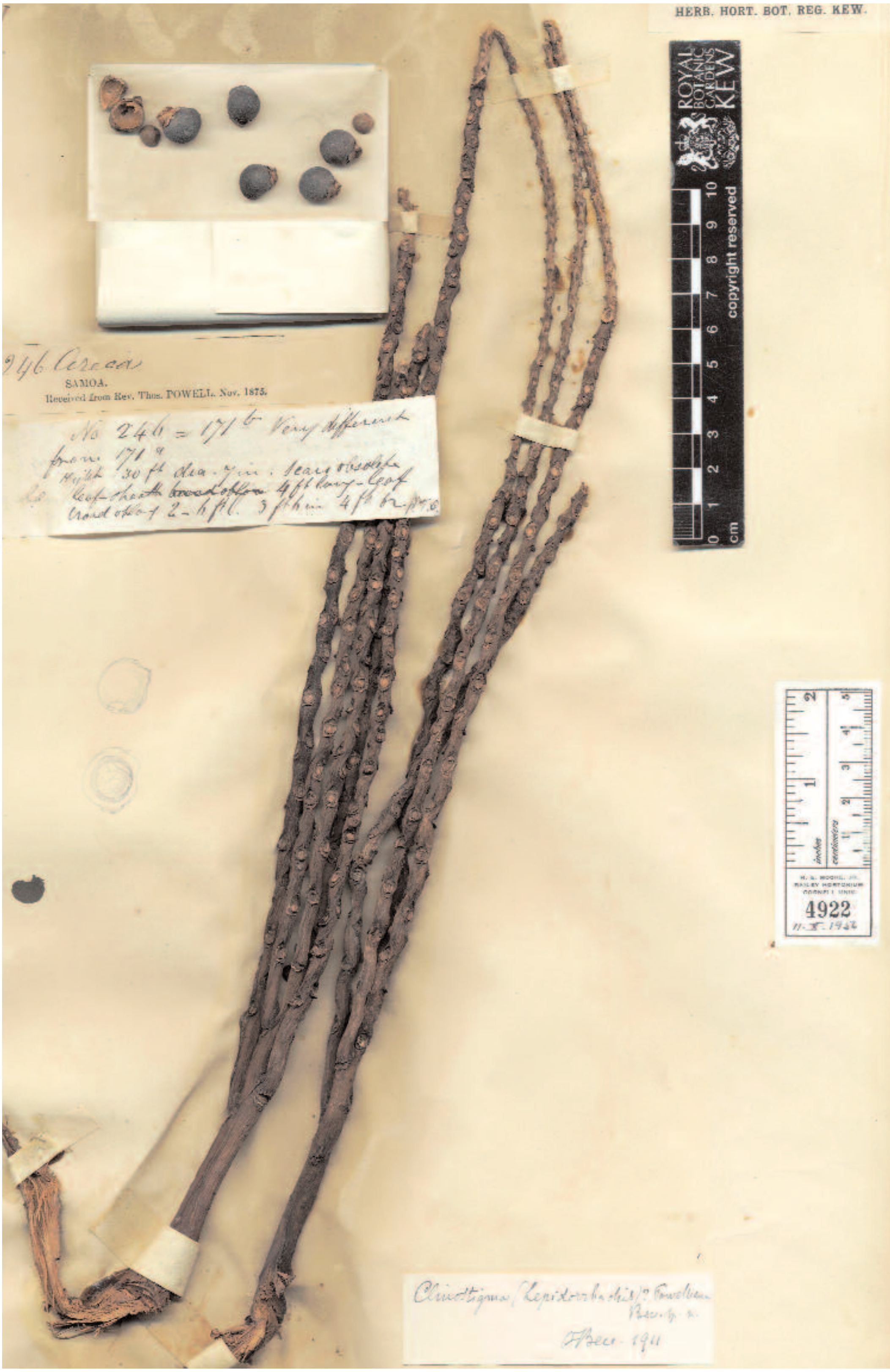
Over 35 years later, Warburg (1898) examined material that Reinecke (*Reinecke 322*) had collected at Lake Lanoto'o in the central highlands of 'Upolu in 1894. Warburg compared it to Wendland's *Clinostigma samoense*, and, while he stated that *Reinecke 322* was probably referable to *C. samoense*, he also enumerated several differences between the two. Warburg then apparently proposed the new name *Cyphokentia samoensis* although his intentions are far from clear.

His actions raise these questions: Had he decided that *Cyphokentia samoensis*, based on *Reinecke 322*, was distinct from *Clinostigma samoense* and, thus he was naming a new species; or, had he decided that *Clinostigma* was an incorrect genus for this species and, thus, he was transferring it to *Cyphokentia* and proposing the new combination?

One might argue that Warburg was, indeed, naming a new species because he cited "*n. 322*," obviously referring to *Reinecke 322*, and enumerated several differences between the two. If so, then two different types are involved and *Cyphokentia samoensis* must be a new species name, not a combination, and the names are considered heterotypic (based on different types). It is unfortunate, though, that Warburg chose the epithet "*samoensis*" for *Reinecke 322* because it offers only confusion, not clarity, to the situation.

However, I feel that *Cyphokentia samoensis* must be regarded as a new combination, based

2. Holotype of *Clinostigma onchorhynchum* (K).



3. Holotype of *Clinostigma powellianum* (K).

on *Clinostigma samoense*, rather than a new species because Warburg used the epithet "*samoensis*" and he did not use the abbreviation "*n. sp*." (new species) after the new name or provide a Latin description, as he did for other, obviously new species he named in the same article. Because he was not naming a new species, he was not designating a type when he referred to *Reinecke 322*; thus, the names *Cyphokentia samoensis* and *Clinostigma samoense* must be considered homotypic (based on the same type).

Regardless, Warburg's illustration of inflorescences and a branch of the inflorescence with narrowly diverging rachillae appear broom-like and somewhat similar to that of *Clinostigma samoense* but the rachillae are much more slender. (We shall see later that a duplicate of *Reinecke 322* discovered at the Bishop Museum, Honolulu, Hawaii (BISH) has slender rachillae like that in the illustration, but they differ dramatically in their spreading nature.) Fruits of *Reinecke 322*, as depicted in Warburg's description and illustration, are immature with the stigmatic remains near the apex.

Several years later, Rechinger (1907, 1910) listed *Cyphokentia samoensis* from 'Upolu and cited two of his collections from higher elevations in the central part of the island, including Lake Lanoto'o, and noted it also occurred on Savai'i. Rechinger stated that *Clinostigma samoense* was probably a synonym of *Cyphokentia samoensis*.

Shortly thereafter Beccari (1910), after examining the sparse material composing *Reinecke 322* at Breslau, took the opposite position and listed *Cyphokentia samoensis* as a synonym of *Clinostigma samoense*, indicating that he thought the two were heterotypic and Warburg was naming a news species in 1898.

Three years later Beccari (1913) named and described two species of *Clinostigma* from Samoa, both with apparently mature fruits, the first known for the genus. One, *C. onchorhynchum* (*C*. "*onchorhyncha*"), was based on material Whitmee (*Whitmee s. n.*) had collected at Lake Lanoto'o on 'Upolu in 1875. Beccari noted it had broom-like inflorescences (he used the term "*scopaeformis*") branched to two orders. While Whitmee's sparse, incomplete type at Kew (K) does not show the broom-like architecture, the rachillae are thick, coarse, and narrowly diverging (Fig. 2) and are rather similar to those of *C. samoense*. Fruits of the type, similar to those of *C. samoense*, are mostly rounded with the stigmatic remains midway between the base and apex or toward the apex. Strangely, Beccari's illustration in the literature clearly shows the fruits to be longer than broad with the stigmatic remains very near the apex.

Beccari's other new species, *Clinostigma powellianum* (*C*. "*powelliana*"), was based on material without a specific locality in Samoa that Powell (*Powell 246*) had collected. Beccari noted it had more spreading inflorescences (he used the term "*diffuses*") branched to two orders and nearly rounded fruits. Examination of Powell's type material at K, though, shows the thick, coarse rachillae to be narrowly diverging and scarcely different from those of *C. samoense* and *C. onchorhynchum* (Fig. 3). Fruits, very similar to those of *C. onchorhynchum* and even *C. samoense*, are mostly rounded with the stigmatic remains near the apex.

Some years later, Burret (1928), after examining Rechinger's collections from Lake Lanoto'o, concluded that *Cyphokentia samoensis* was best placed with *Clinostigma onchorhynchum*, not *C. samoense*, as earlier workers had suggested or concluded.

Later, Beccari had apparently become skeptical about listing *Cyphokentia samoensis* as a synonym of *Clinostigma samoense*. In a posthumously published paper that Martelli prepared after Beccari's death in 1920, Beccari (Martelli 1934) reversed himself and resurrected *Cyphokentia samoensis* from synonymy with *Clinostigma samoense* and renamed it *Clinostigma warburgii* (the epithet *samoense* already being taken by Wendland), stating it differed sufficiently in the nature of the fibers of the fruit mesocarp.

Obviously, Beccari's interpretation of Warburg's intentions when he named *Cyphokentia samoensis* over 35 years earlier differs from mine. Although he provided a Latin description, Beccari used the abbreviation "*n. nov*." (new name), indicating he was not naming a new species but simply proposing a new name for Warburg's existing species. Thus, Beccari clearly regarded *Cyphokentia samoensis* and *Clinostigma samoense* as heterotypic, believing when Warburg named *Cyphokentia samoensis* he did so as a new species rather than a new combination. Also, there was no need for Beccari to designate a type formally because a "*n. nov*." is typified by the name it

4. Isotype of *Clinostigma warburgii* (BISH).

replaces, which in this case is *Cyphokentia samoensis*; thus, under Beccari's interpretation, the type for *Clinostigma warburgii* is automatically *Reinecke 322*.

However, some might contend, as I do, that, if Warburg (1898) were not naming a new species but simply making a new combination when he proposed the new name *Cyphokentia samoensis*, then Beccari would have been obliged to name *Clinostigma warburgii* as a new species and state "*n. sp.*," rather than "*n. nom.*" as he had done, and designate a type, because there would have been no existing species and type upon which Beccari could have based his new "*n. nom.*"

Although I feel that Beccari erred, his misinterpretation of Warburg's intent is a relatively minor point because he had clearly come to the correct and appropriate decision that *Reinecke 322* was distinct from Wendland's *Clinostigma samoense*. Whether Beccari employed the terms "*n. nov.*" or "*n. sp.*" in formalizing his position is a minor, irrelevant detail, especially because rules governing such protocol were lacking and unclear at that time. What is important is Beccari's intent, which is clear, and it should render moot whether Warburg was naming a new species or simply making a new combination when he proposed *Cyphokentia samoensis*.

Martelli (1935), in a listing of palm genera and species, followed Beccari and continued to recognize *Clinostigma warburgii* but placed *C. powellianum* as a synonym of *C. samoense*.


5 (left). *Clinostigma samoense* has broom-like inflorescences branched to two orders with thick, coarse, narrowly diverging rachillae, Ho'omaluhia Botanical Garden (*HBG 78.0891*) *ex* Tiavi, 'Upolu, Samoa (*Hodel 469*). 6 (right). *Clinostigma warburgii* has "bushy" inflorescences branched to three orders with slender, widely spreading rachillae, Ho'omaluhia Botanical Garden (*HBG 78.0889*) (*Hodel 2008*) *ex* Salelesi, 'Upolu, Samoa (*Hodel 462*).

Christophersen (1935) named and described the first *Clinostigma* from Savai'i, *C. savaiiense*, based on material he had collected (*Christophersen & Hume 2267*) above Matavanu Crater. Nearly simultaneously, Burret (1935a) named and described another species from Savai'i, *Exorrhiza vaupelii*, from material that Vaupel had collected near Maugaloa ("Mangaloa"), and almost immediately suggested transferring it to *Clinostigma* (Burret 1935b).

Although the naming of new species of *Clinostigma* from Samoa ceased after 1935, subsequent workers continued to interpret and reinterpret these earlier works and meager collections. Despite the fact that many of the earlier collections had immature fruits, later workers placed much emphasis on fruit size and shape and the position of the stigmatic remains, either in the middle or towards the top of the fruit, in distinguishing species. Little or no significance was given to inflorescence architecture.

For example, Christophersen (1935) felt that Pickering's and Reinecke's material had differences at least of specific value because the fruits, while immature in both cases, were different, rounded in Pickering's and somewhat oblong in Reinecke's. Moore and Fosberg (1956) and Moore (1969) stated that *Clinostigma onchorhynchum* and *C. savaiiense*, with fruits having apical stigmatic remains, differed at a specific level from *C. samoense*, with fruits having stigmatic remains midway between the base and apex.

In contrast, Cox and Moore (1986) lost favor with fruit size and shape as reliable, distinguishing characters and, after examining collections with immature fruits from several localities on 'Upolu, relegated *Clinostigma onchorhynchum* to synonymy with *C. samoense*. Unfortunately, they did not address the disposition of any other names of Samoan *Clinostigma*.

Whistler (1992), returning to fruit size and shape as reliable, distinguishing characters, stated that there were two species on 'Upolu, *C. onchorhynchum* (with large oblong fruits) and *C. samoense* (with small rounded fruits), and one species on Savai'i, *C. savaiiense* (with small oblong fruits). He listed *C. warburgii* and *C. powellianum* as synonyms of *C. samoense* and *C. vaupelii* as a synonym of *C. savaiiense*.

A few years later in a very short, popular summary of the genus (Hodel 1999), I recognized only one species in Samoa, *Clinostigma samoense*, and listed all the other names from Samoa as synonyms.

Recently, after examining *Clinostigma* in Samoa, my living collections in Hawaii, types of *C. samoense*, *C. onchorhynchum*, and *C. powellianum*, and the literature, I recognized three species in Samoa based entirely on inflorescence architecture, two on 'Upolu and one on Savai'i (Hodel 2006). On 'Upolu I recognized *C. samoense* (inflorescence branched to two orders with thick, coarse, narrowly diverging rachillae) and *C.* sp. "Eastern 'Upolu" (inflorescence branched to three orders with slender, widely spreading rachillae). I considered *C. onchorhynchum*, *C. powellianum*, and *C. warburgii* as synonyms of *C. samoense*. I recognized *C. savaiiense* and its synonym *C. vaupelii* as restricted to Savai'i.

However, the recent discovery of authentic material of *Reinecke 322* (Fig. 4) at BISH was key to unraveling the *Clinostigma* puzzle in Samoa because I could clearly see that, with its slender, widely spreading rachillae, it represented *Clinostigma* sp. "Eastern 'Upolu"; thus, the best name for this species is *C. warburgii*.

Summary of *Clinostigma* in Samoa

In summary, there are clearly three species of *Clinostigma* in Samoa, two on 'Upolu and one on Savai'i, and we can now apply names to them with some degree of confidence. On 'Upolu, *C. samoense* has broom-like inflorescences branched to two orders with thick, coarse, narrowly diverging rachillae (Fig. 5) and typically larger, oblong fruits with the stigmatic remains toward or near the apex. Also on "Upolu, *C. warburgii* has "bushy" inflorescences branched to three orders with slender, widely spreading rachillae (Fig. 6) and typically smaller, rounded fruits with the stigmatic remains near the middle. On Savai'i, *C. savaiiense* has open inflorescences sparsely branched to three orders with slender, spreading rachillae, smaller oblong fruits, and abaxial surface of pinnae moderately covered with small scales (lepidia).

While fruit shape and size and, to some extent, rachilla size, by themselves are helpful in distinguishing the three species, they can vary a little. Thus, it is better to rely on inflorescence architecture and the presence or absence of lepidia on the abaxial surface of the pinnae for identification. Unfortunately, this information, especially about inflorescence architecture, is lacking in nearly all collections of Samoan *Clinostigma*. As was typical of many palm collections of the era, the early collections of Samoan *Clinostigma*, including types, are rather poor. Many recent collections are of similar quality. They are meager, sparse, and incomplete, often lacked mature fruits, and label data and other information, especially about diagnostic characters of taxonomic value that are difficult or impossible to encompass on the herbarium sheet, are scant or non-existent.

Key to Species of Samoan *Clinostigma*

1. Inflorescences broom-like, typically branched to two orders, rarely branched to three orders; rachillae thick, coarse, narrowly diverging . . . . 1. *C. samoense*

1. Inflorescences not broom-like, typically branched to three orders; rachillae slender, widely spreading 2

2. Abaxial surface of pinnae moderately covered with gray to brownish, circular to nearly linear lepidia; fruits typically oblong . . . . 2. *C. savaiiense*

2. Abaxial surface of pinnae lacking lepidia; fruits typically +/- rounded . . . . 3. *C. warburgii*

1. Clinostigma samoense H. Wendl., Bonplandia 10: 196. 1862. *Cyphokentia samoensis* (H. Wendl.) Warb., Bot. Jahrb. Syst. 25: 588. 1898. Type: Samoa, 'Upolu, *Pickering s. n.* (holotype GH).

Clinostigma onchorhynchum Becc., Webbia 4: 284. 1914. Type: Samoa, 'Upolu, *Whitmee s. n.* (holotype K; isotype FI).

Clinostigma powellianum Becc., Webbia 4: 286. 1914. Type: Samoa, *Powell 246*. (holotype K; isotype FI).

Solitary, unarmed, pleonanthic, monoecious, forest palm 15–20 m tall (Fig. 7). Trunk erect, green with white waxy glaucous indument, aging to grayish white or brownish, ringed, 25–30 cm diam., internodes 2.5–7.5 cm. Leaves 15, ascending to spreading; sheath 1.5 m long, lime green with slight glaucous bloom, forming a conspicuous and prominent

7. *Clinostigma samoense*, Tiavi, 'Upolu, Samoa.

crownshaft; petiole 30 cm long, concave adaxially, rounded abaxially; rachis 2.6–2.8 m long, flat adaxially, rounded abaxially; pinnae up to 75 per side, elegantly and pendulous, regularly arranged, lower middle the largest, to 65–85 × 3–4 cm, proximal pinnae to 30 × 1 cm, distal pinnae to 20 × 1.5 cm, prominently 3-nerved adaxially, tan medifixed ramentae to 1 cm long on prominent midrib abaxially near rachis, otherwise glabrous. Inflorescences 6–9, infrafoliar, to 1.3 × 0.9 m, broom-like, branched to 2 orders (rarely branched to 3 orders and then with more moderately diverging branches and rachillae), most proximal branches the largest and most complex with up to 7 rachillae each, branches becoming progressively smaller and less complex distally until most distal represented by up to 15 simple rachillae; peduncle 10–15 cm long, 20–25 cm wide at base and ± bulbous and swollen, 7 cm wide and 3–4 cm thick at prophyll scar, light green with glaucous bloom; prophyll 1.5 m long, equaling crownshaft, attached 4–5 cm above base; peduncular bracts 2, attached 1 and 3 cm respectively distally of prophyll attachment, short, rudimentary, 1–3 cm long, triangular, brown, typically caducous; rachis 20–43 cm long with simple rachillae distally and up to 15 branches proximally, most proximal first order branches with unbranched portion 6.5–15 cm long, rachis of first order branches 5–15 cm long; rachillae 45–75 cm long, white in flower, greenish in fruit, narrowly diverging, 1.0–2.5 mm diam.

distally with staminate flowers only and there slightly filiform, attenuate and ± flexuous, 3–5 mm diam. proximally with triads and later fruits, coarse; proximal branches subtended by brown, long-lanceolate bracts to 60 cm long, typically caducous, more distal branches and rachillae subtended by rudimentary bracts 1–3 cm long. Flowers borne in triads in cleft-like depressions in proximal one-half to two-thirds of rachillae, solitary or paired staminate flowers only in distal one-third to one-half of rachillae, each triad subtended proximally by a lip-like bracteole, triads 3–6 mm distant in 2 spiraling rows; floral bracteoles 5–6, unequal in size, 3 inner ones broadly triangular to crescent-shaped, 0.3 × 1.5 mm, imbricate, 3 outer ones often more prominent, the 2 outer lateral ones 0.5 × 0.4 mm, tooth-like, outer middle (proximal) one especially conspicuous and exceeding the triad bracteole, triangular, 1 × 1.3 mm with prominent briefly acute apex, white. Flowers not seen. Fruits 10–20 × 7–13 mm, typically oblong, less frequently somewhat rounded, black or purplish black with glaucous bloom, stigmatic remains near apex, beak-like; perianth 5 × 10 mm, cupular; sepals 5 mm high, imbricate nearly to acute apex, broadly rounded, petals 5 mm high, imbricate nearly to apex, broadly rounded; staminodes 6, 1 mm long, tooth-like, acute, 4–6 toward side of fruit with stigmatic beak.

Specimens Examined. SAMOA. *Powell 246* (holotype *of Clinostigma powellianum*, K; isotype FI); ʻUpolu: *Pickering s. n.* (holotype GH); Malololelei, 550 m elev., 17 Aug. 1929, *Christophersen 303* (BISH); Lake Lanotoʼo, *Whitmee s. n.* (holotype of *Clinostigma onchorhynchum*, K; isotype FI); 700 m elev., 22 Aug. 1929, *Christophersen 383* (BISH); 24 June 2001, *Whistler 11532* (HAW); 29 Aug. 2004, *Whistler 11791* (HAW); Tiavi, 600 m elev., 13 June 1976, *Whistler 3506* (BISH); 740 m elev., 16 July 1971, *Moore 9978* (BH); Magiagi, 600 m elev., 27 Aug. 1991, *Whistler 8117* (HAW); Afiamalu, 510 m elev., 25 Sept. 1991, *Whistler 8388* (HAW); west of Afulilo, 300 m elev., 30 July 1977, *Whistler 3873* (HAW); E of Afulilo, 275 m elev., 30 July 1977, *Whistler 3875* (HAW); 5 km E of Afulilo Dam, 450 m elev., 17 May 1996, *Whistler 10036* (HAW).

Distribution and Ecology. *Clinostigma samoense* primarily occurs in the central highlands of ʻUpolu in the districts of East and West Faleata, West Vaimauga, Safata, and Siʼumu, from 300 to 800 m elevation in moist to wet, usually disturbed, often open forest. It has also been collected a few times in eastern ʻUpolu near

8. A possible hybrid of *Clinostigma samoense* and *C. warburgii*, which might be *C. powellianum*, is this plant at Hoʼomaluhia Botanical Garden (*HBG 78.0891*). It has more spreading inflorescences branched to three orders but with thick, coarse, moderately diverging rachillae.

Afulilo Dam in the district of Va'aofonoti. Typically, *C. samoense* occurs as scattered, emergent individuals on steep slopes or in more level areas.

To a great extent altitude and location on 'Upolu separate the ranges of *Clinostigma samoense* and *C. warburgii*. They do overlap somewhat in the central highlands near Lake Lanoto'o and apparently again near Afulilo in the eastern part of the island. The altitudinal distribution of the two species is dramatically demonstrated along the southern half of the cross-island road from Apia to Si'umu. Near Tiavi at the summit at about 800 m elevation and down to about 600 m elevation one finds *C. samoense*. From about 600 m down to sea level at Si'umu one finds *C. warburgii*. The two species are easy to distinguish from the auto as one passes along the road because of the differences in inflorescence architecture. The changeover from one species to the other occurs rather quickly around 600 m elevation.

That their ranges briefly overlap raises the possibility of hybrids. Indeed, I suspect that *Clinostigma powellianum* might actually be a hybrid, and its placement with *C. samoense* is somewhat problematic. It has the thick, coarse rachillae of *C. samoense* but Beccari described the inflorescence as spreading (he used the term "*diffuses*") and possibly branched to three orders. Also, he did not use the term "*scopaeformis*," meaning broom-like, as he had done for *C. onchorhynchum*. Unfortunately, the meager nature of Powell's type tells us nothing about the inflorescence architecture. However, one plant out of about 25 cultivated at Ho'omaluhia Botanical Garden in Honolulu originating from my collection of *C. samoense* (broom-like inflorescence branched to two orders; thick, coarse, narrowly diverging rachillae; elongated fruits) in December 1978 (*HBG 78.0891*) has more spreading inflorescences branched to three orders with thick, coarse, moderately diverging rachillae (Fig. 8). *Moore 9978* (here referred to *C. samoense*) and *9983* (here referred to *C. warburgii*) also depict this hybrid nature in their inflorescence architecture. In both the cultivated plant in Honolulu and Moore's collections, the inflorescences are spreading because of the wider angle of the proximal primary branches. In all case the secondary branches and rachillae of the primary branches are only moderately diverging.

Some might contend that this hybrid is actually an intermediate form that ties the two species, *Clinostigma samoense* and *C. warburgii*, together, making a case for just one highly variable species. However, there does not appear to be a continuum of variation with a multitude of intermediate forms from one species to another, which one would expect if there were just one highly variable species. Rather, there are the two distinct species with one additional taxon more or less exactly intermediate between the two with no other variation present. Perhaps future study employing DNA will be able to sort these taxa out more satisfactorily.

Several of Whistler's *Clinostigma* collections from Upolu housed at HAW are difficult to assign to species because they are incomplete, consisting only of pieces of fruiting rachillae, which, by themselves, are hardly diagnostic. These include *Whistler 3873*, *3875*, and *10036* from Afulilo, which is in the middle of the range of *C. warburgii*, and *Whistler 8387* and *8388* from Afiamalu, which is in the middle of the range of *C. samoense*. Based on fruit shape alone, I have tentatively included the collections from Afulilo and *Whistler 8388* with *C. samoense* and *Whistler 8387* with *C. warburgii*.

While Whistler (1992) was correct in determining that two species of *Clinostigma* occurred on 'Upolu and could be distinguished by fruit size and shape, what he referred to as *C. onchorhynchum* (with large oblong fruits) is actually *C. samoense* and what he referred to as *C. samoense* (with small rounded fruits) is actually *C. warburgii*.

The palm illustrated in Langlois (1976, fig. 49, p. 47), captioned as *Clinostigma onchorhynchum*, is actually *C. samoense.*

2. Clinostigma savaiiense Christoph., Bernice P. Bishop Mus. Bull. 128: 28. 1935. Type: Samoa, Savai'i, Matavanu Crater, *Christophersen 2267* (holotype BISH; isotypes K, US).

Exorrhiza vaupelii Burret, Occas. Pap. Bernice P. Bishop Mus 11(4): 4. 1935. *Clinostigma vaupelii* (Burret) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 12: 593. 1935. Type: Samoa, Savai'i, Maugaloa, *Vaupel 605* (holotype B?).

Solitary, unarmed, pleonanthic, monoecious, forest palm 10–20 m tall (Fig. 9). Trunk erect, green with white waxy glaucous indument, aging to grayish white or brownish, ringed, 15–25 cm diam., expanding to 45–55 cm diam. at base and their supported with prominent prop roots to 60 cm long and 1.0–1.5 cm

9. *Clinostigma savaiiense*, Matavanu, Savai'i, Samoa.

diam., internodes to 10 cm. Leaves 10–15, ascending to spreading; sheath 75 cm long, lime green with slight glaucous bloom, forming a conspicuous and prominent crownshaft; petiole 30 cm long, concave adaxially, rounded abaxially; rachis 1.8–2.1 m long, flat adaxially, rounded abaxially; pinnae up to 55 per side, slightly pendulous, regularly arranged, lower middle the largest, to 55–80 × 2.2–4.0 cm, slightly falcate, tips splitting and becoming tattered, prominently 3-nerved adaxially, tan medifixed ramentae to 1 cm long on prominent midrib abaxially near rachis, pinnae moderately covered abaxially with brownish, circular to nearly linear, raised lepidia or wart-like structures to 0.4 mm long arranged in raised lines parallel to pinnae margins. Inflorescences 5–6, infrafoliar, to 1 × 0.8 m, branched to 3 orders (Fig. 10), most proximal branches the largest and most complex, branches becoming progressively smaller and less complex distally until most distal represented by simple rachillae; peduncle 5–15 cm long, 15 cm wide at base and ± bulbous and swollen, 4 cm wide at prophyll scar, light green with glaucous bloom; prophyll 1 m long, equaling crownshaft, attached 10 cm above base; peduncular bracts 2, attached 2 and 4 cm respectively distally of prophyll attachment, not seen, typically caducous; rachis 75 cm long with simple rachillae distally and up to 15–21 branches proximally, most proximal first order branches with unbranched portion 10 cm long, rachis of first order branches 30 cm long; most proximal second order branches with unbranched portion 8 cm long, rachis of second order branches 5 cm long; rachillae to 45 cm long, white in flower, greenish white in fruit, diffuse, spreading from rachises at angles of 45–90 degrees, 0.8–1.0 mm diam. distally with staminate flowers only and there very slender, filiform, attenuate and flexuous, 1.5–2.0 mm diam. proximally with triads and later fruits; bracts subtending branches not seen, typically caducous. Flowers borne in triads in shallow, cleft-like depressions in proximal one-third to one-half of rachillae, solitary or paired staminate flowers only in distal one-half to two-thirds of rachillae, each triad subtended proximally by a lip-like bracteole, triads 3–5 mm distant in 2 spiraling rows; floral bracteoles 5–6, unequal in size, 3 inner ones broadly triangular to crescent-shaped, 0.3 × 1.5 mm, imbricate, 3 outer ones often more prominent, the 2 outer lateral ones 0.5 × 0.5 mm, tooth-like, outer middle (proximal) one especially conspicuous and exceeding the triad bracteole, triangular, 1 × 1.5 mm with prominent acute tip, white. Staminate flowers 4 × 5 mm, white; sepals 3, distinct, 2.5–2.8 × 0.4–0.5 mm, narrowly triangular, long-acuminate, margins transparent and membranous, briefly connate or imbricate in basal 0.5 mm; petals 3, distinct, 5 × 1.5 mm, valvate, widely spreading, free nearly to base, long-acuminate, lanceolate, strongly ribbed when dry; stamens 6, 2.5–3.0 mm high, filaments distinct, 1.5–2.0 mm long, very slender, anthers 1 mm long, attached in middle; pistillode columnar, 1.0–1.1 mm long. Pistillate flowers 4 × 3.5 mm, ovoid; calyx 3-lobed, sepals 3 × 3 mm, faintly ribbed, imbricate nearly to broadly rounded apex; petals 3 × 3.5 mm, imbricate nearly to rounded-acute apex, finely ribbed; pistil 2.5 × 1.5 mm, ovoid. Fruits 13–15 × 7–9 mm, oblong, black, stigmatic remains near apex, beaklike; perianth 4–5 × 7 mm, cupular; sepals 3 mm high, imbricate nearly to apex, broadly rounded, margins thin, petals 4–5 mm high, imbricate nearly to apex, broadly rounded; staminodes 6, 1 mm long, triangular, acute.

Specimens Examined. SAMOA. Savai'i: Matavanu Crater, 1300 m elev., 24 Sept. 1929, *Christophersen 808* (BISH); 900 m elev., 10 July 1931, *Christophersen & Hume 1946* (BISH); 15 July 1931, *Christophersen & Hume 2078* (BISH); 5 Aug. 1931, *Christophersen & Hume 2266* (BISH); *Christophersen & Hume 2267* (holotype BISH; isotypes K, US); *Christophersen & Hume 2273* (BISH); 680 m elev., 23 July 1971, *Moore 9982* (BH); above Sala'ilua, 1400 m elev., 8 Sept. 1931, *Christophersen 2565* (BISH); 6 Nov. Sept. 1931, *Christophersen 3088* (BISH); W of Mata-ole-Afi, 1500 m elev., 31 May 1975, *Whistler 2564* (BISH, HAW).

Distribution and Ecology. *Clinostigma savaiiense* occurs on the north, east, and south slopes of Savai'i in the districts of Gagaifomauga III and I, Gaga'emauga III, and West Palauli in wet forest and cloud forest from 900 to 1500 m elevation. I found it in October 2005 at or near the type locality on the steep sides of volcanic craters where it occurred as scattered individuals emerging from the forest canopy. It is probably scattered in a more or less continuous band on the north, east, and south side of the island at the appropriate elevations. Historically, it may have been distributed at lower elevations, perhaps as low as 700 m. The Samoan chief Itutu Avealolo of Fogasavi'i, who guided me into the forest to 700 m elevation above Sala'ilua, said it once occurred at this location, but tropical cyclones and human activity, primarily land clearing and cutting of the trunk for wood, had destroyed all the specimens in the area.

3. Clinostigma warburgii Becc., Atti Soc. Tosc. Sci. Nat. Pisa Mem. 44:155. 1934. Type: Samoa, 'Upolu, Lake Lanoto'o, *Reinecke 322* (holotype WRSL?; isotypes BISH, FI).

Clinostigma sp. "Eastern 'Upolu" Hodel, Palm J. 183: 12.

Solitary, gregarious, unarmed, pleonanthic, monoecious, forest palm to 20 m tall (Front Cover). Trunk erect, green with white waxy glaucous indument, aging to grayish white or brownish, ringed, to 25 cm diam., internodes to 10 cm. Leaves 15–20, ascending to

10. *Clinostigma savaiiense*, infructescence, Matavanu, Savai'i, Samoa

spreading; sheath 2 m long, lime green with slight glaucous bloom, forming a conspicuous and prominent crownshaft; petiole 50 cm long, concave adaxially, rounded abaxially; rachis to 3 m long, flat adaxially, rounded abaxially; pinnae up to 75 per side, elegantly pendulous, regularly arranged, lower middle the largest, to 75 × 4.0–4.5 cm, proximal to 45 × 1.5 cm, distal to 25 × 1 cm, prominently 3-nerved adaxially, tan medifixed ramentae to 1 cm long on all 3 nerves abaxially near rachis, otherwise glabrous. Inflorescences 9, infrafoliar, to 1.7 × 1.1 m, branched to 3 orders, most proximal branches the largest and most complex, branches becoming progressively smaller and less complex distally until most distal represented by simple rachillae; peduncle 20 cm long, 22 cm wide at base and ± bulbous and swollen, 4 cm wide at first branch, light green with slight glaucous bloom and/or grayish brown scales; prophyll 2 m long, equaling crownshaft, attached 10–12 cm above base; peduncular bracts 2, attached 2–3 and 6 cm respectively distally of prophyll attachment, not seen, typically caducous; rachis 1.2 m long with simple rachillae distally and branches proximally, most proximal first order branches with unbranched portion 13 cm long, rachis of first order branches 64 cm long; most proximal second order branches with unbranched portion 10 cm long, rachis of second order branches 12 cm long; rachillae to 30 cm long, white in flower, light green in fruit, diffuse, spreading from rachises at angles of 45–90 degrees, 0.8-1 mm diam. distally with staminate flowers only and there very slender, filiform, attenuate and flexuous, 1.5–2.0 mm diam. proximally with triads and later fruits; proximal branches subtended by brown, long-lanceolate bracts to 50 cm long, typically caducous, more distal branches and rachillae subtended by rudimentary bracts 1–3 cm long. Flowers borne in triads in shallow, cleft-like depressions in proximal one-third to one-half of rachillae, solitary or paired staminate flowers only in distal one-half to two-thirds of rachillae, each triad subtended proximally by a lip-like bracteole, triads 3-4 mm distant in 2 spiraling rows; floral bracteoles 5-6, unequal in size, 3 inner ones broadly triangular to crescent-shaped, 0.75 × 1.75 mm, imbricate, 3 outer ones often more prominent, the 2 outer lateral ones 1 × 0.6 mm, tooth-like, outer middle (proximal) one especially conspicuous and exceeding the triad bracteole, broadly triangular, 1.0–1.3 × 2.0–2.5 mm with prominent acute apex, white. Staminate flowers 4 × 5 mm, white; sepals 3, distinct, 2.0–2.5 × 0.3 mm, narrowly triangular, long-acuminate, membranous toward apex, margins transparent, briefly connate basally; petals 3, distinct, 3.5–4.0 × 1–2 mm, valvate, widely spreading, free nearly to base, strongly ribbed when dry; stamens 6, 2.0–2.5 mm high, filaments distinct, 1.7–2.5 mm long, very slender, anthers 0.7–1.3 mm long, attached in middle; pistillode conical to columnar, 0.7-2 mm high, to 0.75 mm wide at base, 0.5 mm wide at briefly 3-parted apex. Fresh pistillate flowers 3–4 × 3–4 mm, ovoid, greenish white; calyx 1.5–2.0 × 3 mm, 3-lobed, sepals faintly ribbed, imbricate in proximal half to two-thirds, broadly rounded distally with membranous nearly transparent margins and acute apex; corolla 2.8–3.5 × 3 mm, petals imbricate nearly to mucronate apex, whitish, thin-fleshy nearly transparent, ribbed; pistil 3 × 2.8 mm, ovoid, greenish, 3-parted. Fruits 10 × 10 mm, rounded, black, stigmatic remains slightly distal of middle; perianth 3 × 5–6 mm, cupular; sepals 3 × 2 mm, imbricate nearly to acute apex, broadly rounded to triangular with acute apex, petals 4 × 3 mm, imbricate nearly to briefly acute apex, broadly rounded; staminodes 6, 1 × 0.2 mm, tooth-like.

Specimens Examined. SAMOA. ‘Upolu: between Poutasi and Si’umu, 30 m elev., 27 July 1977, *Whistler 3858* (BISH, HAW); between Falelatai and Lefaga, 150 m elev., 28 July 1977, *Whistler 3870* (BISH, HAW); NE of Sa’agafou, 100 m elev., 23 Aug. 1978, *Whistler 3923* (HAW); 0.6 miles E. of road into ‘O Le Pupu Pu’e National Park, 20 m elev., 25 July 1979, *Teraoka & Kennedy 88* (BISH); ‘O Le Pupu Pu’e National Park, 50 m elev., 23 May 1979, *Cox 162* (BISH); 40 m elev., 15 March 1980, *Moore 10540* (BH); upper entrance to cave at Togitogiga, 175 m elev., 13 Sept. 1978, *Whistler 4004* (BISH, HAW); E of Ti’avea, 220 m elev., 24 April 1979, *Whistler 4196* (BISH, HAW); mangrove swamp at Mulivai, 28 Aug. 1991, *Whistler 8134* (HAW); Puntaemo’o swamp, 31 Aug. 1991, *Whistler 8159* (HAW); Punataemo’o, 300 m elev., 14 Nov. 2001, *Whistler 11569* (HAW); Lemafa, 360 m elev., 18 March 1980, *Moore 10541, 10542* (BH); above Sauniatu inland from Salafuata, 200–500 m elev. 27 July 1971, *Moore 9983* (BH); Apia-Si’umu Road, 450 m elev. 7 July 1968, *Bristol 2179* (BISH); Afiamalu, 510 m elev., 24 Sept. 1991, *Whistler 8387* (HAW); Lake Lanoto’o, *Reinecke 322* (isotype BISH, FI). CULTIVATED: American Samoa, Tutuila, W. of Aloau (A’oloaufou?), 12 March 1980, *Moore 10539* (BH); Ili’ili Village, 20 m elev., 10 March 1980, *Moore 10538* (BH). U.S.A., Hawaii, Oahu, Ho’omaluhia Botanic Garden (Honolulu Botanic Gardens *78.0889*, originally collected by D.R. Hodel, 9 Dec. 1978,

11. *Clinostigma warburgii*, gregarious population, east of Lemafa Pass, ‘Upolu, Samoa.

near Salelesi, 'Upolu, Samoa, 10 m elev., *Hodel 462*), 22 March 2006, *Hodel 2008* (BISH).

Distribution and Ecology. *Clinostigma warburgii* primarily occurs on the eastern part of 'Upolu in the districts of East Anoama'a, Va'aofonoti, Aleipata, Lepa, Lotofaga, Falealili, and Si'umu, from sea level to about 600 m elevation in wet, usually disturbed forest (Front Cover). Indeed, I referred to it in an earlier paper as *Clinostigm sp*. "Eastern 'Upolu" (Hodel 2006). It is especially abundant in the Lemafa Pass region and to the east towards Ti'avea, where it forms vast, gregarious stands on steep, well drained slopes and in low, wet or swampy, poorly drained areas (Fig. 11). It has also been collected twice in the central highlands of 'Upolu, once at Afiamalu, where it was probably cultivated, and at Lake Lanoto'o, the latter represented by Reinecke's type specimen.

Clinostigma warburgii occurs sparingly farther west along the north coast in the districts of West Anoama'a and along the south coast in the districts of Safata, Gaaga'emauga, Lefaga, and Samatau and Falelatai. In these areas, though, it is typically found as a few isolated individuals around human habitation, indicating it is probably cultivated.

When Cox and Moore (1986) concluded that fruit shape was variable and could not be used to distinguish *Clinostigma samoense* and *C. onchorhynchum*, the specimens from Lemafa Pass that formed the basis for their conclusions, *Moore 10541* and *10542*, actually were *C. warburgii*. Furthermore, fruits of both collections were immature and at different stages of development. When fully mature they would likely be the same shape and size.

The palm illustrated in Langlois (1976, fig. 50, p. 48), captioned as *Clinostigma samoense*, is actually *C. warburgii*.

Acknowledgments

I gratefully acknowledge the assistance several individuals. Michael Grayum, Missouri Botanical Garden (MO), St. Louis, MO, reviewed the manuscript, and he and John Dransfield, Royal Botanic Gardens, Kew (K), London, England, provided guidance about nomenclatural matters, especially as they pertained to *Clinostigma warburgii*. Images of type specimens were provided by Napua Harbottle, Bishop Museum (BISH), Honolulu, HI; William Baker, Kew; Walter Kittredge, Gray Herbarium (GH), Harvard University, MA; and Piero Cuccuini and Egildo Luccioli, Herbarium Universitatis Florentinae (FI), Museo Botanico, Universita Degli Studi di Firenze, Florence, Italy. Robert Dirig, L.H. Bailey Hortorium (BH), Cornell University, Ithaca, NY sent loans for study. Clyde Imada, Bishop Museum; Rusty Russell, Smithsonian Institution (US), Washington, D. C.; and Art Whistler and Mike Thomas, University of Hawaii herbarium (HAW), answered questions about the existence of specimens at their institutions. Jonel Smith, Keith Nobriga, and Joshlyn Sand, Ho'omaluhia Botanical Garden, Honolulu, HI, provided assistance in identifying and collecting material of cultivated *Clinostigma* at their garden. Audrey and Philip Keeler and the Carl and Roberta Deutsch Foundation partially supported my field work in the South Pacific.

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CLASSIFIED

PALM LITERATURE

GUIDE TO ENDEMIC PALMS AND SCREW PINES OF THE SEYCHELLES GRANITIC ISLANDS. Denis Matatiken & Didier Dogley. Plant Conservation Action, P.O. Box 392, Victoria, Mahé, Seychelles [boga@seychelles.net]. 2005. ISBN 99931-70-01-1. Price unknown. Softcover. Pp. 45.

On a per square kilometer basis, the Seychelles must have highest rate of endemism in the world for palm genera. This archipelago in the Indian Ocean has only 455 km^2 of land (and some of that is coral atoll), but it is home to six endemic genera. That is about one endemic genus for every 75 km^2. Nowhere else in the world can you find that level of palm generic diversity, and for that reason alone, the Seychelles figure prominently in the minds of palm lovers. The six genera, all monotypic, are well known to palm growers: *Deckenia*, *Lodoicea*, *Nephrosperma*, *Phoenicophorium*, *Roscheria*, and *Verschaffeltia*. These palm genera are some of the most distinctive palms in the world, so a guide book devoted to these six palms is most welcome.

The authors, working with the local non-governmental Plant Conservation Action group, have produced an informative and attractive small guide book to the native palms and pandans (screw pines) of the Mahé Group of islands, which are granitic in origin, as opposed to the elevated coral atolls that make up some of the smaller islands in the archipelago. The book is paper-bound and stapled. The image quality is good, and the layout is attractive. A brief glossary and list of references are provided at the end of the book.

The first half of the book is devoted to palms. There is a very brief introduction to the family on a worldwide basis, along with an introduction to the Seychelles endemics. Locality information is given for the palms, so that visitors could easily plan a palm-spotting itinerary with this guide book. Special attention is devoted to the most famous palm of the islands, *Lodoicea maldivica*.

The second half of the book is especially welcome: a guide to the pandans of the islands. *Pandanus* and its relatives are striking plants of the tropics, with unusual growth forms, attractive foliage, large flower clusters and bulky fruits. In many ways, they are like palms, although they are not close relations. Like palms, they can be difficult to study and, consequently, they are not as well known as they should be. Checklists and floristic studies of pandans are rare. Illustrated field guides to pandans are unheard of. In fact, this may well be the first of the genre. In what other book could you find eight color photos of *Pandanus multispicatus*?

This book gives pandans and palms equal treatment. For each species, the authors provide common names (in French, Creole and English), habitat and distribution, a description of growth form of the leaves, flowers and fruits and a summary of past and present uses. The photographs illustrate distinctive features of each plant, from stilt roots to trunk spines to new leaf color. The photographs are so abundant and clear that the text almost becomes inconsequential. This book is worth seeking out just for the pictures.

I have only two technical criticisms of this book. The authorities for the scientific names of the plants are cited in the zoological rather than the botanical style, a small mistake betraying the zoological background of the authors. The other mistake – more serious, to be sure – is the error in pandan taxonomy. A recent study of the Pandanaceae concluded that a group of pandans from Madagascar and the Seychelles belongs to a new genus, *Martellidendron*, which is more closely related to *Freycinetia* than it is to *Pandanus* (Callmander et al. 2003). Users of this guide book will want to pencil in the name *Martellidendron hornei* (Balf. f.) Callm. & Chassot for the species on page 34. It is regrettable that Matatiken and Dogley did not include this new development in Pandanaceae systematics, as it points to a biogeographical relationship between the Seychelles and Madagascar that is not addressed by the guide book.

This book is an excellent guide to the palms and pandans of the Seychelles, and it will surely spark an interest in those plants in anyone traveling to the islands.

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Notes on the Uses of *Metroxylon* in Vanuatu

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1. As members of *Metroxylon* section *Coelococcus,* both *M. warburgii* and *M. salomonense* flower only once and die after the fruit crop is mature (Anatom island).

Sago palms of the genus *Metroxylon* play an important role in the daily life of the inhabitants of these islands. Their primary use is in the making of roofing material for traditional dwellings from the huge leaflets as. The secondary use as a foodstuff is becoming increasingly rare.

Vanuatu is an archipelago composed of more than 80 islands, stretching over 850 kilometers on a southeast to northwest line. Situated in the southwestern Pacific Ocean, Vanuatu is a neighbor of the Solomon Islands to the northwest, New Caledonia to the southwest and Fiji to the east. Its total surface area is 12,189 km2, and the eight biggest islands represent 87% of that surface (Weightman 1989).

The Genus *Metroxylon* in Vanuatu

There are two indigenous species of the genus *Metroxylon* in Vanuatu: *M.warburgii* and *M. salomonense* (Dowe & Cabalion 1996). They belong to the section *Coelococcus*, do not produce suckers and are monocarpic, i.e. they flower only once and die after the fruit crop is mature of (McClatchey 2002) (Fig. 1).

The trunk of *M. warburgii* is rarely taller than 8 meters and has a diameter of 30–40 cm at chest height. The pinnate leaves can be over 4 meters long with leaflets measuring 50–80 cm long and 6–8 cm wide. The petioles are armed with short and rigid spines (Fig. 2).

Metroxylon salomonense is a much more imposing palm. At full maturity the trunk can exceed 15 meters in height with a diameter of 60–80 cm at chest height (Fig. 3). The leaves can be more than 6 meters long with leaflets 100–190 cm long and 14–19 cm wide. The petioles have long and flexible spines (Fig. 4).

Varieties of *Natangura* Palms

Metroxylon warburgii is known as *Natangura* throughout the archipelago. This palm is highly polymorphic and inhabitants differentiate and name several varieties. The variety *Ato*, indigenous to the south of Espiritu Santo, is often taller than 15 meters (Fig. 5), whereas the varieties *Kifacta* of Tanna and *Nuput* of Anatom, in extreme south of the archipelago, rarely produces stems taller than 5 meters (Fig. 6). Both these varieties have spiny leaflets, whereas others found in the northernmost islands do not. Differences in the color of juvenile leaves – red or yellow – are also apparent and are unrelated to the amount of light received by the plants.

In the village of Wala, (northeast Mallicolo) *Niat Dowir* or "Cock-feathered *Natangura*" refers to two cultivated varieties with long leaflets, *Kifacta Black* and *Kifacta White,* which are indigenous to Tanna. The young leaflets of the "*black*" variety are red, and those of the "*white*" variety are yellow. The use of these

2 (left). The petioles of *Metroxylon warburgii* are armed with short and rigid spines (Tanna).
3 (right). *Metoxylon salomonense* is an imposing palm with a trunk that can exceed 15 m at maturity.

4 (left). The base of the leave and petioles of *Metroxylon salomonense* are very distinctive (Tongoa island). 5. (right) The *Metroxylon warburgii* variety *Ato*, is often taller than 15 meters (South of Espiritu Santo.)

English terms suggests that the varieties were introduced during the colonial period. This idea is further backed up by many local people who claim that *Kifacta Black* originates from the north of Vanuatu.

The origin of palms is also revealed by the local common names. The inhabitants of Anatom differentiate between *Nuput* and *Nuput Santo*. The latter would seem to have been introduced either from Espiritu Santo or another neighboring island. Muller et al. (1999) noted that the people of Mele (Efate Island) recognized two types of *M. warburgii*, *Tenibi Maori* and *Tenibi Itonga*. "*Maori*" means "natural," as in native to a particular place. "*Itonga*," which originates from another island, is not thought to be a reference to the island of Tonga.

Several other varieties of *Metroxylon* are known to the inhabitants of the various islands, based on the morphological characteristics of the plant, particularly the leaflets. A distinction between "male" and "female" plants is frequently made. Trees with long slender leaflets are considered to be male, and those

6. The varietiy *Nuput* rarely produces stems taller than 5 meters (Anatom island).


7 (left). The large leaflets of *Metroxylon salomonense* are used for making the *Topor* traditional costumes (Gaua, Banks Islands). 8 (right). The trees were felled just as they were beginning to flower, as at this stage the starch levels in the pith are at their highest (South of Espiritu Santo).

with shorter, wider leaflets are said to be female. It is important to note that the naming of local *Metroxylon* varieties in Vanuatu does not or no longer makes any reference to the color of the pith or the quality of the sago extracted from it, as it does in certain areas of Papua New Guinea.

Ecology

Metroxylon warburgii is common to all the islands of the archipelago, either spontaneously or cultivated. We have seen spontaneous populations in the south of Espiritu Santo and in Gaua. The *Ato* variety of *M. warburgii* grows in forests at low to middle altitudes in the south of Espiritu Santo. In Gaua and more specifically the zone to the east of the island, dense populations of this palm can be found almost everywhere, from the coast to the shores of the lake in the center of the island.

Metroxylon salomonense is found mainly in the north of the archipelago, on Banks Island (Vanua Lava) and Torres Island (Loh). The foliage is used for making traditional dance costumes (Fig. 7) as well as interior and exterior walls in some dwellings. Its quality as a construction material is, however, inferior to that of *M. warburgii,* a fact which may explain its limited distribution on the islands.

I have found several isolated trees of *M. salomonense* on Tongoa and in the south of Espiritu Santo, but these were cultivated purely for ornamental value. Muller et al. (1999) recorded this palm in the north of Pentecost Island and in the east of Ambae. Ehara et al. (2003) noted two stations on Mallicolo Island (northeast and south) and one on Gaua. Photographs in a work by Bonnemaison (1996) show the use of the foliage for costumes in Maewo.

Populations of *M. salomonense*, all probability spontaneous, can be seen in the extreme north of Vanuatu and on Torres and Banks Islands. They are found mainly in coastal marshlands immediately inland from the mangrove zone. Elsewhere they are cultivated ornamentally and are found close to habitations.

Sago in Vanuatu

According to Guiart (1956) sago was extracted only in the most isolated parts of the islands. Barrau (1956) observed this practice among the inhabitants of Pentecost and Tanna Islands. Ehara and al. (2003) noted reports from inhabitants of Gaua (Banks Island) where sago was widely consumed up until the 1950s. More recently, Dowe and Cabalion (1989) described sago extraction in the center of Espiritu Santo.

Most of the islanders that I interviewed were unaware of the nutritional uses of sago, probably due to the decline of traditional culture or the existence of very isolated dietary variations. It is more than likely that sago has never really been a universal foodstuff among the traditional populations of Vanuatu. In fact, the elders of the Paama Islands, to the north of Ambrym, have no knowledge of the ancestral uses of sago.

Today, in times of natural disaster, such as the passage of a cyclone, sago is undoubtedly used as a subsistence crop. The people of Tanna turned to *Caryota ophiopellis* (another sago palm) as a source of nourishment after cyclone Uma destroyed their gardens in 1987. My contacts tell me that sago has been used elsewhere under similar circumstances, notably in Ureparapara and Mere Lava (Banks Island).

Extraction and Preparation of Sago

I was able to witness two instances of sago extraction from *Metroxylon*. The first at Loh, Torres Island, in September, 2003, and the second in the south of Espiritu Santo, in November, 2003. Both extractions used the same method. The trees were felled just as they were beginning to flower, as at this stage the starch levels in the pith are at their highest (Fig. 8).

The trunk was cut into logs of about 1 meter long then split open lengthwise. The pith inside was then pounded with an adz (in Espiritu Santo) or a bamboo hammer (in Loh). This procedure is a vital step in the process as the pith must be ground into very fine powder for optimal starch extraction. The powder is then transported to the extraction plant, always close to an abundant water supply, which is essential for is operation. In Loh, the extraction was done close to a family home with a water pump; whereas in Espiritu Santo, it was carried out in the bed of a stream.

The starch in a water suspension is then filtered to remove the fibers and pith. In Espiritu Santo the filter was made from fern leaves; in Loh, from a piece of jute cloth. The filtered liquid is slowly decanted either into a vessel, in Loh, or a hollow in the bed of the stream lined with *Heliconia indica* leaves in Espiritu Santo. Within half an hour all the starch settles to the bottom, and the water can be drained from the vessel or left to pass slowly through the *Heliconia* leaves. The starch can be either used immediately or left to dry in the sun for later use.

In Loh, apart from the actual cutting of the palm, which was done by men, the work is a

9. In Espiritu Santo, the extraction of starch is an exclusively masculine operation.


10 (left). *Metroxylon* is a potential source of vegetable salt (South of Espiritu Santo). 11 (right) The salt is separated from the ash with water. This saline solution is used for seasoning food and the preparation of sauces (South of Espiritu Santo).

family affair, but in Espiritu Santo, the work is exclusively masculine operation (Fig. 9). This is said to be due to the feeling of insecurity and fear in the forests as a result of continued clan warfare.

Among the people of Loh, southern Espiritu Santo and Tanna (in the case of *Caryota ophiopellis*), sago is not in fact consumed in its natural state. The starch is mixed with other ingredients, such as bananas, paw paws (fruits of *Carica papaya*) and coconuts, before cooking to give it a better consistency.

On Anatom Island, a different method of extraction was explained to me by a tribal chief of the village of Umej. I was told by the elders that *Metroxylon warburgii* had in fact been cultivated for its starch, but I was unable to witness the extraction process. Here the tree is first slit at the base to allow the sap to drain away and felled several days later. The trunk is cut into logs and stripped of its bark, retaining only the pith before being cooked for two more days on stones in a fire pit. The starch is then removed by beating the cooked pith.

It is noteworthy that on Anatom and Tanna, the use of *Metroxylon warburgii* leaves as a roofing material was unknown until quite recently. These islanders preferred coconut palm leaves or stalks of *Miscanthus* species (Poaceae) for thatch. One can reasonably assume that *Metroxylon warburgii* was mainly used as a food source.

Salt

Metroxylon is a potential source of salt ; or more accurately, vegetable salt (Fig. 10). Certain parts of the plant, mainly leaves and petioles, produce ashes rich in salt, which is separated from the ash with water (Fig. 11). This saline solution is then used both for seasoning food and the preparation of sauces. Some traditional societies in the center of Espiritu Santo still use these ashes, and according to my correspondents, this practice was at one time their only method of obtaining salt, as access to the sea was often forbidden in times of local warfare. Some other species, such as banana trees (*Musa* spp.) and tree ferns (*Cyathea* spp.) are also used in the extraction of vegetable salt.

Horticulture

There are two types of traditional gardens on Vanuatu. One is created after cutting and burning the existing vegetation and is used primarily for growing yams (*Dioscorea alata*, *Dioscorea esculenta*). The other, an irrigated garden, is usually for the cultivation of taro (*Colocasia esculenta*). The lifespan of a garden is highly variable, ranging from one single growth cycle, after which the garden is subsequently abandoned, to several generations of farmers if the garden is well maintained.

Metroxylon palms are often associated with both types of garden. In the first instance, they are often found around the edges of the garden, the central part being reserved for growing the yam crop. I also observed them in irrigated gardens near the village of Olpoï in north west Espiritu Santo, planted in the surrounding dikes to combat erosion and landslides. When these palms are introduced into other cultivated areas their culture is necessarily of short duration. The rapid growth and invasive root system render all other cultivation impossible. All *Metroxylon* must be cut down and roots allowed to degrade during a two to three year period before any new culture can be undertaken.

In Vanua Lava, *Metroxylon warburgii* is occasionally planted alongside coconut palms (*Cocos nucifera*). The two species are planted at the same time, but whereas *Metroxylon warburgii* rapidly becomes productive, leaves being usable in two or three years, the coconut palms do not produce fruit for ten years, at which time the *Metroxylon* palms have reached full maturity and are felled. The density of the plantations is often a compromise between maximum exploitation of the surface available and quality of production. On Loh and Vanua Lava, *Metroxylon* palms are given 6–10 m^2 per plant. A higher density would adversely affect the quality of the foliage. Leaves too close together would become damaged and unusable.

Metroxylon warburgii and *M. salomonense* are both very easy plants to grow, their demands can be summed up by moist soil and plentiful exposure to the sun. They can grow in shady forest conditions, but speed and quality of growth are severely restricted. They require very little attention, and an abandoned plantation can remain in good condition for many years. This situation can be seen clearly in Gaua, where an extensive population of *Metroxylon* remains today.

In the south of Espiritu Santo, the *Ato* variety of *Metroxylon warburgii* grows spontaneously in sparse forests and bush land, it seems to be perfectly suited to this forest ecosystem and thrives without any human intervention. It must be said however that this environment is heavily influenced by the actions of man, such as wood cutting and fruit picking, which are possibly beneficial to the survival of the *Metroxylon*.

Metroxylon salomonense and *M. warburgii* do not produce suckers at their base, they reproduce only from seed and cannot be reproduced vegetatively, as with *M. sagu*. The ideal seeds are produced by older trees which have had good quality leaves and are already germinated when collected. In the Torres Islands the seeds are buried to protect them from the voracious coconut crabs, but in Paama they are simply scattered around gardens and by roadsides. The growth is rapid and more vigorous than the competing vegetation, although occasional weeding and thinning may be carried out in the first year.

Conclusion

The use of palms of the genus *Metroxylon* for sago production is exceedingly rare and can only be found in the most isolated regions of the archipelago. It is also completely unknown as a dietary staple; yams, taro, cassava and imported rice are much preferred. Cyclones and other natural disasters have in some cases led to renewed efforts and interest in sago where the older islanders were able to pass on their knowledge to a new generation. Further studies are necessary if we wish to have a better understanding of the traditional uses of *Metroxylon* and other indigenous palms in Vanuatu.

Acknowledgments

I thank Sam Chanel of the Port-Vila Herbarium and the Forestry Department of the Vanuatu, Ministry of Agriculture Forestry and Fisheries. This study could not have been achieved without the enthusiastic help, hospitality and guidance of all the people I met, men and women, young and old. A big thank you to you all.

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Geonoma appuniana – A Palm of The Lost World

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1. Kukenán *tepuy* in southern Venezuela is adjacent to Mt. Roraima.

After six days of difficult trekking across savannah, through rainforest and ascending Mt. Roraima's 1200 meter sheer perpendicular sandstone wall, we finally reached the place where one of the most remote palms in the world is said to grow. In April 2005, we went in search of *Geonoma appuniana* (once known as *Geonoma roraimae*) in an area known as The Lost World (Fig. 1).

Mt. Roraima is in the Guyana Highlands region of southern Venezuela, at the border with Brazil and Guyana. Cascading from a nearby mountain is Angel Falls. At 979 meters (3212 feet), it is the tallest waterfall in the world. About one hundred of these table top mountains (locally called *tepuys*) cover the landscape. Each *tepuy* rises about 1000–1250 meters above the surrounding land. These ancient remnants of continental drift and other natural processes are estimated to be 1.8 billion years old. Many of them have never been visited.

Sir Arthur Conan Doyle made Mt. Roraima famous when he wrote the *The Lost World*. The book described a fictional British expedition in the 1880s to confirm the existence of prehistoric dinosaurs living in an isolated world that time forgot.

The sheer sides of the mountain create a geological barrier behind which the plant life has evolved in isolation for millions of years. A strange plant life grows on these isolated, island-like mountains. Many species are carnivorous because of the lack of soil and nutrients. The mountains have one of the highest rates of endemism in the world. An estimated 75% of the plants are endemic to this region, and about 50% are endemic to single *tepuys*. A large *tepuy* may harbor an amazing 500–1000 plant species. Many new species await discovery.

Geomona appuniana appears primarily at the base of the *tepuy* (Fig. 2). They grow in dense populations of about 100 individuals. This large *Geonoma* attains a height of 10 meters. Little is known of its ecology or natural history. How did some of the palms get distributed into crevices (Fig. 3) on top of the *tepuy*? Oilbirds (*Steatornis caripensis*), known locally as *guacharos*, feed on the fruits and sometimes carry the seeds to this moist and protected place.

2. A large population of mature *Geonoma appuniana* found at the base of Mt. Roraima.

3. Overlooking the crevice where *Geonoma appuniana* was found growing on Mt. Roraima.

4. *Geonoma appuniana* hugs the ledge of a crevice on Mt. Roraima. The seeds were distributed here by oilbirds. This photograph required hanging over the side of the crevice without any way to steady the camera.

The ascent up Mt. Roraima to see *Geonoma appuniana* was arduous; however, one last major obstacle still lay ahead of us: The palm grows far inside a deep, deadly crevice on top of Roraima's soiless and weather-scared plateau. It grows in one of the most scenic but inaccessible places on earth. Expedition team members Cesar Diaz and Roberto Campano each held my ankles as I inched out over the side of the crevice to photograph this palm. It is seen here in what could have been a very expensive photograph (Fig. 4).

PALM LITERATURE

THE PALMS OF ODOARDO BECCARI. Piero Cuccuini & Chiara Nepi. Dipartimento de Scienze Botaniche dell' Università di Palermo. 2006. Pp. 251, many photographs.

Odoardo Beccari was the most important palmologist of the late 19th and early 20th centuries. His published oeuvre is astonishing, ranging from papers published in botanical or horticultural journals to massive folio works illustrated by drawings and crisp black and white photographs. He monographed many genera and had a worldwide interest in the family, although his major interests were undoubtedly in the palms of Asia, Malesia and the West Pacific. It comes as something of a surprise to realise that his own fieldwork was limited. However, the time he spent in Sarawak in the 1860s was to instil in him an enthusiasm for tropical plants, especially palms.

Once he had returned to Italy, Beccari began to work up his collections and once his expertise in palms was established, botanists began to send palm material from all over the world to Beccari in Florence for his judgement. His enormous collection of dried pressed palms, separate fruit and material stored in alcohol was deposited eventually in the Herbarium of the Botanic Institute in Florence, which, consequently, holds one of the premier palm collections in the world.

The Palms of Odoardo Beccari could easily have been produced as a bare listing of names and collections. Instead it is much more and thus of much greater appeal. The volume contains a brief introduction explaining the two major herbaria collectively catalogued – the Erbario della Malesia consisting of Beccari's own collections from Sarawak, Sumatra, the Moluccas and New Guinea, and the Herbarium Palmarum containing the material accumulated by Beccari from other collectors. The Malesia herbarium comprises 405 herbarium specimens and 28 carpological (fruit or seed) specimens, while there are 6800 dried specimens, 214 carpological collections, 1205 illustrations and 1368 photographic plates in the Herbarium Palmarum.

The authors provide a synopsis of Beccari's life, his interest in palms and the events relevant to the accumulation of the Herbarium Palmarum. This magnificent herbarium was in fact Beccari's own personal herbarium. On his death it was donated by his children to his disciple, Ugolino Martelli. Martelli bequeathed Beccari's collections to the University of Florence, where botanists of today can enjoy the beautifully curated herbarium and the wonderful Renaissance city!

The authors describe the current status of the collections, illustrating the cupboards and bundles of palms, and providing samples of original drawings, carpological collections and one of the large photographs that were included in many of Beccari's sumptuous monographs. The herbarium specimens are then catalogued by the scientific names under which they are stored.

The volume also includes biographical notes on the collectors of the specimens included in the Herbarium Palmarum with cross references to the genera collected and also a listing collectors by genus. Finally there are geographical listings of taxa and lists of types including a separate list of all the types recognized in the herbarium by Harold E. Moore Jr. There are also many reproductions of annotation labels.

The catalogue refers to the palm specimens by the name under which they have been filed in the herbarium, which is often the name used by Beccari himself. There has been no attempt to bring the nomenclature up to date. In fact this is probably the most useful way of presenting the data, as the palm taxonomist who consults the Florence Herbarium will most likely to want to see the types of the Beccari names.

The authors have provided an essential reference for the serious palm taxonomist, while the general reader who dips into the publication may find much of interest in the general introductory notes on Beccari. Congratulations to the authors on a most worthwhile publication.

To obtain a copy, send an amount corresponding to the shipping charges by a postal order (Italy) or an international postal order (other countries) to the following address: Dr. Piero Cuccuini, Sezione Botanica, Museo de Storia Naturale, Via La Pira 4, I-50121, Firenze, Italy. For Europe (Including Mediterranean Africa and the Middle East) – Euros 6.00; For Africa, Asia and the Americas – Euros 8.50; For Oceania – Euros 11.50.

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Korthalsia rogersii – A Vanishing Endemic Palm of the Andaman Islands

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"The forest in its pristine glory, if found anywhere in Southeast Asia, it is in the Andaman Islands." This remark, referring to the tropical islands in the Bay of Bengal, was made by Sir H. G. Champion, who had explored and studied the phytogeography and vegetation types of the Indo-Malayan region during the latter part of the Nineteenth Century. The tropical rain forests in Andaman and Nicobar Islands are known to host about 2000 Angiosperm species. The palms of these islands are of great interest in terms of their degree of endemism. Several insular palms have become "narrow endemics" and presently they are on the road to either endangerment or extinction. *Korthalsia rogersii* Becc., one of the endemic rattans thought to be extinct in these islands until recently rediscovered in South Andaman, is described and illustrated here.

The tropical islands of Andaman and Nicobar comprise more than 320 islands and islets, far off from the Coromandel coast of Peninsular India in the Bay of Bengal; they carry luxuriant tropical rain forests seemingly rather undisturbed by human activities. The tropical climate and geographical isolation from the major landmasses of South and Southeast Asia over millions of years are responsible for a unique flora with remarkable diversity with multi-dimensional affinities to nearer and distant geographical regions such as northeast India, Myanmar and Malesia. Geologically, the Andaman and Nicobar Islands are the emergent peaks of a submerged mountain range in continuation with the Arakkan-Yoma Mountains of Myanmar. It has been officially estimated that over 83% of the total land area of these islands are covered by dense tropical rain forests. However, this statistic on forest cover needs re-estimation, since the recent tsunami blasted among these islands in December 2004, causing severe damage.

According to Rabinowitz (1981), "the magnitude of rarity depends on factors like geographical range in distribution of species, habitable sites of the species within the limited geographical range and population size of the species." Current enumeration of phyto-diversity of the Andaman and Nicobar Islands highlights more than 3000 taxa, which include about 2000 Angiosperms, within 8249 sq km area of fragmented land in the Bay of Bengal. This floristic statistic indicates the high degree of diversity in limited geographical region. It also suggest that several endemics are surviving as "narrow endemics" with restricted chances for out-breeding in small gene pools confined to isolated pockets. This fragile ecological equilibrium, if altered by any means, would certainly culminate in endangerment of species.

The wild palms of Andaman and Nicobar Islands have a wide range of distribution from aquatic tidal zones to hilltop vegetation, and many of them, especially several endemic palms, are on the way of endangerment or extinction. According to current information, the Andaman and Nicobar Islands host 38 wild species of palms including 22 endemic taxa. Thirteen endemic taxa exclusively belong to the Andaman group and another seven taxa

1. *Korthalsia rogersii* – Habit, a close up view from TBGRI campus.

are restricted to the Nicobar group of islands. Two endemic species have common occurrence in both groups of islands. Fifteen indigenous insular palms, including a new species of *Phoenix* recently described from North Andamans, are believed to be either rare or critically endangered (Balakrishnan & Rao 1983, Mathew & Abraham 1994, Renuka & Vijayakumaran 1995, Barrow 1998, Mathew 1998).

Rattans, the spiny climbing palms, comprise three genera in Andaman and Nicobar Islands – *Calamus, Daemonorops* and *Korthalsia* – and comprise 18 taxa. These climbing rattans have immense economic value in the cane industry. *Calamus andamanicus* and *C. longisetus* are economically important species. However, several rattans of these islands are becoming rare and some are known only from type collections. *Korthalsia rogersii, Daemonorops kurziana, Daemonorops manii, Calamus nicobaricus, Calamus pseudorivalis, Calamus dilaceratus* and *Calamus unifarius* var. *pentong* are categorized as endangered or nearing extinction.

The genus *Korthalsia* contains 27 species centered on the perhumid areas of the Sunda Shelf with outliers to the north as far as Indochina, Myanmar and the Andaman Islands and with three species being found east of Wallace's Line (Dransfield 1981). In Andaman group of islands, it is represented by two species, *Korthalsia laciniosa* and *K. rogersii*. The former is a common species found to occur in the moist deciduous and semi-evergreen forest belt of these islands. This robust durable cane is occasionally used for the framework of cane chairs by local people. *Korthalsia rogersii* is a critically endangered species known only from two collections (*C.G. Rogers 143*, Andamans, 22 Mar. 1904 & *C.G. Rogers 62*, S. Andamans, Potatang stream, 02 Feb. 1904). According to Dransfield, the type specimens of *Korthalsia rogersii* deposited at Kew apparently resembles a miniature version of *Korthalsia laciniosa* with unarmed sheaths and ocrea. However, he suggested that this insular taxon has more similarities with *Korthalsia concolor,* an endemic species of Borneo, rather than *Korthalsia laciniosa.*

Korthalsia rogersii has been relocated in South Andamans in 1993 by one of the authors (SPM) during his exploration for the Flora India Project of the Botanical Survey of India. Later in 1994, live samples collected from South Andamans were introduced in the Tropical Botanical Garden and Research Institute (TBGRI). One of these live samples has flowered and fruited in 2004. However, the live specimen displayed differences in the length of petiole and inflorescence as described by Basu (1992) and Renuka (1995). A detailed taxonomic account based on the herbarium collections from Burmanalla, South Andamans and the live plant conserved in TBGRI is given below.

Taxonomic Description

Korthalsia rogersii Becc. in Ann. Roy. Bot. Gard. (Calcutta) 12(2): 131. 1918.

Korthalsia rogersii – 2 (left). Inflorescence and leaves. 3 (right). Fruiting branch.

Korthalsia rogersii – 4 (upper left). Mature fruits in close up. 5 (bottom left). Ruminate endosperm. 6 (upper right). Seedling.

Clustering, slender, hapaxanthic, hermaphroditic, climbing, aerially-branching rattan palm. Stem ca. 40–45 m long , with sheath 10 mm diam., without sheaths 7 mm diam.; internodes c. 20 cm. Sheaths without knee, sparingly armed with ca. 4–5 bulbous based spines, 2–5 mm long , and covered with brown indumentum; ocrea tightly sheathing, covered with indumentum, unarmed, disintegrating only at distal ends, not forming an ant chamber; leaves with petiole 50–120 cm long, culminating in a well developed cirrus with recurved spines, 2–5 mm long, close towards distal ends; petiole well developed, ca. 7–8 cm long, oblate spheroid in cross-section, armed with spines, 3–5 mm long, brownish at base, black at tips; rachis angled adaxially, armed with 2 rows of spines, covered with brownish indumentum; leaflets rhomboid, praemorse ca. 5–8 pairs; ansa (leaflet stalk) versatile, 1.5 cm long yellowish green; proximal leaflets to 14 × 7 cm; mid leaflets to 15 × 9 cm; distal leaflets smaller; margins unevenly praemorse with teeth to 5mm; leaflets multicostate, costae 9–10, radiating from ansa; lamina mid-green on adaxial surface, whitish on abaxial surface; terminal leaves subtending inflorescences smaller, with 5–6 leaflets. Inflorescences to 45–50 cm long, lax, bursting through the leaf-sheaths, 3–4 in number, branching to 2 orders, each branch subtended by closely sheathing tubular bracts, 7 × 1 cm, persisting up to maturity, unarmed and with brownish indumentums, bract limbs triangular; main axis subtending ca. 4 or 5 or more first order branches (partial inflorescences), each with up to 5 rachillae; rachillae lax, 10 × 0.5 cm, brownish, rachilla bracts enclosing a pit filled with woolly brownish hairs. Flower to 5 × 1 mm; calyx cup-shaped, sepals 3, 2 × 1 mm, gamosepalous, broadly ovate, light brown; corolla rigid, fleshy, petals 3, 5 × 1 mm, boat-shaped; stamens 6, 3+3, slightly inflexed towards the center, filaments short, fleshy at base, brownish, 4 × 1 mm, dehiscing abaxially; carpels 3, rounded, style short, stigma pyramidal, 3 × 1 mm. Fruit obovoid with persistent calyx and stigma, 20 × 18 mm, scales imbricate arranged in 15 vertical rows; endosperm ruminate.

Specimens examined: South Andaman, Burmanullah, 24 Dec. 1994, *S. P. Mathew 20904* (K), *45201, 47138* (TBGT).

Conservation Status

The Tropical Botanic Garden and Research Institute located in the foothills of the Southern Western Ghats was established for the conservation of plant genetic resources of the country, especially from Peninsular India and Andaman and Nicobar Islands. The Institute has a well established Palmetum, which conserves 102 species and 7 varieties in 67 genera of palms. To strengthen the germplasm collections of TBGRI from the Andaman Islands, a team of botanists explored the South Andaman Islands in 1994 and collected many live samples and seeds. During the exploration, the population of *Korthalsia rogersii* was relocated at Burmanallah, the southernmost part of the South Andaman main island and interestingly the palm was fruiting. The fruiting season was about to terminate and a few samples were collected. The seeds were brought back very carefully and germinated under controlled conditions at TBGRI. One of the seedlings survived at the institute campus and flourished, flowering after eight years. Detailed taxonomical studies were carried out in 2004, and the specimens and images were sent to Dr. Dransfield at Royal Botanic Gardens, Kew, who confirmed the identity as *Korthalsia rogersii*. The rediscovery of this species has great significance in view of the Institute's mandate.

Burmanallah in South Andamans is a forest village where the settlers are mostly migrants from South India who settled during the period of Indian independence. Coconut palms and fishing are their main income generating sources. The villagers also depend on minor forest produces such as canes and bamboos for their livelihood and other domestic needs. The tropical rain forest in this region is luxuriant and hosts *Korthalsia laciniosa* and several other *Calamus* spp. The uncontrolled and unsustainable extraction of canes from this region is a major threat to this species. During our exploration in the Andaman Islands, we could locate only one population of *Korthalsia rogersii* at this region surviving along with *Korthalsia laciniosa* on a steep undulating slope. The major constraint for conservation of critically endangered palms of these islands is the paucity of information. Extensive explorations for insular palms among the islands of Andaman and Nicobar would certainly be essential for collecting accurate information, especially on critically endangered palms and their populations. According to current information, no intensive protective steps by any government agencies have been taken for the *in situ* conservation of *Korthalsia rogersii* at Burmanallah. Detailed studies on seed biology and storage of this endangered endemic palm may be of value for its conservation.

Acknowledgments

The authors (SPM & AM) are thankful to Department of Biotechnology, Government of India, New Delhi, for financial assistance to National Gene Bank Project. One of us (PL) is grateful to the Director, Botanical Survey of India, for facilities. The authors also would like to record their sincere thanks to Dr John Dransfield, Royal Botanic Garden, Kew, England for his valuable comments on this species.

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Dypsis ambositrae

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On the high plateau of Madagascar, south of the town of Ambositra and in a rocky valley at ca.1440 m above sea level, a very rare palm stills clings to existence: *Dypsis ambositrae* (Fig. 1). This species was first described by Dransfield and Beentje in The Palms of Madagascar (1995), and they commented, "...in 1992 12 trees were known and by 1994 at least 5 of these had been cut down." By 1999, only 2 palms remained, and these were cut for fuel shortly thereafter (pers. obs.). Several small juveniles were obtained from local villagers in 2003 and are surviving in Tsimbazaza Botanical and Zoological Gardens in Antananarivo. In 2005, a single 14 m tree was shown to us, and several hundred old seeds were collected. The seeds (ca. 11 × 9 mm) had fibrous endocarps and were sparsely ruminate to 2 mm. This year we returned to be shown a small farm containing three mature specimens. These are protected by local fady (tradition), and we learned that a few others were still alive but "far away." Reasonably fresh seeds were collected, and prospective seedlings will be distributed to various tropical and subtropical botanic gardens and serious palm collectors.

The world of palm collecting is awash with various palm species described as *Dypsis ambositrae*. Few, if any, fit the description of the species, and this is hardly surprising as fertile seeds have rarely if ever been collected. The juvenile of the species is highly colorful with red petioles and leaf rachis. Later development shows a thickset palm with a grey white crown shaft. Some of these have one or two suckers, but it appears that suckers are lost by fire as the main stem matures.

The region in which this palm grows is small in area. Unless further populations are found, the prospect of these singular palms becoming extinct in their natural habitat is very real. (Editors' Note: an additional healthy population with substantial regeneration was discovered in 2003 by Tianjanahary Ranarivelo, Royal Botanic Gardens Kew in Madagascar).

Acknowledgments

The author thanks Guy Rafamantanantsoa, Dr. Peter Balasky and Pierrot Rahajanarina who, at different times since 1999, significantly contributed to the search for this palm species.

1. *Dypsis ambositrae*. Photo by John Dransfield.

Once again we will offer a *Palm Tour of the Amazon*. This tour is designed for palm enthusiasts who are interested in experiencing the rich and diverse palm flora of the Amazon. We will explore the central Amazon region, a fascinating ecosystem with a great diversity of plants, animals, birds, and fish. The region includes a variety of palm habitats and we will look for several interesting species – *Barcella odora, Manicaria saccifera, Leopoldinia pulchra, Leopoldinia major, Leopoldinia piassaba, Mauritiella aculeata, Mauritia carana*, and *Euterpe catinga*. Along the river margins and in nearby forests we will see a great variety of species of *Syagrus, Hyospathe, Socratea, Iriartella, Oenocarpus, Geonoma, Bactris, Astrocaryum, Mauritia,* and *Euterpe*. On each of the previous trips we have seen between 50 and 60 different species of palm.

The trip is planned to take advantage of the good weather of the dry season. We will live and travel aboard a brand-new, comfortable Amazonian riverboat. The boat has fans, showers, and toilets in each cabin, and a small library of books on Amazonian natural history. The owner/captain is the legendary Amazon guide Moacir Fortes, who took us on our earlier trips. "Mo", as he is known to one and all, is fluent in several languages, and enjoys sharing the fascinating, and often humorous, legends of the Amazon region, where he grew up.

In our motorized canoes we can travel among the rain forest trees, enjoying close up views of palms and other plant and animal life (on previous trips we have seen the giant Amazon water lily and an anaconda!). We will often get off our boat for short hikes in the forest, and to visit the friendly "caboclos" who live along the riverbanks. These people use an amazing variety of palms in their daily lives, and always know of some interesting palm that grows "not far away"! Frequent swims, fishing opportunities, and occasional cookouts add to the enjoyment of our trip. In Manaus, our port of departure in Brazil, we will visit the famous Opera House and be able to buy such artifacts as hammocks made from palm fiber, and also sample ice cream made from the fruits of *Euterpe* and *Astrocaryum*!

The tour will be led by Dr. Andrew Henderson of the New York Botanical Garden. Henderson is author of *Palms of the Amazon* and *Field Guide to the Palms of the Americas*. The 10-day trip is planned for 5-15th October 2007. For additional information see http://www.nybg.org/botany/amazonpalmtour/ or contact Andrew Henderson at ahenderson@nybg.org, or by phone at 718 817 8973, or by mail at The New York Botanical Garden, Bronx, NY 10458.

Fee: estimated $3400 including round trip airfare from Miami, accommodation, meals, and field trips.

PHOTO FEATURE

Coccothrinax ekmanii, Prov. Pedernales, Dominican Republic

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