Palms

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FRONT COVER

Gulubia costata in cultivation in Miami, Florida, USA. See article by C. Migliaccio, p. 122. (Photo: C. Migliaccio)

Palms (formerly PRINCIPES)

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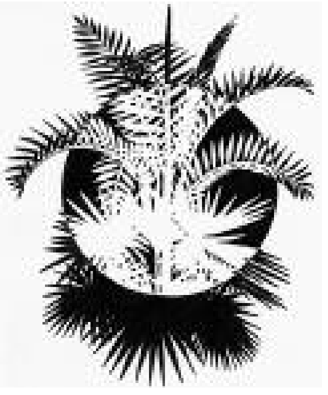
The fruits of *Gulubia costata* reveal the meaning of the specific epithet: “costata” means “ribbed.” Photo by C. Migliaccio.

BACK COVER

Beccariophoenix in flower in Stan Walkley’s garden, Brisbane, Australia (Photo: Hugh Kunze).



NEWS FROM THE WORLD OF PALMS

As this part of PALMS goes to press, we hear that our recently retired co-editor, Dr. Natalie Uhl, is about to receive one of North America's most prestigious botanical awards, the Asa Gray Award, given by the American Society of Plant Taxonomists in recognition of her outstanding contribution to plant systematics. Our heartiest congratulations, Natalie.

One of us (JD) paid a brief visit to Lae in Papua New Guinea to work in the herbarium on the palm collections for the Palms of New Guinea project. Throughout the town of Lae one of the most conspicuous palms is *Gulubia costata*, towering over coconuts and other planted palms. What an elegant and spectacular palm this is, and it seems most surprising that this wonderful palm should be so restricted in cultivation in the tropics. It is every bit as beautiful as *Roystonea regia*. Why is it so restricted? Is it simply lack of supply? Chris Migliaccio's front cover photograph and article on p. 122 of this issue should alert IPS members to the ornamental potential of this exciting palm.

This issue marks the regular appearance of Palm Research, a feature started by this journal's first editor, Dr. Harold E. Moore, Jr. The column, now compiled by Dr. Andrew Henderson of the New York Botanical Garden, is a bibliography of palm research articles spanning a variety of disciplines. A quarter of a century ago, there were only nine articles, one conference proceedings, and three books listed in all of volume 21. A glance at this issue's column, with its 75 entries (69 articles, five books and one CD-ROM) from the preceding year, shows just how active and vibrant the many fields of palm research are. We are sure Hal Moore would be gratified to see that his interest in palms is shared by so many researchers from all over the world.

We are saddened by the news of the death of Dr. Onaney Muñiz on June 7, 2002, in Cuba. He was a fine, respected and devoted scientist who made an important contribution to phytogeography, taxonomy and ecology of Cuba. In particular, he described dozens of new species – including many palms – and was committed to preserve and protect the remains of Cuba's unique flora. He is commemorated in the palm name *Coccothrinax munizii*. We hope to have a more detailed profile of Dr. Muñiz in a forthcoming issue of PALMS.

Preparations for the 2002 Biennial in the south of France are well under way. The organizing committee of the Association Fous de Palmiers is putting together tours of some of the area's finest gardens, lectures from palm experts and, of course, opportunities to sample the famous Niçoise cuisine. The Post Tour will take participants to outstanding Mediterranean gardens in Spain and Italy. Two of the articles in this issue will whet readers' appetites for the Biennial: one on the historic date grove at Elche by Michel Ferry et al. and another on Mediterranean palm collections by Jean-Christophe Pintaud. We look forward to meeting old and new friends on the French Riviera for a week or two of concentrated palm enthusiasm and enjoyment.

Readers will undoubtedly notice that the Horticulture Column is absent from this issue. Katherine Maidman has stepped down from the position after an exemplary term of service. We are grateful for her many interesting contributions to the column, and we invite anyone wishing to take on the task of writing the column to contact the editors.

THE EDITORS

Alfred Russel Wallace and the Palms of the Amazon

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Alfred Russel Wallace went to South America with Henry Walter Bates in 1848; both men intended to collect plants, but both rapidly chose to focus on insects and birds. Wallace returned to England in 1852; however, a fire on his ship destroyed all of his collections en route. Upon his return he published a small book on palms, based upon the few drawings he had rescued from the burning ship. We here demonstrate that Wallace also successfully dispatched a few specimens of Amazonian palms to Sir William Jackson Hooker at the Royal Botanic Gardens, Kew, for use in the Museum of Economic Botany, where they have lain largely unnoticed for many years. These specimens are not only the important physical evidence of Wallace's interest in palms, but are also exciting clues to his early development as a field naturalist.

Alfred Russel Wallace is best known for his meticulous collecting in the Malay Archipelago (Camerini 1996, Raby, 1996), for the eponymous Wallace Line (Camerini 1993, van Oosterzee 1997), and for his bombshell of a letter from the tiny island of Ternate outlining his theory of the origin of species that galvanized Charles Darwin into finally publishing his seminal masterpiece *Origin of Species* (Desmond & Moore 1991). While in Southeast Asia, Wallace collected zoological material, and his wonderful specimens of birdwing butterflies and birds of paradise were among the first to be available to enthusiasts and museums in Europe. Wallace's essay contained in the letter to Darwin was read at the Linnean Society of London on Thursday, July 1st, 1858, in conjunction with a contribution on the same subject from Darwin, but neither man was physically present at the meeting. Darwin never strayed far from his home in Downe, Kent, and Wallace was still engaged in fieldwork in Southeast Asia.

Wallace was a first class observer and collector. His descriptions of bird and butterfly behaviour are without parallel, and his book about his experiences in Southeast Asia, *The Malay Archipelago* (Wallace 1869), is compulsive reading. But he did not jump straight from his profession as a surveyor in Middle England to being one of the great collectors of all time in the wilds of Borneo without practice – he had been in the field

1A (upper left). All of the palm specimens collected by Wallace and Bates laid out on table, with the authors and Kate Davis consulting *Palm Trees of the Amazon*; 1B (upper right). *Bactris maraja* Mart. (Kew # 38748); 1C (lower left). *Mauritella armata* (Mart.) Burret (Kew # 38782); 1D (lower right). A modern specimen of *Mauritella armata* (Mart.) Burret from the Kew Herbarium.

before, in Amazonia. In 1848, Wallace and his friend Henry Walter Bates decided to set off to explore the Amazon and to investigate the question of "the origin of species," intending to collect and sell specimens in order to finance their adventure (Bates 1863, Wallace 1905). Before they left, they consulted widely in the scientific community of London, making frequent trips to the British Museum (today's Natural History Museum) for advice on collecting butterflies, beetles and birds, and to the Royal Botanic Gardens at Kew for advice from the director, Sir William Jackson Hooker, on the collection of plants. Hooker wrote a letter of introduction for both men to use in Brazil (Bates & Wallace 1848), which would be useful for opening doors that would otherwise be closed to two impecunious young Englishmen.

Wallace explored the Amazon and upper Rio Negro and Rio Uaupes for four years, reaching places where no European had ever been. Bates stayed for another seven years after Wallace had returned to England (Bates 1863, Beddell 1969), travelling as far as Rio Solimões while mainly collecting butterflies and beetles. Many of Bates' collections are in the Entomology Department of the Natural History Museum in London; they remain among the first and finest from those parts of the world. Wallace too collected many insects and also birds, but the bulk of his collections met a quite different and regrettable fate.

After four years of collecting, largely alone or in the company of hired guides, Wallace decided to return to his family. He discovered that all of his collections had been impounded by Customs in Barra (present-day Manaus) and had not been sent on to be sold in England as he had wished. He reclaimed them, and quite ill with what was probably malaria, made his way down the Amazon to Pará (present-day Belem). He booked passage on the trading ship *Helen*, which was carrying a cargo of balsam of capivi, tree sap used in the manufacture of varnish. He was ready to return home, and hoped to see his friends and family before long. Halfway across the Atlantic, however, disaster struck. The *Helen* caught fire, probably due to irresponsible packing of the highly flammable balsam, and was beyond saving. All hands, including Wallace, evacuated to lifeboats and were eventually picked up many days afterwards – nearly out of drinking water and close to death. All Wallace's specimens and diaries were packed in the *Helen*'s hold and so were lost.

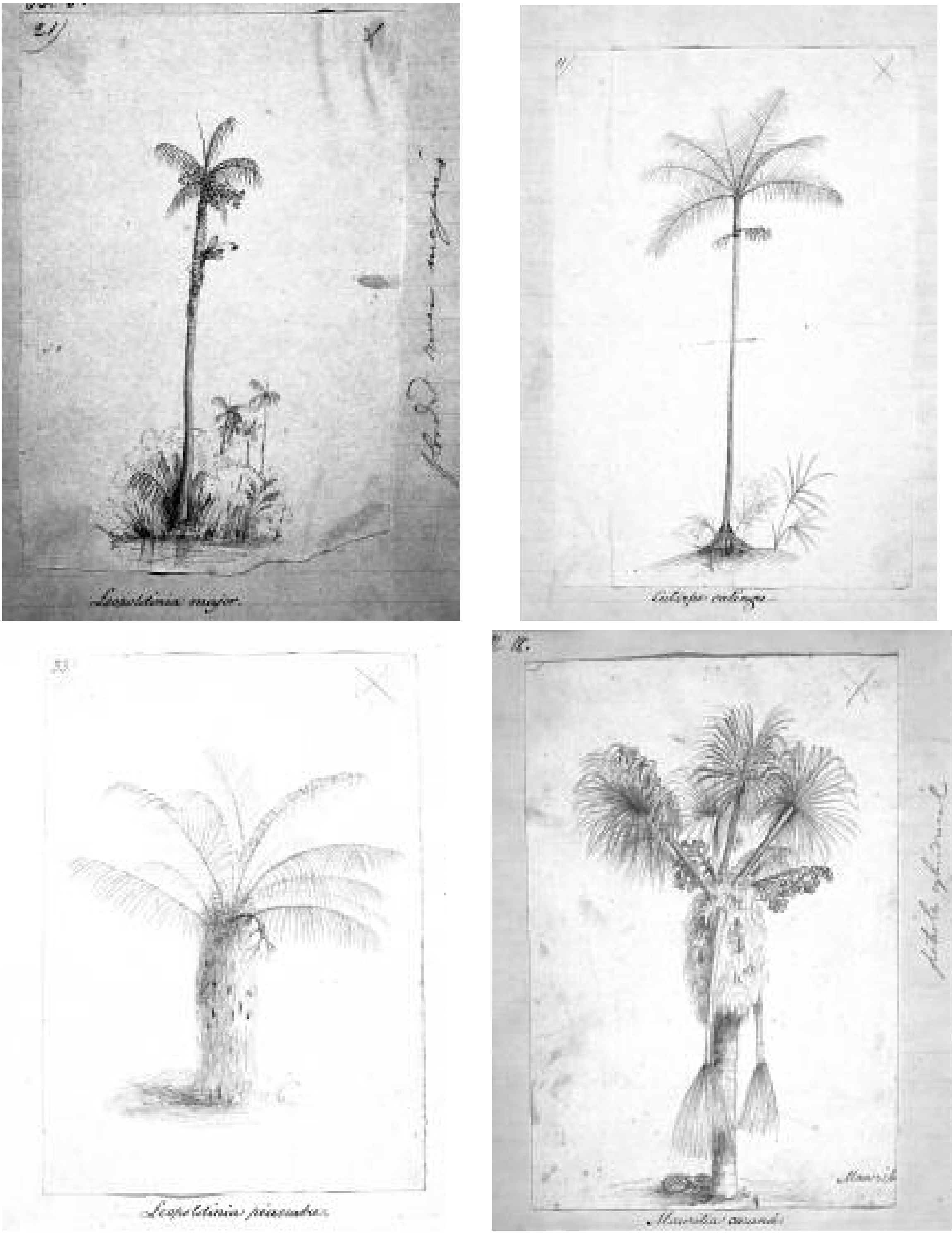
As the ship was sinking, Wallace raced back to his cabin and grabbed a small tin box containing some drawings he was working on during the voyage, together with his watch and a few shirts. He left a large portfolio of sketches and most of his clothes – something he had trouble explaining to himself and others later (Wallace 1852, 1853b). The small drawings he saved were of fishes, native implements and of palms, with which he had become fascinated while in the forests of the Rio Negro. Once back in England, Wallace had to recover something more than the insurance his agent Samuel Stevens had taken out on his behalf, so he set about publishing some of his experiences (Sanders & Knapp in prep.). His book about his voyage, *Travels on the Amazon and Rio Negro* (Wallace 1853b), was written from memory – he had no notes to remind him of daily happenings. He published a few papers on the geography of the Rio Negro (Wallace 1853c), electric eels (Wallace 1853d), insects (Wallace 1854a, b) and, at his own expense, a small book about the palms of the Amazon and their uses (Wallace 1853a). The book was illustrated with lithographs prepared from his pencil sketches saved from the sinking of the *Helen*, and rather than complicated Latin botanical diagnoses, contained broad descriptions of each palm, focusing on the aspects of the plant easily seen and appreciated by the non-specialist, along with accounts of their native uses and ecology. Whether or not Wallace collected botanical specimens in the Amazon has always been in doubt, partly because the loss of most of his Amazonian collections destroyed any possible evidence. However, he did collect some plants – but not specimens as botanists know them today.

In this paper, we catalogue the palm specimens held at the Royal Botanic Gardens, Kew. These palm specimens are among the very few plants Wallace collected either in the Amazon or in Southeast Asia (although the relatively small, but still incompletely documented, fern collections he made in Borneo are held both at Kew and the NHM), and as such are of considerable historical importance. The material sent to Hooker differs radically from today's typical palm herbarium specimens, but is the only solid evidence of Wallace's plant collecting in the Amazon. These specimens also comprise evidence upon which Wallace based his *Palm Trees of the Amazon*, in addition to his drawings rescued from the sinking *Helen*. Wallace's contribution to knowledge of the palms of the Amazon has occasionally been overlooked (but see Balick 1980, Henderson 1995, Kahn 1997). We hope that by elucidating the material he used to produce the book, his contribution can be properly appreciated.

Wallace the botanist

Natural historians have assumed that Wallace did collect specimens of palms, in the manner of a trained botanist (Henderson 1995, Prance 1999, G. Nelson pers. comm. 1999), and that they were of course all lost in the sinking of the *Helen*. However, there is ample evidence that Wallace and Bates soon gave up trying to collect plants (see below), collecting only a few specimens for Hooker's Museum of Economic Botany.

Wallace and Bates arrived in Pará in late May of 1848. They spent about a year together, travelling in the vicinity of Pará and up the Rio Tocantins, during which time they sent specimens back both to their agent Samuel Stevens, and to Sir William Hooker at Kew. In a letter dated August 20th, 1848, sent from Pará, Wallace told Hooker, "we send to you by the "Windson" from hence to Liverpool a box of dried specimens, principally palms & we trust they will arrive in good order & prove acceptable." These specimens were destined for use in the Museum and Hooker apparently had agreed to pay £10 plus freight costs for the specimens. The Museum's entry book at Kew records their arrival on 28th December 1848, as entry number 77-1848; "A box containing stems and leaves of palms as per list. also some pods and



2. Some of Wallace's drawings of palms (courtesy of the Council of the Linnean Society of London). A (upper left) *Leopoldinia major* Wallace; B (upper right). *Euterpe catinga* Wallace; C (lower left) *Leopoldinia piassaba* Wallace; D (lower right) *Mauritia carana* Wallace.

leaves." The term "pods" most likely refers to the large pod-like peduncular bract, which is present in one of the nine surviving specimens (Table 1). Although leaf sheaths are present in some of the specimens, none of the specimens includes full leaf material. Perhaps the reference to "leaves" in

Table 1. Palm specimens collected by Wallace and Bates in Brazil now held in the Herbarium of the Royal Botanic Gardens, Kew.

Kew Catalog No.	Current Name	Description
38854	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.	Peduncular bract enclosing juvenile inflorescence
35050	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.	Inflorescence
35069	*Astrocaryum aculeatum* G.Mey.	Inflorescences
34981	*Astrocaryum gynacanthum* Mart.	Fruits
38748	*Bactris maraja* Mart.	Petiole
38868	*Bactris maraja* Mart.	Stem apex with leaf sheaths
35170	*Bactris maraja* Mart.	Stem apex with leaf sheaths
38749	*Euterpe oleracea* Mart.	Stem apex with leaf sheaths and inflorescences
38782	*Mauritiella armata* (Mart.) Burret	Stem apex with leaf sheaths and inflorescences

the Catalogue note refers to material that has perished in the century and a half since the specimens arrived at Kew. Alternatively, the "leaves" of the Museum entry could have been not palms, but ferns. In a postscript to his August letter Wallace wrote, "I send the few dried plants (a few hundred specimens) principally ferns. – You can perhaps dispose of them or allow what you consider them to be worth." Nothing is known of the fate of the fern specimens, as we have been unable to locate them in the collections at Kew. It is tempting to think that Hooker did exactly as Wallace suggested and disposed of them, although we have no evidence for this.

Hooker had opened his Museum of Economic Botany in 1847, and was actively accessioning material of economic value and interest for public display from all over the world. At that time he also maintained a private herbarium, which may have been the logical destination for Wallace's fern specimens. The public herbarium at Kew was not founded until 1852, and even then Hooker's herbarium was not incorporated until 1866, when it was purchased by the British Government after Hooker's death in 1865. Thus, Wallace's palms survived perhaps by being intended for public display, rather than being specimens of purely "scientific" value.

Later in his August 1848 letter to Hooker, Wallace stated, "We have hitherto found quite enough to do attending almost entirely to Insects only. – we are now commencing also at Birds so that it will be quite impossible to find time to make any thing of a general collection of plants," and again, "I fear I shall find no time to collect plants but shld I meet with any thing very curious I will endeavor to preserve it." It seems quite clear from this letter that Wallace did not intend to collect plants in any comprehensive or coherent way during his four-year stay in Brazil, whatever his intentions may have been before leaving England. Yet, despite this concentration on birds and insects, Wallace's interest and imagination was quickly captured by the beauty and magnificence of the "virgin forest" (Wallace 1905), and the palms in particular drew his admiration:

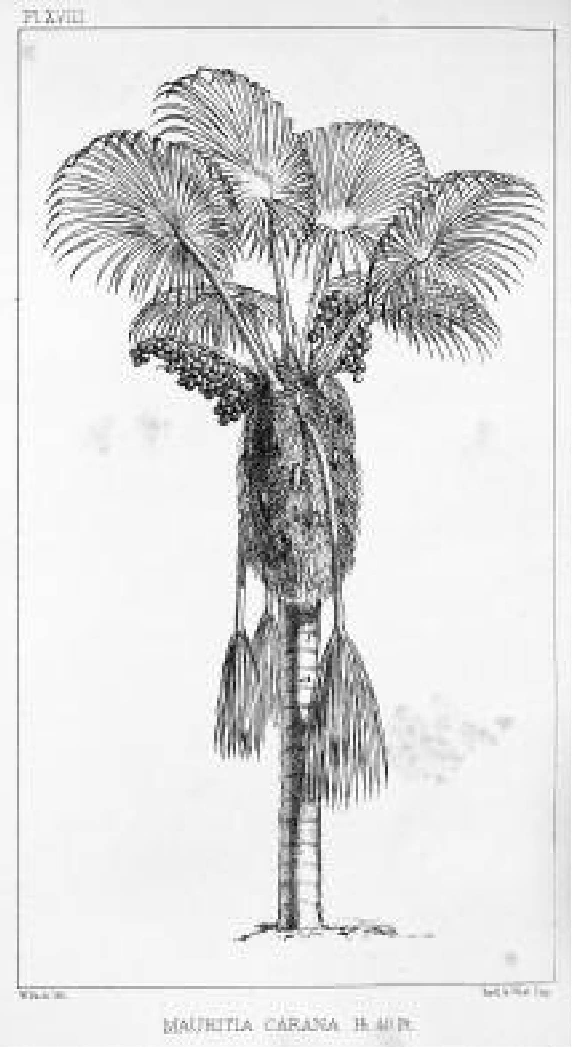
> "everywhere too rise the graceful Palms, true denizens of the tropics, of which they are the most striking and characteristic feature. In the districts which I visited they were everywhere abundant, and I soon became interested in them, from their great variety and beauty of form and the many uses to which they are applied." (Wallace 1853a, p. iii)

The collections made by Wallace and Bates and sent to Hooker are far from conventional in comparison to modern botanical specimens (Fig. 1A, B, C). To understand how they differ, we must provide some details of current herbarium methods. A herbarium is a botanical museum which houses preserved plant specimens for scientific purposes. A typical specimen consists of representative plant parts (e.g. leaves, stems and, ideally, both flowers and fruit) which are pressed and dried over a gentle heat source shortly after they have been collected. When a specimen is brought to a herbarium, it is usually mounted on a rectangular sheet of card which provides support to the specimen, space to attach both field notes and annotations, and which is readily filed away in a herbarium cupboard. There is some variation among institutions in the size of the sheets but in general, the size of the sheet limits the size of the specimen itself. Palms defy the standard herbarium method on account of their bulk and complexity. A palm specimen must be collected very carefully

3. The lithographs of Wallace's palms prepared by Walter Fitch for *Palm Trees of the Amazon*. As these plates are the only botanical elements specifically associated with the new names Wallace coined for his palms, they remain the type "specimens" of Wallace's names and thus of enduring importance to palm taxonomists. A (left). *Leopoldinia major* Wallace; B (right). *Euterpe catinga* Wallace.

and with copious notes to be both useful to botanists and compact enough for storage in a herbarium (Dransfield 1986). However, even the highest quality palm specimens can present herbarium staff with severe curatorial problems. Although many botanical institutions continue to mount palm specimens on their standard-sized sheets, others use extra-large sheets for some specimens. The sheet mounting of palm specimens has been abandoned altogether at Kew, in favour of loose storage in standard-size boxes of assorted depths (Fig. 1D), a technique developed at Cornell University by Liberty Hyde Bailey (1933). This method suits well the awkward shapes and sizes of such material and avoids the need to mount the individual components of a single complex specimen on numerous sheets. Nevertheless, the specimens collected by Wallace and Bates do not even submit to this sort of treatment. Some are up to 100 cm in length and include large portions of stem, complete inflorescences, leaf sheaths, spiny petioles and bracts (Fig. 1A, B, C). They are far too cumbersome to be curated by any method described above and are now stored in large plastic bags with fragile parts protected with padding.

In addition to their curatorial peculiarities, all the specimens are very incomplete, consisting of very few organs in each case. This begs the question: are the specimens of Wallace and Bates of any scientific significance at all? Before judging the specimens too harshly, however, we should reflect



3 (continued), C (left). *Leopoldinia piassaba* Wallace; D (right). *Mauritia carana* Wallace.

on the motivation of the collectors so as to understand why the specimens are the way they are. Wallace and Bates primarily collected animal specimens and, as indicated above, they were more than occupied by that task.

In fact, neither of the two had any particular plant collecting expertise; despite Wallace's early interest in the British flora, he had not collected specimens, preferring instead to identify plants in the field (Wallace 1905). In this light, their collecting decisions are not surprising if one imagines the dismay that they might have felt when confronted by a monumental palm from which they planned to make a specimen. It is also possible that they selected only bulky parts for collection, knowing that they would survive rough handling during the expedition and journey home better than fragile specimens. Furthermore, in his letter to Hooker, Wallace is clearly aware that their specimens were destined for the Museum of Economic Botany and possible public display, rather than Hooker's herbarium. They may well have chosen large pieces which would make striking curiosities for a museum display cabinet. Wallace's own interest in economic botany is very evident in his *Palm Trees of the Amazon* (Wallace 1853a) which contains numerous references to local uses of palms. In the book, Wallace lists local uses for four of the six species represented by the nine specimens known today (Tables 1, 2).

The entire holdings of palms in the Economic Botany collections at Kew were the subject of a recent review by Dr. Sasha Barrow. The study revealed a total of more than 1600 accessions, ranging from specimens through raw materials to processed products (Barrow 1998). During the

Table 2. Comparison of the palm names used by Wallace in his *Palm Trees of the Amazon* and their currently accepted names according to Henderson (1995). Taxa described by Wallace and still known by those names are in bold.

Wallace 1853	Henderson 1995
Leopoldinia pulchra Martius	*Leopoldinia pulchra* Mart.
Leopoldinia major, n. sp.	***Leopoldinia major* Wallace**
Leopoldinia piassaba, n. sp.	***Leopoldinia piassaba* Wallace**
Euterpe oleracea Martius	*Euterpe oleracea* Mart.
Euterpe catinga, n. sp.	***Euterpe catinga* Wallace**
Œnocarpus baccába Martius	*Oenocarpus bacaba* Mart.
Œnocarpus batawá Martius	*Oenocarpus bataua* Mart.
Œnocarpus minor Martius	*Oenocarpus minor* Mart.
Œnocarpus distichus Martius	*Oenocarpus distichus* Mart.
Iriartea exorhiza Martius	*Socratea exorrhiza* (Mart.) H.Wendl.
Iriartea ventricosa Martius	*Iriartea deltoidea* Ruiz & Pav.
Iriartea setigera Martius	*Iriartella setigera* (Mart.) H.Wendl.
Raphia tædigera Martius	*Raphia taedigera* (Mart.) Mart.
Mauritia flexuosa Linnæus	*Mauritia flexuosa* L.f.
Mauritia carana, n. sp.	***Mauritia carana* Wallace**
Mauritia aculeata Humboldt	*Mauritiella aculeata* (Kunth) Burret
Mauritia gracilis, n. sp.	*Mauritiella aculeata* (Kunth) Burret
Mauritia pumila, n. sp.	*Mauritella armata* (Mart.) Burret
Lepidocaryum tenue Martius	*Lepidocaryum tenue* Mart.
Geonoma multiflora Martius	*Geonoma maxima* Mart.
Geonoma paniculigera Martius	*Geonoma deversa* (Poit.) Kunth
Geonoma rectifolia, n. sp.	*Geonoma deversa* (Poit.) Kunth
Manicaria saccifera Gærtner	*Manicaria saccifera* Gaertn.
Desmoncus macroacanthus Martius	*Desmoncus polyacanthos* Mart.
Bactris pectinata Martius	*Bactris hirta* Mart.
Bactris ___, n. sp.	
Bactris elatior, n. sp.	*Bactris maraja* Mart.
Bactris ___, n. sp.	
Bactris macrocarpa, n. sp.	*Bactris maraja* Mart.
Bactris tenuis, n. sp.	*Bactris simplicifrons* Mart.
Bactris simplicifrons Martius	*Bactris simplicifrons* Mart.
Bactris maraja Martius	*Bactris maraja* Mart.
Bactris integrifolia, n. sp.	*Bactris hirta* Mart.
Guilielma speciosa Martius	*Bactris gasipaes* Kunth
Acrocomia lasiospatha Martius	*Acrocomia aculeata* (Jacq.) Lodd.
Astrocaryum murumurú Martius	*Astrocaryum murumuru* Mart.
Astrocaryum gynacanthum Martius	*Astrocaryum gynacanthum* Mart.
Astrocaryum vulgare Martius	*Astrocaryum vulgare* Mart.
Astrocaryum tucuma Martius	*Astrocaryum aculeatum* G.Mey.
Astrocaryum jauari Martius	*Astrocaryum jauari* Mart.
Astrocaryum aculeatum ? Meyer.	*Astrocaryum aculeatum* G.Mey.
Astrocaryum acaule Martius	*Astrocaryum acaule* Mart.
Astrocaryum humile, n. sp.	*Bactris acanthocarpa* Mart.
Attalea speciosa Martius	*Attalea speciosa* Mart.
Attalea excelsa (as mention in section about *A. speciosa*)	*Attalea phalerata* Mart. ex Spreng.
Attalea spectabilis (as mention in section about *A. speciosa*)	*Attalea spectabilis* Mart.
Maximiliana regia Martius	*Attalea maripa* (Aubl.) Mart.
Cocos nucifera Linnæus.	*Cocos nucifera* L.

review, some herbarium-type specimens, including the Wallace and Bates collections, were transferred to the Herbarium at Kew. Many of these specimens are very large and are not easy to store, but all are invaluable scientific specimens. At times, even the best modern palm specimen does not contain all the information that a botanist might require because relevant parts have been trimmed to fit the curatorial method. Important features are often preserved in oversized specimens. For example, the Wallace and Bates specimens include entire inflorescences and large bracts, parts which would be otherwise unobservable without access to living material.

Wallace's contribution to knowledge of palms of the Amazon

It has been suggested that Wallace contributed little to the scientific study of Amazonian palms (Hooker 1854, Spruce 1855, Balick 1980). However, his contributions can be judged substantial in two areas; firstly, in the identification and naming of palm species new to science, and secondly, in the production of the first field guide to tropical palms.

In *Palm Trees of the Amazon*, Wallace identified 14 species as new to science and coined names for 12 of these (Table 2, column 1). Four of these names are still in use today, indicating that Wallace was the first scientist to name the species (Table 2, column 2). In the naming of plants, botanists adhere to the *International Code of Botanical Nomenclature* (Greuter et al. 2000), one of whose rules is that the scientific names coined first takes priority and takes precedence over names coined later – one reason for name changes in plants can be the finding of an older name. That four of Wallace's new species are still known by the names he gave them testifies to his more than superficial knowledge of palm taxonomy. He was the first "botanist" to correctly identify the source of piassaba fibre, commonly used in brooms in Wallace's day. He commemorated the palm's native name in the scientific name he gave it – *Leopoldinia piassaba*.

Wallace relied heavily on the works of two German noblemen, Alexander von Humboldt (1818) and Carl von Martius (1823–1853). Humboldt, who with his companion Aimé de Bonpland, was the first great European explorer of the Rio Negro, and was fascinated by palms, though he never described any botanically. Martius was a Prussian botanist who explored Brazil at the behest of the Brazilian government (for a account of Martius' importance to palm taxonomy see Henderson 1995); in his monumental work on Brazilian palms he described 85 species as new, 54 of which are still known by his names today (Henderson 1995). While in the Amazon, Wallace may have had a copy of Martius' work, or at least had access to a copy – some of Wallace's pencil sketches held at the Linnean Society of London have identifications in pencil, perhaps done in the field.

Wallace clearly knew about the details of palm identification, otherwise he would not have been able to accurately and correctly place species in genera. Today, when botanists describe new species, the rules of the Code (Greuter et al. 2000) say that a Latin diagnosis (distinguishing the new species from all others in the genus) and a type specimen designation must be provided. Thus, a single collection serves as the point of reference for the name, allowing all future botanists to examine unequivocally authentic material. In Wallace's day, however, the International Code of Botanical Nomenclature did not exist (it came into being formally in 1905), and so type specimens were not required. Thus, the names he coined must be typified using authentic material, which in the case of these sorts of older names can either be an illustration or a specimen. Consequently, in the absence of any specimens directly named by Wallace, the illustrations in his *Palm Trees of the Amazon* (1853a) are the types of the names he coined. Palm taxonomists have usually referred to the lithographs in Wallace's book as the types of his names (Henderson 1995), thus they become the lectotypes (a type designated by a later botanist, see Articles 8 and 9 of ICBN) and are the reference material tied to the species names (Fig. 3). The lithographs are thus important scientifically as lectotypes, but Wallace's original drawings are more accurate and convey more clearly the palms themselves (see Fig. 2). Unfortunately, none of the palm specimens held at Kew relates to any of the taxa described by Wallace, so cannot serve as type material.

Wallace's book *Palm Trees of the Amazon* (1853a) was not intended as a turgid botanical tome. His interest in palms was sparked in part by his interest in their uses by local peoples, and this relationship between people and palms is at the centre of the book. People then, as now, were interested in far-away cultures and peoples. Wallace was much more interested in ethnobotany than in botanical detail, and his descriptions of the uses of palms bring them alive, even today. In a way, Wallace's little palm book was the first real field guide to palms, a popular book intended for the general public. Unfortunately, only 250 copies of the palm book were ever printed, making it among the rarest of books on Amazonian botany (Ewan 1992). Even though the book was reprinted (Wallace 1971), it is still difficult to obtain. Palms are ideal organisms for field guides; large and stately, they are easily distinguishable from the rest of the forest foliage, and they have captured the imaginations of botanists and enthusiasts alike for centuries. The tradition of accessible books about palms begun by Wallace has continued, the field guides of Henderson, Galeano & Bernal (1995) and Kahn (1997) being the most recent examples from the Amazon region. The production of field guides for the non-specialist is more important now than ever before, as the biodiversity crisis deepens.

The Wallace and Bates specimens are far more than oversized museum curios. They are undeniably important as scientific specimens, but perhaps more significantly, they are rare physical remains of Wallace's early development as one of the premier natural historian and biological thinkers of his age. His admittedly somewhat anecdotal account of the palms of the Amazon and their uses, written from memory due to the loss of his collections, can be considered to have begun a tradition of producing field guides to palms. Rather than being an amateur with little knowledge of the niceties of palm taxonomy, Wallace was ahead of his time in using palms to convey the importance and beauty of the Amazon forests themselves, something for which all palm enthusiasts can be grateful.

Acknowledgments

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CLASSIFIED

Palm Research in 2001

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Gulubia costata – a Handsome Palm for the Warm Subtropics

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1. *Gulubia costata* in the author's garden, Miami, Florida.

***Gulubia costata* – a striking palm with distinctive pendant leaflets – is worthy of more widespread cultivation in the warm subtropics.**

PALMS 46(3): 122–124

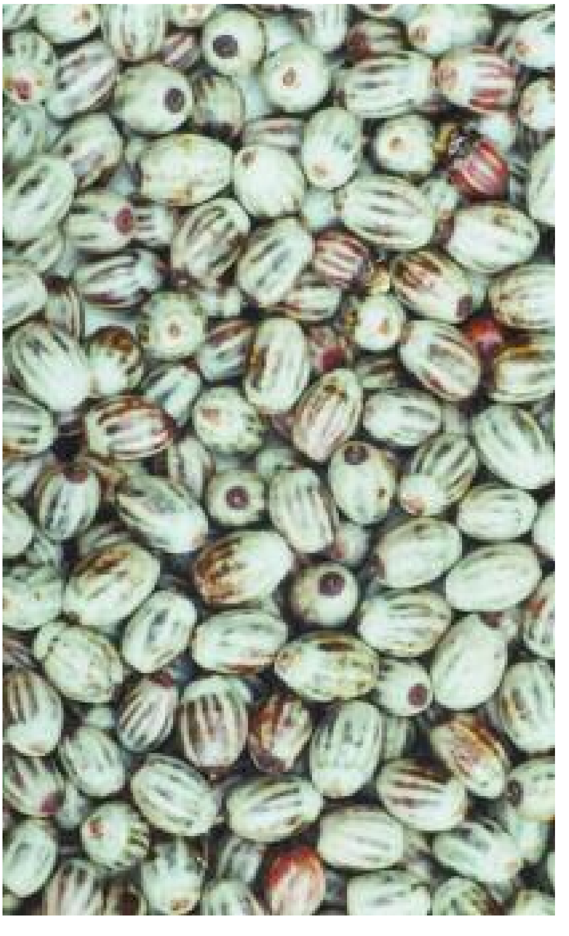
2. *Gulubia costata* infructescence, full of pale orange-yellow fruit.

In October 1989 at a Fairchild Tropical Garden sale, I purchased a juvenile palm that I knew little about at the time – *Gulubia costata*. Later I discovered that two years earlier, the Garden had received seed collected from Cape York, Australia (FTG 87-525) and had grown the plants in quantity for their members.

In May, 1990, I planted the palm in a sunny but wind-protected location on the northwest side of my home – about six feet from the cement block structure. Soils in my garden are all derived from alkaline limestone marl but have been heavily augmented with mulch for over twenty years. This specimen was only 0.5 m tall at planting but I soon learned it was a fast-growing species. Unfortunately, when Hurricane Andrew hit South Florida in August 1992, the *Gulubia* was 3 m overall and was easily knocked down by the 100 kph winds that blasted our neighborhood. A week after the storm, I set the palm upright , staking it with a support tripod for the next year. Sadly, all the plants in the ground at FTG from this accession were destroyed.

In the past nine years, the *Gulubia* has grown to an overall height of 8 m and holds a crown of about 16 leaves with broad pendant leaflets (Fig. 1). Winter winds annually take their toll by shredding the relatively thin leaflets and browning their tips when the temperatures drop into the 5 – 7°C range. In this regard, *Gulubia* shows greater susceptibility to cold damage than my 9 m tall *Pigafetta filiaris* planted 10 m away. In January 1996, a combination of cold and dry winds over a three-day period damaged the *Gulubia* so much that I was not sure it would survive. The following growing season saw a complete recovery. Then, from late December, 2000 to early February, 2001, South Floridians experienced the fourth coldest winter on record with temperatures lingering for many days in the 12–15°C range before warming slightly. Interestingly, in the week immediately following two consecutive nights of temperatures barely above freezing, this palm dropped the four oldest fronds that had previously not shown any signs of senescence. Eight months later, during the June–October rainy season, the plant has recovered and is again pushing out new leaves and two inflorescences.

3. Fresh *Gulubia costata* fruit; note the distinctive striping.



In November 1999, the *Gulubia* flowered for the first time and set three infructescences with over 500 fruit each. Cream flowers were followed by pale yellow-orange ovoid fruits (Fig.2) that ripened to a blue-grey background with prominent longitudinal charcoal grey striping (Fig. 3). Within two days of harvesting, the fruits turned black. As if this color change was not dramatic enough, the thin pulp was raspberry-red in color.

Fruits range from 6–10 mm in length and because the pulp, while thin, is difficult to remove by hand, I have simply soaked the fruit in water for two days and sowed them on the surface of a standard nursery mix (peat moss/perlite/silica sand). Two community pots of about 100 seeds each were held in the FTG Nursery at about 30ºC from December 1999 until June 2000 when the first seedlings emerged. Within a month, approximately 75% of the seeds had germinated and by September 2000, all had a second leaf. Most of these seedlings were donated to FTG for future planting and distribution to members.

The subsequent fruiting in December 2000 resulted in over a thousand fruit which were distributed to collectors and nurseries in South Florida. At that time I cleaned the fruit by hand by adding some silica sand to a handful of seed and vigorously rubbing my handful of sand and seed to remove the pulp. This process yielded very clean seeds in less time than any other methods I had tried. These seeds were sown on 8 January 2001, but upon dissection in October 2001 all the ungerminated seeds I sampled were desiccated or showed signs of fungal activity. Despite my hope that depulping the seeds would improve germination, this was not the case. I wonder if the act of removing the endocarp somehow promoted fungal infection or speeded up desiccation before the seeds germinated.

This year, I shall clean some seeds but not the entire batch to see if epicarp removal is the limiting factor in germination.

Of all the pendant leaflet palms that are so graceful and so reminiscent of the tropics, *Gulubia* seems to be the best adapted for cultivation in warm areas outside the tropics. As attractive as they are, I have found *Euterpe oleracea*, *E. precatoria* and *E. edulis* to be even more cold-tender and intolerant of our alkaline soils and dry winter winds. Although *Gulubia costata* has been rarely available to collectors in South Florida, we now know that this species can be raised to maturity in our area with only minimal cold protection when young and can become a welcome addition to the landscape. Once the germination problems are solved, cultivated seedlings of this palm may be available to more palm enthusiasts than ever before.

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Observations on Two Dwarf *Dypsis* Species in Betampona, Eastern Madagascar

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***Dypsis schatzii* and *D. betamponensis* are two beautiful dwarf palms, restricted to a very small area of eastern Madagascar. This paper describes them in detail and provides much new information about their occurrence.**

Since August 1997 I have been employed by the Madagascar Fauna Group (MFG), a consortium of zoological parks in the U.S. and Europe, as research co-ordinator for the black and white ruffed lemur re-stocking project at the Betampona Reserve (Britt et al. 2000). Obviously my main focus is on the lemurs, but long term residence at Betampona has allowed me to develop varied interests in other fauna and the flora. I first came across the book, "The Palms of Madagascar" (Dransfield & Beentje 1995) at a colleague's house in 1998. I was intrigued by the fact that two species of dwarf palm were recorded only from Betampona. *Dypsis schatzii* was known still to occur, but *Dypsis betamponensis*, known from a single specimen, was thought to be extinct as it had not been seen for seventy years. It seemed odd to me that a dwarf palm, which was not used by the local people, should disappear when the forest at Betampona remained relatively intact. Following a brief visit to Betampona (one afternoon) by John Dransfield in 1999 I became determined to "re-discover" the species, but it was not until the year 2000 that I began seriously looking. Unfortunately the illustration in Dransfield and Beentje (1995) of material collected by Perrier in 1929 is not very representative of the species. There was a clustering dwarf palm in the reserve that looked similar, but was considerably taller with much broader leaves than was described. However, in October 2000, this species flowered, and from the appearance of the inflorescences I became convinced that this was the elusive *Dypsis betamponensis*. Confirmation came, when in February 2001, I was invited to give a presentation at Kew about the MFG's work at Betampona. As I hoped, John Dransfield was in the audience. I clicked up a slide of *Dypsis betamponensis* in flower and said "two species of palm are known only from Betampona". Tentatively I inquired "I believe this is *Dypsis betamponensis*, is it John?" – and it was!

This short paper provides further description of both these dwarf *Dypsis*, information on their ecology, locations of sites outside of Betampona where these species occur, and comments on their conservation.

Betampona and nearby forests

The Betampona reserve was originally established in 1927 and later became the first of the Réserves Naturelles Intégrales (Strict Nature Reserves) created by Decree 66-242 of 1st June 1966 (Andriamampianina & Peyrieras 1972). The reserve covers an area of 2228 ha of lowland dense evergreen rain forest. It is situated between 17°15′–17°55′ S and 49°12′–49°15′ E, on the east coast of Madagascar, 40 km north-west of the city of Toamasina. Altitude ranges from 275–650m above sea level. In the late 1950's the Betampona forest was continuous with two nearby classified forests, Sahivo and Antanamalaza (Britt et al. 1999), but now stands completely isolated.

Unfortunately the reserve has not been spared from human incursion and it is currently estimated that only around 50% of the area remains as primary lowland rain forest, with large regions of degraded secondary forest, especially around the boundary, characterized by the presence of the Traveller's Tree (*Ravenala madagascariensis*) and exotic species, particularly Chinese Guava (*Psidium cattlyaena*). Evidence of previous cultivation within the reserve is provided by vast monospecific stands of 'longoza' (*Afromomum augustifolium*). The remaining

1(left). *Dypsis schatzii* in flower at Betampona, Dec. 2000. 2 (below). The crown of *Dypsis betamponensis*.

primary forest at Betampona is dominated by trees of the families Lauraceae, Moraceae, Euphorbiaceae, Clusiaceae, Sapotaceae, Myrtaceae, Arecaceae, Liliaceae and Burseraceae, lianas of the families Dilleniaceae and Apocynaceae, and numerous epiphytes of the families Aspleniaceae and Orchidaceae (B. R. Iambana pers. comm.). The canopy height averages 20–25m and is very broken, with occasional large emergents taller than 30m. The terrain is steep with numerous ridges. The climate is humid tropical. Mean annual temperatures range from 21–24ºC and annual rainfall averages 2500–3000mm. There are no dry months and humidity within the forest remains generally higher than 90%. Rainfall peaks from January to March and June to August, while October and November are relatively dry. Temperature falls markedly between June and September with a mean of 18ºC.

The reserve is currently managed by l'Association Nationale pour la Gestion des Aires Protegées (ANGAP) – with the Chef de Reserve and four agents based in the village of Fontsimavo some 4 km from the reserve. The MFG's "Project Betampona" team are based in the village of Rendrirendry at the south-western corner of the reserve.

Other sites surveyed were the Sahivo (17º53' S, 49º 10' E) and Antanamalaza (17º 50' S, 49º 11' E) classified forests and the Ambakaka forest (17º 52' S, 49º 10' E), which is sacred to local people. The two classified forests consist of a few small fragments of highly disturbed forest, which are rapidly being cleared for rice cultivation. At Sahivo there are no fragments larger than 5 ha, while Antanamalaza is somewhat less devastated with a couple of blocks which may be up to 15 ha. Ambakaka is a relatively intact block of about 30 ha.

Dypsis schatzii Beentje

This species is known locally as 'amboza'. The stems were formerly used to make blowpipes, but hunting with blowpipes is no longer practised in the region. *Dypsis schatzii* is widespread at Betampona and certainly numbers are in the mid hundreds. Distribution is patchy, but it can be very common where it occurs. For example, 30 plants were counted in an area of 500 m² along the main ridge in the reserve. It is most commonly found in primary forest along the tops of ridges, but also occurs on steep mid slopes and in the bottoms of valleys. *Dypsis schatzii* was also located in the Ambakaka forest (c. 20 plants recorded), but was not seen at Sahivo or Antanamalaza.

Dypsis schatzii is usually solitary, but does occasionally occur in clusters of 2 to 7 stems. Stems are usually unbranched, but one specimen has been observed with a branched stem. The stems of mature plants are 1.62–3.75 m in height (mean = 2.66 m ± 0.62, n = 20). It should also be noted that the length of the crown is often 1 m or more. Stem diameter ranges from 12 mm just below the crown to 28 mm at the base. Nodal scars are distinct distally but become in-distinguishable towards the base. Internodes are 20–48 mm long. Leaves are usually entire, but sometimes have 2 pinnae, usually on only one side of the apex. The elongated crown consists of 8–22 leaves (12–15 being most common) and there is no crownshaft. Leaf sheaths are 52–90 mm long, the remnants of which usually clothe the distal part of the stem. Leaf lengths are 170–486 mm (mean = 359.9 mm ± 79.7, n = 35).The leaf rachis is 140–440 mm long (mean = 316.7 mm ± 75.0, n = 35). Maximum leaf width is 95–182 mm (mean = 137.7 mm ± 25.5, n = 35). Petioles are often absent but can reach up to 116 mm in length. The apices and the leaf edges to around halfway down the leaf are dentate. The interfoliar inflorescences, which are branched to one order and covered in yellow flowers, appear in September. Peduncle length is highly variable,

3. Close-up of *Dypsis betamponensis* inflorescence, Nov. 2000.

from 2–134 mm, as is prophyll length, at 50–190 mm. Two bracts are present. The inflorescence rachis is 42–208 mm in length and has 3–6 first order branches (5 being most common). The branches are covered in reddish stellate scales. Fruiting occurs from October to December. The pink fruits are a little over 10 mm long and narrowly ovoid.

Dypsis betamponensis (Jum.) Beentje & J. Dransf.

This species is known locally as 'vonombodidronga.' This name means "tail of the Drongo" – the Crested Drongo (*Dicruris forficatus*) is a common Malagasy bird with a forked tail – thus the name refers to the similarly shaped leaves of *Dypsis betamponensis*. The species is apparently not used by local people. *Dypsis betamponensis* is abundant at Betampona, with numbers estimated to be in the high hundreds (possibly more than 1000). One of the main reasons I doubted my initial identification was the fact that this palm was everywhere in the reserve! The species has been observed in primary forest on ridge tops, mid-slopes and at the bottoms of valleys. *Dypsis betamponensis* was also recorded at Ambakaka and Antanamalaza, but not at Sahivo.

Dypsis betamponensis generally occurs in clusters of 2 to 14 stems, although it is occasionally solitary. The unbranched stems of mature plants are 1.6–4.4 m tall (mean = 2.99 m ± 0.82, n = 20). Stem diameter ranges from 10 mm just below the crown to 22 mm at the base. Nodal scars are very distinct, with internode distances of 8–80 mm. The crownshaft is 71–140 mm in length (mean = 112.2 mm ± 22.3, n = 20). Leaves are entire and much broader than cited in Dransfield and Beentje (1995), with sparse reddish scales and dentate apices. Leaf lengths are 400–670 mm (mean = 530.5 mm ± 65.7, n = 41). The leaf rachis is 150–368 mm in length (mean = 268.4mm ± 51.2, n = 41). Maximum leaf width is 110–211 mm (mean = 161.5 mm ± 26.5, n = 41). While petioles are most commonly absent, petiole lengths of up to 80 mm have been recorded. The crown consists of 4–9 leaves (7 and 9 being most common) The inflorescence is interfoliar and much-branched to 2 orders. Peduncle length is highly variable, from 10 to 140 mm, as is prophyll length, 64–152 mm. Two bracts are always present. The inflorescence rachis is 82–320 mm in length, with 15–31 first order and 12–25 second order branches. The rachis is sparsely covered in red curly hairs, up to 2 mm in length. Flowering begins in September and fruiting has been observed in December. The red fruits are about 10 mm long and roundly ovoid. One plant was observed with an aerial root descending to the ground from a height of ca. 30 cm on the stem.

It appears that the leaf of *Dypsis betamponensis* illustrated in Dransfield and Beentje (1995) is from a young plant and not a mature specimen.

Conservation

As long as the continued protection of the Betampona reserve can be assured, the future survival of *Dypsis schatzii* and *D. betamponensis* seems to be secure. However, only one individual of *D. betamponensis* has been observed to produce fruit, and only a few of *D. schatzii*. It is unclear why this should be so. Their absence from Sahivo suggests that they do not tolerate habitat disturbance well. They are certainly reliant upon the perhumid environment of low altitude rain forest. While it is encouraging to be able to report range extensions for both species at Antanamalaza and Ambakaka, the future of both these forests seems bleak. I have observed with dismay the rapid reduction of forest cover at Antanamalaza and Sahivo since 1997, from over 100 ha of forest at each site to the current situation described in the introduction. Although these species may occur in other forest patches, their distribution must be regarded as extremely limited and fragmented.

It is proposed to establish a living palm collection at Parc Ivoloina, near Toamasina (C. Welch pers comm.). Attempts should be made to establish both these species in cultivation as part of this collection. Such action would provide a safeguard for both species against the potential total loss of natural habitat within their limited range.

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I am indebted to Michael Powell of Powell's Books, Portland, Oregon for donating a copy of "The Palms of Madagascar" to Project Betampona – this really spurred my interest in the palm flora of the reserve and palms in general. The support of the MFG and in particular Charlie Welch and Andrea Katz is gratefully acknowledged. Many thanks also to John Dransfield at Kew for encouraging me to write this paper. Thanks to Tsirindahy and Ianesy Fidel (MFG Project Betampona) for information and assistance with data collection. Finally special thanks to ANGAP for permission to work in the beautiful forest of Betampona.

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Beccariophoenix Flowers in Cultivation

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Stan Walkley poses next to the inflorescences of *Beccariophoenix* (Photo: Hugh Kunze).

Beccariophoenix **has flowered for the first time in cultivation, in the garden of Stan Walkley near Brisbane, Australia (Back Cover and Figs. 1 and 2).**

Stan bought his plant as a seedling at a PACSOA (Palm and Cycad Society of Australia) show about 14 years ago and he assumed that it originated from the first batch of seeds imported into Australia by nurseryman Rolf Kyburz. The plant was kept in a pot for several years and was finally planted out in its present location eight years ago. The location is on the top of a small ridge of coastal sandy loam that is very well drained. The original vegetation was open eucalypt forest, with the surrounding lower areas being covered in melaleucas that prefer slightly swampy conditions. The palm has not been watered regularly and has relied mainly on rain water (1100 mm/year in nearby Brisbane), although it was watered whenever the weather was very dry. The ground was prepared initially with chicken manure, but since then it has not been regularly fertilised apart from occasional applications of chicken manure and Nitrophoska.

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Many growers of palms will be aware of the fact that there appear to be two different types of *Beccariophoenix* in cultivation – one with juvenile leaves displaying rather soft broad terminal leaf segments with pronounced “windows,” the other with much stiffer leaflets with the terminal segments with very few “windows.” The former type was illustrated in *Palms of Madagascar* (Dransfield & Beentje 1995). In the wild *Beccariophoenix* is known from two distinct habitat types – montane forest at c.900–1000 m above sea level, where it grows on ridge-tops, and coastal forest on white sand. In ‘Palms of Madagascar’ we illustrated palms from both habitats but were unaware at the time the book went to press that there were two seedling types. There are some differences between the palms in the coastal forest and those in the montane forest, the former having short inflorescence stalks (peduncles) while the latter have strikingly long stalks. The latter is definitely the true *Beccariophoenix madagascariensis*, as it occurs today more or less where the type specimen was collected by Perrier de la Bâthie almost 90 years ago and matches the type specimen in the Paris herbarium. Larry Noblick, of the Montgomery Botanical Center, Miami, Florida, USA, made a collection from a third locality near to the coast but not from white sands, where the population apparently consists of a single individual. This individual has inflorescences with very short peduncles, that make it appear rather different from the true *B. madagascariensis*. Seedlings from this individual have been planted out at the Montgomery Botanical Center and they all have leaves with broad apical segments with conspicuous “windows.” Unfortunately I cannot say with certainty, which of the two distinct juvenile forms belongs to the true *Beccariophoenix madagascariensis*. There are apparently more populations of *Beccariophoenix* in Madagascar but they have yet to be documented scientifically. Since its rediscovery in 1986 (Dransfield 1988), many commercial shipments of *Beccariophoenix* seeds have been exported from Madagascar, and as far as I am aware, there has been no documentation of the natural source of these shipments.

I am still not sure whether we are dealing with one variable species or with two or more. The differences in the juveniles, both in the leaf shape and in their performance and survival, suggests that there is important variation that is not yet reflected in a formal taxonomy. We are hoping that colleagues in Madagascar will start to make a detailed study of the population size, structure and variation as part of a new project funded by the Friends of Kew Threatened Plants Appeal.

Close-up of the flowers of *Beccariophoenix* (Photo: Hugh Kunze).

Stan Walkley’s handsome *Beccariophoenix* has small inflorescences that, astonishingly, do not resemble those of any of the wild individuals; perhaps the inflorescences being produced at present are small and in the future, as the palm matures, more normal inflorescences will be produced. In the meantime, we have to assume that the palm is *B. madagascariensis*.

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Name Changes in *Attalea*

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In recent years, consensus has grown for the recognition of just one genus, *Attalea*, in place of the many genera that once comprised subtribe Attaleinae.

In 1999, Dr. Sidney Glassman, professor emeritus of the University of Illinois at Chicago and research associate of the Field Museum of Natural History, published a taxonomic revision of the palm subtribe Attaleinae, in which he recognized the genera *Attalea*, *Scheelea*, *Orbignya*, *Markleya*, *Maxmilliana* and *Ynesia*, as well as intergeneric hybrids. These palms, because of their large size, have been neglected by most botanists, so Glassman's work is welcomed by all persons interested in these economically and ecologically important palms. His revision, the culmination of many years' study, is a detailed account of the species of the subtribe, including 13 species new to science. Many users of Glassman's revision prefer his treatment of species to the more broadly defined species of Henderson et al. (1995), which, although not a monograph, is the only other modern treatment of the species comprising the subtribe. Glassman's taxonomic revision recognized fine-scale variation that the Henderson et al. field guide cannot. Although future monographic studies of the Attaleinae may not maintain all of the species recognized by Glassman, his revision is the most complete to date and of great value to those interested in biodiversity, conservation, ecology and ethnobotany.

The characters once used to separate the genera – variation in stamen and petal shape – did not unambiguously separate natural groups of species, so generic boundaries were ill-defined. Following arguments presented by Wessels Boer (1965) and further advanced by Henderson and Balick (1991), most authors now recognized only *Attalea* (Henderson 1995, Henderson et al. 1995, Dransfield & Uhl 1998, Uhl & Dransfield 1999).

Unfortunately, many of the names in *Scheelea* and *Orbignya* have not been transferred to *Attalea*, and those persons and botanical gardens wishing to follow the latest generic concepts in their publications, labels and interpretative materials do not have validly published names in *Attalea* at their disposal. Lacking these names, botanic gardens, conservation databases and floristic checklists cannot provide accurate information to their end users. To remedy that situation, Glassman's species of *Scheelea* and *Orbignya*, and one name in ×*Attabignya*, which do not already have combinations in *Attalea*, are herein transferred to *Attalea*.

Attalea amylacea (Barb. Rodr.) Zona, **comb. nov.**

basionym: *Scheelea amylacea* Barb. Rodr., Pl. Nov. Jard. Bot. Rio Jan. 1: 17, t. 5A, 6. 1891.

Attalea anisitsiana (Barb. Rodr.) Zona, **comb. nov.**

basionym: *Scheelea anisitsiana* Barb. Rodr., Palm. Mattogross. 63, t. 20. 1898.

Attalea bassleriana (Burret) Zona, **comb. nov.**

basionym: *Scheelea bassleriana* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 655. 1929.

Attalea brejinhoensis (Glassman) Zona, **comb. nov.**

basionym: *Orbignya brejinhoensis* Glassman, Illinois Biol. Monogr. 59: 84. 1999.

Attalea camopiensis (Glassman) Zona, **comb. nov.**

basionym: *Scheelea camopiensis* Glassman, Illinois Biol. Monogr. 59: 138. 1999.

Attalea degranvillei (Glassman) Zona, **comb. nov.**

basionym: *Scheelea degranvillei* Glassman, Illinois Biol. Monogr. 59: 139. 1999.

Attalea fairchildensis (Glassman) Zona, **comb. nov.**

basionym: *Scheelea fairchildensis* Glassman, Illinois Biol. Monogr. 59: 163. 1999.

Attalea glassmanii Zona, **nom. nov.**

avowed substitute for *Orbignya phalerata* Mart., Palm. Orbign. 126, t. 13, fig. 2, 32A. 1844 non

Attalea phalerata Mart. ex Sprengel, Syst. Veg. 2: 624. 1825.

Attalea guacuyule (Liebmann ex Mart.) Zona, **comb. nov.**

basionym: *Cocos guacuyule* Liebmann ex Mart., Hist. Nat. Palm. 3: 323. 1853.

Attalea guianensis (Glassman) Zona, **comb. nov.**

basionym: *Scheelea guianensis* Glassman, Illinois Biol. Monogr. 59: 137. 1999.

Attalea huebneri (Burret) Zona, **comb. nov.**

basionym: *Scheelea huebneri* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 633. 1929.

Attalea kewensis (Hook. f.) Zona, **comb. nov.**

basionym: *Scheelea kewensis* Hook. f., Curtis Bot. Mag. 123: t. 7552, 7553. 1897.

Attalea lauromuelleriana (Barb. Rodr.) Zona, **comb. nov.**

basionym: *Scheelea lauromuelleriana* Barb. Rodr., Contr. Jard. Bot. Rio Jan. 4: 108, t. 25. 1907.

Attalea leandroana (Barb. Rodr.) Zona, **comb. nov.**

basionym: *Scheelea leandroana* Barb. Rodr., Pl. Nov. Jard. Bot. Rio Jan. 1: 19, t. 7, 8B. 1891.

Attalea liebmannii (Becc.) Zona, **comb. nov.**

basionym: *Scheelea liebmannii* Becc., Agr. Colon. 10: 617. 1916, avowed substitute for *Cocos regia* Liebmann ex Mart., Hist. Nat. Palm. 3: 323. 1853 non *Attalea regia* (Mart.) Wessels Boer, Fl. Suriname, 5(1): 150. 1965.

Attalea lundellii (Bartlett) Zona, **comb. nov.**

basionym: *Scheelea lundellii* Bartlett, Publ. Carnegie Inst. Wash. 461: 45. 1935.

Attalea magdalenica (Dugand) Zona, co**mb. nov.**

basionym: *Scheelea magdalenica* Dugand, Mutisia 26: 1. 1959.

Attalea maripensis (Glassman) Zona, **comb. nov.**

basionym: *Scheelea maripensis* Glassman, Illinois Biol. Monogr. 59: 140. 1999.

Attalea minarum (Balick, Anderson & Medeiros-Costa) Zona, **comb. nov.**

basionym:× *Attabignya minarum* Balick, Anderson & Medeiros-Costa, Brittonia 39: 27. 1987.

Attalea moorei (Glassman) Zona, **comb. nov.**

basionym: *Scheelea moorei* Glassman, Illinois Biol. Monogr. 59: 127. 1999.

Attalea peruviana Zona, **nom. nov.**

avowed substitute for *Scheelea tessmannii* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 682. 1929. non *Attalea tessmannii* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 538. 1929.

Attalea plowmanii (Glassman) Zona, **comb. nov.**

basionym: *Scheelea plowmanii* Glassman, Illinois Biol. Monogr. 59: 144, 145. 1999.

Attalea salazarii (Glassman) Zona, **comb. nov.**

basionym: *Scheelea salazarii* Glassman, Illinois Biol. Monogr. 59: 146. 1999.

Attalea teixeirana (Bondar) Zona, **comb. nov.**

basionym: *Orbignya teixeirana* Bondar, Arq. Jard. Bot. Rio Jan. 13: 58. 1954.

Attalea vitrivir Zona, **nom. nov.**

avowed substitute for *Orbignya oleifera* Burret, Notizbl. Bot. Gart. Berlin-Dahlem14: 240. 1948. non *Attalea oleifera* Barb. Rodr., Nov. Rev. Bras. Rio Jan. 7: 123. 1881. [from *vitri-* (L. glass) and *vir* (L. man), to be treated as a noun in apposition.]

Attalea weberbaueri (Burret) Zona, **comb. nov.**

basionym: *Scheelea weberbaueri* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 659. 1929.

Attalea wesselsboeri (Glassman) Zona, **comb. nov.**

basionym: *Scheelea wesselsboeri* Glassman (as *wesselsboerii*), Illinois Biol. Monogr. 59: 170. 1999.

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A Brief History of the Coconut Palm in Australia

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1. Cultivated coconuts and John Dowe amid the coconut sculptures, The Strand, Townsville, Australia. Photo by Andi Cairns.

Coconut palms form a dominant part of the coastal vegetation throughout much of tropical Australia. Historically, the species has been considered to be non-indigenous, although some documentary evidence suggests that there were indeed extant populations at the time of European settlement in the mid 1800s.

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2. Coconuts on the Frankland Islands as sketched by O. W. Brierly in his diary of the voyage of H.M.S. Rattlesnake in 1848, reproduced with permission of the Mitchell Library, State Library of New South Wales.

There has been considerable debate as to whether the now ubiquitous coconut palm, *Cocos nucifera* L., is indigenous to Australia. Today, coconuts are extensively cultivated throughout tropical Australia, having been introduced in many areas during European settlement. For example, coconuts were listed among the first plants grown in the 'Acclimatisation Gardens' that were to eventually become regional botanical gardens in many northern Australian cities and towns during the late 1800s. The origin of the coconut cultivated in urban settings (Fig. 1) is fairly well understood; however, the naturalness of some populations in Australia is unresolved. This paper provides a brief history of the coconut palm in Australia.

Early reports of coconuts in Australia

Although Europeans first began to visit the tropical coasts of Australia in the early 1600s (Dampier 1703, Drake-Brockman 1963, Cornell 1974, Henderson 1999), it was not until the voyage of the *Endeavour* along Australia's east coast in 1770 that coconuts were first reported. However, these reports were not of palm trees swaying in the tropical breeze, but merely of coconut fruits, either washed up on shore or floating in coastal waters. Banks described coconuts as part of the flotsam that he found on the banks of the Endeavour River (Beaglehole 1962):

> [1 July 1770]: . . . *our second lieutenant found the husk of a cocoa nut full of barnacles cast up on the beach; probably it had come from some island to windward, from Terra del Espirito Santo possibly as we are now in its latitude. . . .*

> [5 July]: . . . *walked along a sandy beach open to the trade wind. Here I found innumerable fruits many of plants I had not seen in this countrey, among them were some Cocoa nuts that had been open'd (as Tupia told us) by a kind of crab called by the Dutch Beurs Krabbe (Cancer latro) that feeds upon them . . . all these fruits were encrusted with sea productions and many of them covered with Barnacles.*

During the voyage of the Endeavour, coconuts were indeed sought after as a welcome supplement to an otherwise dull and inadequate diet endured as part of shipboard life. An indication of how much they were sought after was noted by Cook (1771) in his diary:

> *In the PM we saw several large smooks on the main, some people, canoes and as we thought Cocoa-nutt trees upon one of the islands, and as a few of these nutts would have been acceptable to us at this time I sent Lieutt. Hicks a shore with whom went Mr. Banks and Dr. Solander to see what was to be got . . . they returned on board having met with nothing worth observing, the trees we saw were a small kind of Cabbage Palm.*

Similarly, Banks also wrote of this same event (Beaglehole, 1962):

> . . . *an appearance very much like cocoanut trees tempted us to hoist out a boat. . . where we found our supposed cocoanut trees to be no more than bad cabbage trees. . . .*

Incidentally, the location of these accounts was the Palm Islands, just north of Townsville, and 'the bad cabbage tree,' *Livistona drudei*.

Further exploration of the Australian coast was undertaken during the early 1800s (Flinders 1814), but still there were no reports of coconut palms. King (1828), in his voyage of 1818, recorded a recently opened coconut on a beach on the east coast, assuming that Aborigines had opened and consumed the flesh. During King's third voyage in the Mermaid in 1820, the botanist Allan Cunningham noted:

> . . . *I landed on Cook's Lizard Island (where a whaler's ton butt and several cocoanuts - one quite sound and perfect - were found on the beach). . .* (Lee 1925).

It was not until the mid 1800s, during the voyage of the Rattlensake (1846–1850) along the east coast of Australia, that a report verifying the occurrence of a small population of coconuts was provided. On that expedition, both the naturalist, John MacGillivray (1852), and the artist, Oswald Brierly (1848), included an account of a group of coconut palms that were observed on one of the Frankland Islands, to the southeast of Cairns. The MacGillivray diary account was as follows:

> *The southernmost island . . . Two small clumps of cocoa-nut trees, loaded with fruit, were found on the eastern side of the island, within reach of the spray, in a place where they might have originated from a floating nut or two thrown upon the beach. This is the only instance in which I have seen this useful plant growing wild in any part of Australia, or the islands strictly belonging to it.*

In his diary, Brierly (1848) described the same grove of coconuts. This was accompanied by a sketch of two mature fruit-bearing palms and a younger trunkless palm growing among boulders near the water's edge (Fig. 2). This same population was to be described later by Hill (1873):

> *Frankland Island, No. 4 . . . on the extreme end of the island we found two clumps of cocoanut-trees, extending for about fifty yards inland, but within reach of the sea spray. They were twenty-eight in number; thirteen of them were bearing, and the others will bear in the course of two or three years. Three or four of them were about fifty feet in height. The trunks, in some cases, were much cut: and two trees had been felled, no doubt for the purpose of obtaining the nuts.*

Mueller (1867) and Thozet (1869), both of whom described coconut palms from locations on the Queensland coast provided other reports. These reports were summarised by Bentham (1878) in *Flora Australiensis*, where he described plants as having "*stunted and crooked growth in the open sandy flats of Keppel Bay and about 30 ft high.*" By the early 1900s, the widespread introduction of coconuts had began to obscure the palm's status in Australia as being either indigenous or non-indigenous, with Bailey (1902) in his Queensland Flora, providing the summary, "*Common on the tropical coast; but I have some doubts of it being truly indigenous.*"

The current debate

Despite the early accounts, and some evidence of pre-European-contact Aboriginal use (Hynes & Chase 1982, Tucker 1988), there has since been an active debate on the natural status of coconuts in Australia, with general consensus that they are non-indigenous, and that the coconut "*owes its presence here to people rather than to the ability of its fruit to float across oceans*" (Cribb & Cribb 1985). The debate in some areas has even seen local authorities instigating policies to ban the continued planting of coconuts, and to encourage the removal of coconuts from both public and private locations on the premise that the species is not indigenous, and therefore contravened their "Australian plants only' landscape policy. [If this policy were to be extended to other non-indigenous things, such as resorts, Europeans and sugar cane, northern Australia would indeed be a very 'natural' place!]

Research on Australian coconuts

The problem of the origin of coconuts in Australia was taken up by a number of researchers. Buckley and Harries (1984) hypothesised that a population of coconuts occurring on Lizard Island was of a wild type, known as *niu kafa*. They differentiated wild coconuts from cultivated coconuts, known as *niu vai*, on the basis of the former having long angular fruit, thick husks, and representing the putative ancestral condition best adapted to disseminated by floating, while the *niu vai* type, of cultivar origin, has spherical fruits, thin husks and disseminated by humans (Harries 1978). The location of this particular population suggested that it was self-sown rather than a result of cultivation. This was considered to be evidence for the natural establishment of wild coconuts on the Australian coast. Tucker (1988) recognised some populations that may have been established due to currents that act as dissemination agents for plant propagules. These populations were of various types of coconut, including wild types with small spindle-shaped seeds similar to Harries' *niu kafa* type.

Extending the time-frame

So far we have discussed the coconut in a relatively short time-frame. The coconut, of course, has taken millions of years to evolve, and the most logical place of origin is in the arc of oceanic islands stretching from the Indian Ocean through to Melanesia. This is argued on the basis of the species' morphological diversity, symbiotic relationships, and ethnobotanical importance in that region (Harries 1978). Harries (1995, 2001), however, further investigated the distinction between 'place of origin' and 'centre of diversity' of the coconut, but could not fully resolve this question. The fossil record for plants resembling coconuts is relatively meagre, though specimens have been located in India from Eocene deposits, about 40 mya (Sahni 1946), and New Zealand, with a small *Cocos*-like fruit from Pliocene deposits, about 4 mya (Berry 1926). Similarly, in Australia, there is compelling evidence in the fossil record for the previous occurrence of coconuts on the continent. Rigby (1995) described a silicified coconut fruit from the Chinchilla sands in southern Queensland and dated it to the late Pliocene, about 2 mya. Chinchilla is situated about 250 km west of Brisbane, and the area is otherwise rich in fossils of semi-aquatic animals such as crocodiles and tortoises, thus suggesting a previously more tropical and humid climate than at present.

Conclusion

So where does this lead to in the debate about the naturalness of coconuts in Australia? Fossil evidence indicates an occurrence dated to millions of years ago. Did climate change cause a decline or even eradication of the species from continental Australia? And then there is evidence that at least a few small populations were present at the time that Europeans first explored and settled the continent. Were these populations the remnants of a once widespread population, or were they the result of chance establishment by coconuts that drifted from areas such as Melanesia where the coconut was indeed well established, and thus possibly represents outliers of those populations? In either case they are natural and not introduced. Coastal coconuts have been regular natural visitors to Australian beaches since the earliest times and should be welcomed and encouraged.

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The Date Palm Grove of Elche, Spain: Research for the Sustainable Preservation of a World Heritage Site

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1. The palm grove at Elche, Spain with the original Arab castle in the background.

The date palm (*Phoenix dactylifera*) grove (Fig. 1) of Elche, Spain, is unique. Its creation at a northern latitude, very marginal for date palm culture, and its maintenance to the present represent a living testament to the historical Arabic Berber presence in Spain from the 8th to 17th Centuries. Because of the cultural and historical value of this legacy, the Elche palm grove was declared a World Heritage Site by UNESCO in December 2000.

One of the proposals to maintain this heritage in a sustainable way is to renew the interest in date fruit production in Elche. To this end, a research station has been established named Estación Phoenix (representing a collaboration between Spain and France, for the Spanish side the Municipality of Elche, the Government of Valencia and the Universities of Elche and Alicante, and, for the French side, the National Institute of Agronomic Research and the Centre of International Co-operation of Agronomic Research for Development). To fulfil its applied objective, the research station is carrying out original research on the very peculiar characteristics of date palm culture in Elche – characteristics related to the northern latitude, the peculiar traditional agricultural practices, specific pests and date palm uses, original legal status and a unique socio-economic context.

Background

Date palm cultivation is considered typical of a hot and arid climate. However, as an ornamental tree, it is grown in many other locations where winter conditions are not too severe. In southern Europe, the date palm is also cultivated for its fruits and leaves. The palm grove of Elche, Spain is the largest and best known. There also exist some small plantations elsewhere in Spain (Ferry 1994) as well as in Italy and in Turkmenistan (Munier 1973). The climate of Elche, located at 38°N latitude, is marginal for date growing.

The palm grove of Elche is made up of about 180,000 adult date palms, in a total planted area that does not exceed 400 ha. The total date fruit production in Elche is estimated to be 5,000 tons per year, of which only about 100 tons are sold for human consumption (Ferry et al. 1997). The Elche palm grove exhibits many peculiarities wherein specific problems persist and threaten the survival and development of the agricultural system (Ferry 1999). This article presents the major original characteristics of the Elche palm grove, the problems related to the development of this relict date cultivation system and the different lines of research that are being pursued to try to resolve these problems and to preserve the historical character of the landscape that has led to its designation as a World Heritage Site by UNESCO.

Climatic limitations and research on date technology

During the critical period for ideal date cultivation, the months of fruit maturation, temperatures are below the optimal level in Elche. This lack of heat can be expressed by the heat fructification index. Heat units are calculated by subtracting 18 from the mean temperature during the fuiting season and then multiplying by the number of days from pollination to harvest. Elche has 792 heat units as compared with 1,854 for Touggourt, Algeria, a typical date growing location (Munier 1973).

Fruit maturation

The temperature deficiency in Elche has some general consequences with regard to date fruit maturation.

A portion of the fruit produced never reaches maturity or matures imperfectly so that it is unsuitable for human consumption.

There is a high degree of heterogeneity of fruit maturation (Fig. 2) on the same tree and within the same fruit bunch. It is common to find in the same bunch, fruits at the *kimri* (green, hard) stage as well as the *kalal* (red or yellow, hard) and *rutab* (soft) stages. As a consequence, date fruits are generally harvested one by one. Date harvesting in Elche requires that an individual tree be climbed twelve to fifteen times to gather all the ripe dates. This increased labor cost is an important negative factor as far as profitability is concerned. Traditionally, an artificial technique is used to ripen the immature fruits when entire bunches are harvested at the same time. The immature dates are moistened with vinegar and kept in a closed environment for two days.

The majority of the date palms grown in Elche are of the soft type when the fruit is ripe. The dates have to be picked at the appropriate time because they deteriorate rapidly and must be sold and consumed quickly since their shelf life is only two to five days.

Research on date technology

Some rare date palms in Elche produce fruits that possess appealing commercial potential, such as attractive size and color, good taste and distinctive quality as a soft date. There are inherent problems of soft dates with respect to harvesting and shelf life as described. Nevertheless, if appropriate technologies are developed, it is possible to take commercial advantage by offering a new type of date fruit, very different from the common imported varieties such as 'Deglet Nour' and 'Medjool.' Because of the high production costs it is to Elche's advantage not to attempt to compete with producers of the more common varieties. Moreover, the soft dates grown in Elche fit into current consumption tendencies where freshness, natural production and lower caloric content are attractive.

Consequently, research undertaken by the Phoenix Station has focused on two associated issues –

controlled maturation and processing/preserving to offer the market "fresh" soft dates (Vilella 1996) (Fig. 3). To create these technologies, the physiological and biochemical mechanisms of development and maturation are being investigated (Ros 1996, Vilella et al. 1999). Indeed, although a significant number of papers on the chemical composition of dates have been published, little is known about the mechanisms functioning during date fruit development and maturation. An efficient new technique has been devised to ripen dates and to keep them "fresh" without resorting to freezing. Because of the industrial interest and potential, the technique is in the process of being patented.

In Elche, the rare and interesting date palms for commercial fruit production represent uniquely different genotypes. Therefore research on date fruit technology makes sense because it parallels research on the propagation of these unique genotypes, as well as on the agricultural and farming systems that will make profitable the establishment of new date palm plantations.

Propagation research

Traditional seed propagation: an historical farming system based explanation

Surprisingly, date palms in Elche are propagated only by seed (Fig. 4), and as a consequence, the palm grove consists of a population of hybrids. Curiously, although the date palm has been propagated by seed for centuries, and probably since its introduction, the grove presents very high phenotypic diversity.

Why vegetative propagation by offshoots has never been used in Elche is interesting. Date palms were present in this and various other locations on the Spanish coast before the arrival of the Arabs (Pliny the Elder 77, translation from Ernout 1956). However, the date grove of Elche and the associated agricultural system, were created by Moslem conquerors, perhaps, much later, contrary to what was stated in an earlier publication (Ferry 1997). In the few extant documents concerning Elche during the Moslem domination, no reference is made to the date grove. As emphasized by Jaén (1994), and contrary to what is often claimed in publications about Elche, nothing is recorded about Elche date palms in the chronicle of James I of 1267, when the Christians regained control of this region of Spain. In fact, the founding of Elche itself and the Islamic conquest of the area were relatively late, perhaps in the 10th or 11th Century (Ramos 1994). Furthermore, Islamic conquest does not mean that the area was occupied by Arab people or by people with knowledge of date palm cultivation.

However, even in the many other locations in Spain, where agro-ecological conditions were similar to or better than at Elche, and where Arabs or Berbers remained for several centuries, date palm cultivation was not developed. We believe that, if this type of cultivation was not developed widely in Spain, even during the Islamic domination when there would have been high demand for date fruit among Moslems, it is because of the problem of date quality at this northern latitude. As already stated, because of the lack of heat, dates do not generally ripen well and, above all, they cannot be stored for more than a few days. Already in the 1st Century, Pliny mentioned the absence of a sweet taste in Spanish dates.

In Elche, the development of date cultivation reached, probably little by little, modest importance but it has always been very limited. As emphasized by Jaén (1994), the number of date palms probably never exceeded 70,000–80,000 before the 20th Century (again contrary to what is usually claimed).

Date palms have been grown in Elche as a secondary crop, at a high density, on the periphery of plots of major crops (Fig. 5). As in many other date groves in the world, they have been grown for their multiple uses – handicrafts, construction, fuel-wood, forage or landscaping. Furthermore, in Elche, the ancient (15th Century) and continued production of white leaves has probably contributed to a heightened interest in date palm growing. We consider that the white leaf production has played an essential role in the conservation of the palm grove to the present day.

As Elche's dates were cultivated for various uses other than just for fruit production, there was no need to select and propagate date palms by offshoots. Propagation of the date palms by seeds is a simple and quite satisfactory technique. This situation explains well why, in Elche, vegetative propagation and the creation of varieties have not occurred.

In vitro propagation

There are no true date varieties to be found in Elche; moreover, because the offshoots are not used for propagation, they are pruned to facilitate the work at the base of the date palms and to promote the growth of the parent tree. The only offshoots that are not eliminated are those that develop above ground level in a small number of palm trunks. These offshoots are sustained by metal supports to avoid their breaking off. These

2. Uneven ripening of date fruit.

"branched" palm trees constitute remarkable ornamental specimens. The most spectacular and famous is the Imperial date palm of the Huerto del Cura garden, in Elche. It has seven branches at the same level around the main stem.

Besides the absence of varieties and the traditional practice to eliminate offshoots, the majority of the adult date palms in Elche are old – more than fifty years of age. Over the past decade, numerous date palm nurseries for ornamental purposes have been established, but these date palms are still too young to evaluate with regard to the quality of their fruit production. The rare genotypes of interest for their commercial date quality are thus all old trees.

The only efficient way to propagate these promising date palms is by tissue culture. However, knowledge of the use of adult palm trees for tissue culture is rare. Consequently, the initial work of the Phoenix Station has been to study the structural biology of the adult date palms and, particularly, of the shoot tip and of the production of axillary buds. It has been established that it is possible to extract a large number of undifferentiated axillary buds from the shoot tip (Ferry 1996, Ruiperez 1996).

As a result, research on *in vitro* propagation by organogenesis has been carried out. A very high percentage of reactive explants of this type has been obtained by culturing them in liquid media (Ruiperez et al. 1995). Vegetative plantlets have been obtained *in vitro*, but in the majority of them, the development of the explants has been floral (Ferry 1994, Ferry et al. 1999). Research is continuing to find a way to eliminate the floral signal.

In a parallel way, research on the propagation from other initial explants (young spikelets, small leaves) is on-going. *In vitro* plants have been obtained either by indirect (Navarro et al.1996, Navarro et al. 1999) or direct somatic embryogenesis, or by adventitious organogenesis (Ferry et al. 2000). In any case, the proliferation

3. Date processing research.

4. Plantation at high density and traditional propagation by seedlings.

5. Date palms within a complex agrosystem.

stage is obtained and maintained without callus. Research has also been carried on to study the behavior of exotic varieties under Elche conditions. *In vitro* plants of eleven varieties produced by the GRFP (Groupement de Recherche Français sur le Palmier Dattier) by means of organogenesis techniques were planted in Elche in 1989–1990. The study of the harvest in recent years has demonstrated that the *Medjool* variety produces dates that reach maturity in Elche.

Besides research work, the Phoenix Station also is carrying out tissue culture date palm production activity. Two genotypes selected for their high economic potential are being propagated by tissue culture in response to local demand. They are *Medjool* and *Confitera* (a local genotype very similar to *Medjool*). The first out-plantings were scheduled for the spring of 2001.

White leaf production and insect pest problems

The production of white leaves

There is also in the palm grove of Elche a use of the palm leaves that is very old and nearly unique in the world – the commercial production of white leaves (Gomez et al. 1999a). In Bordighera (Italy), a small date grove was created probably in the 15th century for the production of leaves for Palm Sunday and for the Jewish Soukkhot religious feast (Castellana, pers. comm.). The process of the production of white leaves in Elche has been described in a previous paper (Gomez et al.1999b). It constitutes a very elaborate and impressive technique transmitted from generation to generation. The oldest written document found that mentions white leaf production dates to 1429 (Castaño 1992). For more than five hundred years, white leaves have been sold for religious purposes. Each Palm Sunday, processions take place in Elche and in other Spanish cities in which people walk in processions carrying a white leaf to commemorate the reception given Jesus Christ when he arrived in Jerusalem.

Red date scale and other new insect pests

During the winter of 1992/1993, a new exotic pest appeared in Elche. The red date scale insect (*Phoenicococcus marlatti* Cockll.), considered in the other palm groves of the world to be of minor or no importance, developed here in a very explosive way (Gomez et al. 1995). Within a few years, all the date palms of the area have become infected.

Very likely, the red date scale was introduced with the large number of adult date palms imported from Egypt. During the last fifteen years, a high demand for adult palm trees has developed in Spain for planting in municipal gardens and parks, as well as for landscaping associated with events such as the Olympic Games in Barcelona. The successful adaptation of the exotic red date scale to Spanish ecological conditions, along with the absence of effective local natural controls, explains its explosive development.

In Elche, the introduction of red date scale has taken on great importance because of its impact on white leaf production. The red date scale insect sucks sap from the leaflets or the rachis. Around the opening they cause tissue necrosis or a fungus spreads out to create a brown stain. To be sold, the leaves must be perfectly white; therefore damaged leaves must be discarded. Furthermore, the microclimate created within the cone and cowl for white leaf production is very favorable to the development of red date scale.

Research has been carried out to control this pest. Red date scale is mainly present hidden deep in the leaf bases. However, characteristic external symptoms of its presence have been well-established – brown spots at the base of the leaflets and terminal part of some of the central leaves totally white. Knowledge of these characteristics is very useful to establish the presence of the red date scale in date groves where it has not yet been reported.

No specific pesticide is known to be effective against the red date scale. To reach the hidden insect colonies efficiently, chemical treatments would be difficult to apply, and they would more probably kill a large proportion of the fauna present in the date palm crown without eliminating the red date scale. For these reasons and also for human health considerations, where a large proportion of the date palms are located within the city, research on biological control of the red date scale has been pursued (Gomez 1996a).

Two local predators of red date scale have been identified, *Rhyzobius lophantae* and *Chilocorus bipustulatus* (Gomez 1996b). Thousands of these two predatory insects have been raised and released in the urban part of the palm grove over the last two years. It is believed that more than 50% of the palm grove is now protected by biological control against the red date scale.

In addition to the red date scale, at least two other exotic pests have been introduced into Spain, probably also arriving with the imported date palms (Gomez et al. 1999a). The insect *Arenipses sabella* Hmps was reported for the first time in 1996 (Gomes 1997). The very serious insect pest, *Rhynchophorus ferrugineus*, was recorded in coastal Grenada Province in 1994 (Barranco 1996); it has not yet been observed in the palm grove of Elche.

Socio-economic factors

Disappearing traditional agricultural system

As stated previously, the date palm has probably always been cultivated in Elche as a multipurpose tree in association with other fruits trees and annual crops. In addition, date palm cultivation was initiated when irrigation systems had already been present for centuries, at least since Roman times. This circumstance explains quite well the peculiar organization of the date plantings in Elche. The trees are planted, in one or two rows, around cultivated and irrigated plots that are generally rectangular in shape and about 1,000 m^2 in area. This division into small cultivated parcels existed for centuries and was probably adopted with the installation of the irrigation works and was compatible with the irrigation management constraints of the farmers.

Another reason may explain the planting of date palms around the plots. Compared with typical date-growing regions, Elche suffers from insufficient sun and heat and has relatively high humidity; these conditions are not favorable to a system where the associated crops are shaded by date palms. As a consequence, the date palms cannot be planted over the entire cultivated area but only along the edges. This particular planting pattern exists in other locations, such as in Gabes, Tunisia.

The major crops formerly cultivated in plots in Elche were cereals, alfalfa, cotton and fruit trees such as citrus or pomegranate. Animal husbandry with small livestock completed the system (Fig. 6). Nowadays, this complex agricultural system has virtually disappeared because date palm growing has practically lost all its original economic value and interest in the multiplicity of its uses. There is no market for most of the date fruits produced because of the higher quality demands of consumers that cannot be met. Very little use is made of immature, culled or bad quality dates for animal consumption because of the virtual abandonment of local animal husbandry; moreover, nearly no use is made of the leaves (apart from white leaves) and the trunk because of alternative raw material substitutes (Ferry 1999).

A new interest has appeared over the past 30 years; date palms with 2 m or more of trunk are being used for ornamental purposes. Although it is illegal to remove date palms, some exploitation does occur. Since the mid 1980s, many date palm nurseries have also been created inside the plots surrounded by the protected date palms. The new system superficially resembles the traditional agricultural system, but it is not fully functional as compared to the traditional system.

It is pertinent to pose the question as to whether it would be beneficial to enact new regulations to allow exploitation, for ornamental purposes, of a portion of the larger protected date palms, providing that they are replaced. Such a measure would act as a stimulant to the traditional agricultural system, or at least to the traditional plantation structure. An added advantage would be to promote a gradual replacement of the protected date palms and assure future maintenance of the traditional structure.

Because of the sharp decline of economic interest in the date palms for fruit production, replacement of senescent palms has not been realized. Date palm maintenance has been reduced or abandoned altogether; consequently, a high proportion of Elche's date palms, particularly within the city, are old and in danger of dying.

An important tradition of work on date palm

The ancient tradition of date palm cultivation in Elche has resulted in an original and very effective knowledge of certain date palm cultivation practices that has been transmitted over the generations to the present day. These practices are concerned mainly with leaf pruning techniques and the production of white leaves.

Formerly, the individuals who climbed the palms for leaf pruning and fruit harvesting, utilized a climbing rope made from fiber derived from the date palm leaves. This previously-used traditional rope is very similar to the ones used in many other date groves in the world. Nowadays, the climbing rope is made of six-nylon strands. To each strand has been added a metallic cable located in its center. This improved rope is rather rigid. This characteristic constitutes an important improvement over the traditional one because the rigidity greatly facilitates the ascent of the date palm. An improvement of this climbing system was realized in 1997 to assure more safety and to offer new advantages to this system (Vilella et al. 1997).

Apart from the rope, the date palm farmers of Elche have created various original and specific manual tools. Examples of two of these tools are the *corbillote* – a heavy cutting tool that facilitates removal of dead leaves – and the *gumia* – a cutting tool that has a long handle and with which it is very easy to cut the green leaves. We consider that these two tools are quite superior to those used for date palm maintenance elsewhere. These tools could be very profitably adopted for use in other palm groves of the world. We will not elaborate further on the work, know-how and special tools concerning the production of white leaves. They are very specific to Elche and represent an impressive level of proficiency in working at the top of the date palm and in managing the crown of leaves. In contrast to the sophisticated crown maintenance techniques for white palm production, management practices for date production are not so well developed. The exception is the traditional artificial maturation of the dates with vinegar. There is little or no knowledge concerning offshoot cutting. Leaf pruning practices are hard to understand. Pruning is very severe and in Elche, a well-cared date palm never bears more than 50 to 60 leaves. Leaves are often mistakenly considered as competing with trunk growth and even fruit production.

These misconceptions also explain why the traditional producers of white leaves cut off the green external leaves instead of keeping them to help the tree to recover. A campaign has been initiated by the Phoenix Station to induce producers to maintain as many green leaves as possible and some of producers are now following

6. Livestock associated with date palm culture.

this advice. In fact, the technical deficiencies in the cultural practices of Elche's date palm grove can be explained by the traditional multipurpose role attributed to the palm. The trees are cultivated at a very high density, reaching an average 400 trees per ha (if the density is calculated based on the trees distributed over the entire surface). However, in fact it is even higher because the trees are planted close together at the periphery of the plot. This external position of the plantation is associated with reduced care for the date palms; fertilizer and irrigation is used for the main crops. The force of this tradition is so strong that, nowadays, even though there are no associated crops, irrigation water is usually still applied to the entire surface of the plot!

Research to maintain the date palm heritage

The date palm grove is part of the patrimony of Elche and now of the patrimony of the world. Its maintenance represents a collective obligation. Various solutions are proposed. Two research avenues are currently being pursued.

Reestablish economic interest in date fruit production

One proposed solution to maintain the date palm patrimony is to rekindle economic interest in fruit production. This research constitutes the main applied local objective of the date palm research center of Elche. The realization of this objective means the future creation of new plantations of date palms that are economically profitable. Research is being carried out to establish the technical and economic conditions necessary to assure profitability.

Studies on the very competitive date market and on date demand are being realized to define better the quality, prices and quantity of date fruits, and how to satisfy market requirements (Greiner 1996a, 1996b). Parameters of the production costs in Elche have been studied to simulate the various possible profitable production systems (Greiner 1996d). Labor cost and the need for specialized work time per tree and per year will limit significantly the number of possible solutions. The need for irrigation water is high in the area. Potential evapo-transpiration is about 1,000 mm whereas average annual rainfall is about 250 mm. This represents another limitation to different possible solutions because irrigation water is costly and/or not available and/or of bad quality. In reference to this aspect, the areas of El Hondo and Las Saladares, where there is a water table close to the surface, seem to be the more appropriate locations for future date plantations in Elche. The higher humidity of these areas that affects date fruit maturation should not be a problem because the objectives of the research on date technology assume harvesting date fruits before maturation, at the *kalal* stage.

Development of the rural and urban date palm landscape

Research has begun to ascertain the expectations of residents and tourists concerning the date palm grove of Elche. This research is concerned specifically with the landscape of the city and its environs (De Los Rios 1998). Results will determine whether the present policy to maintain the traditions of the date palm grove is responsive to the landscape desires of local people and visitors and how, eventually, policies could be improved. Current policies, including the legal protection of the date palms, promote the maintenance of the traditional plantation structure. However, the essence of the structure derives from the overall agricultural system of which it was an original part. Without the associated crops, as is very often the case nowadays, this plantation structure has lost a key component and, perhaps as a consequence, its landscape value (Ferry 1996).

The question may be asked: is it possible to find a new raison d'être for this traditional agricultural structure and, at the same time, to produce a compatible urban landscape of value? Research has begun to study, through computer image simulations, the various types of urban and rural landscapes possible based on the date palm. This work will also permit simulation of the urban date plantations in the future, assuming the natural death of the tallest and oldest trees.

Conclusions

The existence for centuries of a tradition of date palm cultivation in a location quite different from classical date palm areas, has created certain unique characteristics These characteristics concern the date palm itself being grown under marginal conditions, and also the farming practices and systems that local people have devised and adopted.

The study of these characteristics is necessary to find solutions to maintain this original agricultural system, currently at the point of disappearance. Research has to be conducted in a variety of complementary disciplines.

Farming systems based on the date palm are threatened with disappearance in Elche and are also declining (apart from mono-cultural plantations) elsewhere in the world (Ferry 1995). Research being carried on in Elche is also underway in most of the other research centers concerned with the date palm.

Comparison of the situations, approaches and of the research and development efforts among palm grove and date palm centers located within such different contexts, presents, without doubt, an opportunity of great potential benefit. Research must be conducted in such a way as to promote exchange and co-operative projects. This is the reason why part of the activities of the Phoenix research station is devoted to international research/development cooperation projects. One of these ones concerns the development of oasis agriculture in the Sahel.

Acknowledgments

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From Barcelona to Bordighera: Palm Gardens on Mediterranean Shores

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1. Native *Chamaerops humilis* south of Barcelona. The species occurs in large numbers on rocky limestone slopes in front of the sea.

Palms and palm landscapes are acknowledged as symbols of exoticism and as such contribute greatly in attracting people, especially tourists, to the Mediterranean region. Thus there is a need to preserve the region's many historical palm gardens. Municipalities play a very important role in the conservation of the palm heritage. Nice has a network of parks, mostly originating from ancient private properties, and is developing a new botanical garden. The cities of San Remo, Menton, Cannes, Hyères, Toulon and Le Pradet are developing comprehensive new palm collections in old, renovated gardens, often in association with the French Palm Society (Fous de Palmiers).

The northwestern part of the Mediterranean Sea and adjacent European continent have an unusually warm climate for this latitude (41–44°N). Palms reach the northern limit of their natural distribution there, with the Mediterranean fan palm *Chamaerops humilis*. This species is a typical component – an indicator – of the warmest Mediterranean vegetation zone. People realized very early on that this zone was most favorable for the cultivation of plants from warm climates, especially palms.

Chamaerops humilis

The Mediterranean fan palm occurs sporadically and is of doubtful indigenous status in the area considered. It begins to be a major component of the vegetation just south of Barcelona (Fig. 1). In France and northern Italy, it is difficult to assess its status due to urban and garden development along the coast. Some small populations, including large, mature specimens exist in apparently natural conditions (Médail & Quézel 1996). The Mediterranean fan palm is extensively used in landscaping. Its clustering and relatively small habit is unusual among the commonly cultivated palm species and, as it is native, it is especially well adapted to the climate. There is a great variability in habit, leaf color, indument and shape, which make this species even more interesting.

The date palm at Bordighera

The date palm (*Phoenix dactylifera*) has been cultivated at Bordighera, near the Italian-French border, at least since the 16th century, for religious purposes (Castellana 2001). The date palm groves are established on a succession of terraces maintained by dry stone walls built on the steep slopes of the Sasso Valley, and irrigated by a complex network of canals and tanks. The number of palm trees was estimated at around 15,000 at the beginning of the 20th century. The palms were densely planted and the largest stems generally cut to promote resprouting and maintain easy access to the crowns. The leaves were processed for both Christian Palm Sunday and Jewish New Year ceremonies.

The abandonment of the date palm cultivation and its irrigation system after World War II resulted in major changes in the landscape. In the highest parts of the valley neglected palms began to suffer or die from drought and nutrient deficiencies. Many of these palms that appeared useless and in the way were cut down. At present, 90 % of the palms have disappeared (1500 remain), but paradoxically, the visual effect of Sasso Valley has never been so pleasing as it is today. However, if nothing is done rapidly to regenerate the cultivation, the date palm will completely disappear.

Bordighera's date palms also played an important role in several respects in the 19th century development of the Riviera. Early palm landscaping was made with Bordighera's palms, the only significant source of well-grown plants before the establishment of nurseries. The German botanist Ludwig Winter created a botanical garden on the lower Sasso valley, just in front of the date palm plantings. His garden contains a great diversity of palm species, often planted in groups of several individuals. This method of planting which is now standard in botanical gardens was experimental at the time.

Great plant collectors and gorgeous palm landscaping on the Rivieras

The introduction of exotic palms outdoors in the Mediterranean region began in the early 19th century with the development of plant exploration in Asia, Australia, North and South America. Intrepid botanists, horticulturists and plant collectors brought countless new species into cultivation in European conservatories. A few species where tried and soon established in Mediterranean gardens.

From 1860, botanical collections developed rapidly in the Mediterranean region as botanists and wealthy plant-loving landowners realized the potential for the cultivation of subtropical and tropical plants. At Nice, Viscount Vigier developed a splendid garden, with a special interest for rare and new palms. He introduced three plants of *Phoenix canariensis* outdoors in 1864, bought from the famous Linden Nursery, at Gand, Belgium. *Phoenix canariensis* rapidly appeared to be a majestic palm perfectly adapted to the climate of the Riviera. Chabaud, who formally described the species in 1882, was especially active in promoting it into cultivation on the Riviera : "*The Canary date palm is the most majestic, the most sumptuous, the most marvelous of all* Phoenix *species. It grows magnificently outdoors and produces, by its exuberant and opulent vegetation as well as by its wonderful and grandiose appearance this peculiar style of the Riviera which seduces the visitors: it reigns as the master and king*" (Chabaud 1915).

Near the Spanish border, at Collioure, another prominent French botanist, Charles Naudin, developed an experimental garden where he introduced many plant species, and especially palms, between 1868 and 1878. Among the palms planted were *Trachycarpus martianus*, *Butia yatay* and *Jubaea chilensis*. As Chabaud did with *Phoenix canariensis*, Naudin spent much energy to promote the cultivation of *Jubaea*. He obtained seeds from Chile, encouraged nurserymen to grow it and wrote numerous articles about this palm in horticultural reviews. As numerous seeds were imported on several occasions, the cultivation of *Jubaea* was established on a wide genetic basis, resulting in a great diversity of shape, color, growth patterns and fruit size of the trees (Fig. 2).

In late 19th–early 20th century, two dedicated plant collectors were especially active with palm introduction on the French Riviera – Dr. Axel Robertson Proschowsky at Nice and Eugene Mazel at Golfe Juan. Just like today's palm enthusiasts, they introduced – with more or less success – about every palm species potentially suitable for outdoors cultivation available in the seed and nursery market. Their observations on frost hardiness were especially interesting. Robertson Proschowsky maintained *Acrocomia aculeata*, *Copernicia alba*, *Chambeyronia macrocarpa* and *Livistona mariae* among many other species. Mazel grew a sizable specimen of *Polyandrococos caudescens* and *Rhopalostylis sapida* flowered in his garden in 1882. Golfe Juan was at the forefront of palm cultivation at this time. Apart from Mazel's garden, Edouard André, the well known landscaper, had his garden there (Villa Colombia) with interesting palms. André also designed a magnificent palm garden at Golfe Juan for the Count of Eprémesnil (Le Jardin des Cocotiers), with impressive plantings of *Syagrus romanzioffiana* producing a very tropical effect. Nabonnand, immortalized by the hybrid × *Butiagrus nabonnandii*, also established a nursery at Golfe Juan.

At the time all these botanical and collector's gardens were being developed, palm landscaping flourished everywhere in the cities of the Riviera (Fig. 3). Luxurious hotels all had palm gardens (Fig. 4). Numerous urban parks, public or private, were also created at that time, mixing English style with formal palm compositions. Rows of *Washingtonia filifera* are especially typical of these parks (Fig. 5). *Livistona australis, Sabal bermudana* and *Jubaea chilensis*, three species now rarely planted, are also constant features of these old gardens.

Hidden treasures in the countryside

Away from the cities of the Riviera, the *chateaux* of the countryside also had parks beautifully landscaped with palms. Prosperity came principally from the development of vineyards and some visible sign of wealth had to be demonstrated. This could be a single *Phoenix canariensis*, *Washingtonia filifera*, *Jubaea chilensis*, or a whole planting of numerous species (Fig. 6). A fine example is the Chateau de la Moutte at Saint Tropez, which has extensive palm collections including several very large *Jubaea*, many *Butia*, *Brahea*, *Washingtonia*, *Phoenix* and *Chamaerops*. A similar assortment of species is found in Parc des Capellans at Saint Cyprien. Sometimes a whole plot a palms was planted, in rows, just as people planted vines.

Modern palm landscaping

Modern palm landscaping relies heavily on the availability of mature – or at least large – specimens. Fast growing species such as *Phoenix canariensis*, *Washingtonia robusta* or *Syagrus romanzoffiana* are produced in large quantities in Italy, France or Spain. Many other species are directly imported as mature plants from their country of origin. Unfortunately, several pests and diseases were also introduced with the palms (Mercier & Louvet 1973). Such introductions may seriously threaten palm cultivation in the Mediterranean region.

Conclusions

Palm fashion is spreading around the Mediterranean shores, and urban landscapes show daily changes towards more palm plantings. The long history of palm introduction in Mediterranean Europe gives countless opportunities for the visitor to discover beautiful gardens and palm specimens (Fig. 7). However, the development of the ornamental palm business has its drawbacks. Measures need to be taken to promote palm plantings and species diversity without compromising the future of palm landscaping with the introduction of new pests and diseases, which can quickly become out of control.

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6. *Phoenix canariensis* and *Washingtonia filifera* on side of a farm in Roussillon, France. Vineyard on the foreground.

7. Villa Garnier at Bordighera with its beautiful palms.

facing page

2 (upper left). A surprising octostichous specimen of *Jubaea chilensis* at Parc Magnol, Montpellier. 3 (upper right). 1880's park "Alsace-Loraine" at Nice, inspired from English style, mixing palms (25 m tall *Phoenix canariensis*, *P. reclinata*, *Washingtonia filifera, Trachycarpus fortunei*) and conifers. 4 (lower left). An elegant *Howea forsteriana* in front of a hotel at Menton, French Riviera. 5 (lower right). A spectacular row of *Washingtonia filifera* in Park de l'Indochine, Nice.

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Nypa fruticans, a Weed in West Africa

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***Nypa fruticans*, the mangrove palm, was introduced into West Africa in the early Twentieth Century and is now becoming a serious weed.**

The natural range of the mangrove palm, *Nypa fruticans* Wurmb, occurs from Sri Lanka and the Ganges Delta to Australia and the Solomon and Ryukyu Islands (Uhl & Dransfield 1987). However, the ability of *Nypa* to colonize areas outside its existing natural range has been reported from Trinidad (Bacon 2001), Panama (Duke 1991) and probably most extensively, West Africa (Zeven 1973). It is speculated that the source of the germplasm that has led to the establishment of colonies of *Nypa* in the Neotropics originated in West Africa (Bacon 2001), where it was introduced during the early and middle parts of the 20th century. Unlike in West Africa, the colonies of *Nypa* reported from the Neotropics are said to be somewhat localized and do not currently cover vast expanses of coastline.

Nypa in West Africa

Although *Nypa fruticans* is currently restricted to SE Asia, its historical distribution was much greater, and pollen and fruits of *Nypa* are common fossils in many parts of the world. *Nypa* has not been present in West Africa since the end of the Eocene (Gee 1989); however, *Nypa fruticans* was introduced to West Africa at two main locations in Nigeria. In 1906, seeds from the Botanic Gardens of Singapore were used to establish a trial plantation in Old Calabar from where a subsequent plantation was initiated in Oron in 1912 (Holland 1922) – the Cross River Delta population. In 1946, a further 6000+ seeds originating from Malaya were planted throughout the brackish swamps of the Niger Delta (Zeven 1971). It is from these two single points of entry that the species has today colonized large areas of coastline throughout West Africa.

Zeven hinted at the potential capacity of the species to become naturalized and forecast that ".. [*Nypa*] will eventually spread rapidly throughout the coastal districts of West Africa" (Zeven 1973: 36). Today, *Nypa* has colonized large areas along the coastline of the Bight of Biafra, particularly in brackish and sheltered tidal areas such as river deltas – areas where the dicotyledonous mangrove species are more commonly found. The species has now established itself as far south as the Wouri Estuary near Douala, Cameroon and westwards to Lagos.

Unfortunately, this colonization has considerable ecological implications. It has been observed that *Nypa* is a highly opportunistic species and the dense monospecific stands that the species forms are out-competing the indigenous mangrove vegetation. This opportunism is exacerbated by the fact that much of the mangrove forest of Nigeria and Cameroon is being felled to provide fuel wood for smoking fish for commercial sale. The resulting exposed mudflats are ideal colonization areas for *Nypa*, and the indigenous mangroves are unable to re-colonize the areas.

Recent environmental impact assessments carried out for the oil industry observed that *Nypa* has invaded the mangrove areas of the Niger Delta especially around the Bonny and Imo Rivers and

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is causing long-term ecological damage (SGS Environment, 1995). Mangroves in areas adjacent to petrochemical installations are frequently in poor condition. Wherever mangrove cover is poor and the ground is bare *Nypa* can rapidly invade, out-competing native mangrove species and causing permanent displacement. The study concluded that "*Nypa* is extending its range within the Niger mangrove system and has the potential to become a substantial problem" (SGS Environment, 1995).

It has been observed that where *Nypa* colonizes the mangroves, it completely chokes the mangrove vegetation in which fish breed. It is possible that dense *Nypa* colonization is affecting the breeding of fish in the Niger Delta thus contributing to the decline of fish populations throughout the area (Living Earth Nigeria Foundation, pers. comm.).

The Nigeria Delta and the communities that live there are relatively remote from mainstream life in Nigeria, and thus, *Nypa* colonization has barely begun to be an issue in Nigeria. Some environmental organizations are beginning to realize that *Nypa* could be a potential problem. Two years ago, the Nigerian Conservation Foundation (NCF) began project to assist local communities with the manufacture of jewellery from *Nypa*. The idea was that utilization would curtail the growth of the palm in the area. The project has made little impact because it seems that NCF did not consider the marketing aspect and certainly to date, there is no mass market for *Nypa* jewellery in Nigeria. A more viable alternative might have been to teach local people in Nigeria how to tap the *Nypa* palm for alcohol as is widely practiced in SE Asia (Fong 1993; Päivöke 1984).

Conclusion

There is an urgent need for research to be undertaken into the effects of the *Nypa* palm on the ecology of the West African mangrove ecosystem and fish populations. Additional research is also needed into possible means of developing biological control methods to supplement human control through harvesting and utilization.

Why was *Nypa* introduced to Africa in the first place? Initially intended to provide the people with "a crop more valuable than mangroves" (Zeven 1973: 36), it was hoped *Nypa* would provide cheap and readily available sources of thatching as well as a light alcoholic drink (to provide an alternative to felling the oil palm, the traditional source of palm wine). Unfortunately these development interventions were not appreciated by the local people and, despite some minor cutting for thatching (Holland 1922), the *Nypa* palm remains considerably under-utilized in West Africa. Most communities in the Niger Delta seem to be completely unaware of the possibility of obtaining 'palm wine' from *Nypa*. Teaching local communities to tap the inflorescence would certainly restrict the ability of the species to reproduce. Hence the spread of *Nypa* throughout West Africa could be somewhat curtailed.

There have been some encouraging developments recently. In June 2002, Elf Petroleum Nigeria Ltd. announced that it would investigate means by which the *Nypa* invasion could be controlled (Obari 2002). A month later, the Nigerian Federal Ministry of Environment announced that plans were underway to eradicate *Nypa* and rehabilitate the Niger Delta's mangrove habitat (Oghifo 2002).

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