AN INTRODUCTION TO THE PALMS OF NEW CALEDONIA

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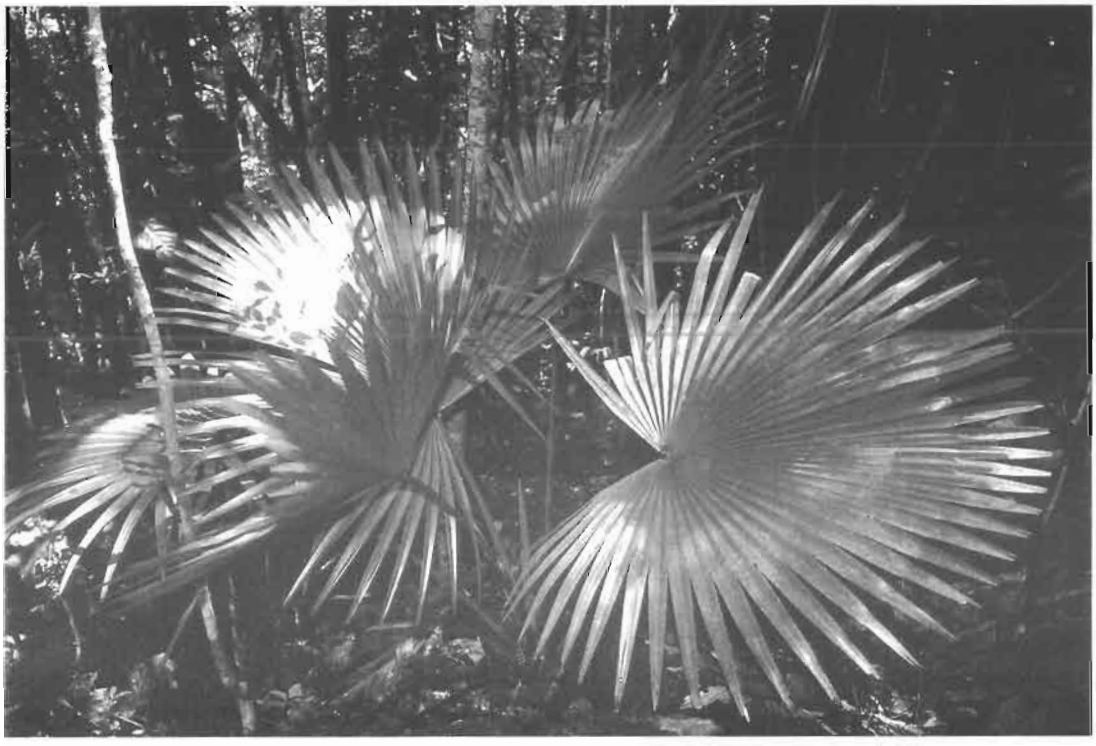


1. *Pritchardiopsis jeanneneyi.* One of the few juveniles growing near the only known adult specimen, southern New Caledonia.

The unique palm flora of New Caledonia has had a special appeal to palm enthusiasts, nurserymen and scientists ever since the earliest days of botanical exploration of the island.

Palms were among the first groups of native plants to be studied by the French botanists Brongniart and Vieillard in the 1860–70s (Brongniart & Gris 1864, Brongniart 1873, Vieillard 1873). At the same time, Linden, the great Belgian nurseryman of the late 19th century appointed another botanist, Pancher, to collect seeds of New Caledonia palms. A few years later, Linden's catalog included species such as *Actinokentia divaricata* and *Cyphokentia macrostachya* at prices that only the most prominent palm collectors of the time, such as Dr Prochowski on the French Riviera, could afford. In the 1890, Charles Moore from the Royal Botanic Gardens, Sydney became especially interested in an undescribed fan palm, the only one in New Caledonia, known from a single population at the southern tip of the island. It was being destroyed by convicts of Prony's penitentiary settlement who were harvesting palm hearts. Charles Moore sent to the Royal Botanic Gardens Kew complete herbarium material as well as living specimens of what is now known as *Pritchardiopsis jeanneneyi* (Fig. 1).

Nothing is left from these early days of palm introductions in Europe (Pintaud 1999a) but the good fortune of New Caledonia palms was just beginning. Beccari, the great palm specialist of his time wrote a full treatment of the island's palms which was published in 1920, and remained the standard reference until H. E. Moore began a modern revision in the 1960s. At that time, the taxonomy of New Caledonia palms was still extremely confused. Hal Moore made several field trips to New Caledonia between 1966 and 1980; throughout the island he collected excellent material, later studied at Cornell University by himself, Natalie Uhl and their collaborators. Moore sorted out most of the problems left by his predecessors, described many new species and genera, and built a firm taxonomic base for the years to come. These achievements resulted in "The indigenous palms of New Caledonia" (Moore & Uhl 1984), the first practical book on the subject. This work looked so definitive that botanists, even in New Caledonia, did not see the need for further research on palms there, and I had to be quite persuasive to justify new taxonomic work when I wanted to prepare a Ph.D. thesis on the New Caledonia palms in 1994. In the mean time, local interest on palms was growing rapidly, with the creation of Association Chambeyronia in 1993, bringing together palm enthusiasts who rapidly gained excellent expertise on the local palm flora. They brought to my attention several unusual palms which now are among the five new species I described from the island with Don Hodel (Pintaud & Hodel 1998a, b), allowing us to update Moore and Uhl's treatment in our "Palms of New Caledonia" (Hodel & Pintaud 1998).

As an introduction to what is to be seen during the year 2000 IPS Biennial Meeting, I will present some general features of New Caledonia palms, which should be helpful for visitors to get a better understanding of the palms they will encounter.

Endemism

Endemism is a magical word in New Caledonia, most of the living things there being endemic–that is to say existing nowhere else in the world. New Caledonia separated from Australia and New Zealand about 75 million years ago and the relative position of these land masses in the western Pacific was fixed about 65 million years ago (Kroenke 1996). In addition to this long isolation, New Caledonia did not undergo the climatic changes that affected Australia, which began to desertify about 20 million years ago, and New Zealand, which lost most of its tropical flora during the Pleistocene glaciations (Stevens 1980, White 1998).

Figs 2–5, p. 134.

2 (upper left). *Basselinia pancheri* , habit, Upper Neuméni River, 900 m elevation, Port Bouquet, southeastern New Caledonia.

3 (upper right). *Basselinia pancheri*, crownshaft, Upper Neuméni River, 900 m elevation, Port Bouquet, southeastern New Caledonia. *Basselinia pancheri* is a species very widespread on the main island of New Caledonia, but occurring only on ultramafic rocks. It is an extremely variable species. The montane form of the Neumeni River is distinctive by its small size (1–3 m tall), regularly pinnate leaves with somewhat twisted leaflets, and a spectacular, waxy-bluish crownshaft. It possibly hybridizes with the co-occurring *Basselina deplanchei*, giving intermediate forms that retain the regularly pinnate leaves of *B. pancheri* but have the cespitose habit of *B. deplanchei*.

4 (lower left). *Basselinia pancheri*, habit, Col de Yaté, 350 m, southeastern New Caledonia.

5 (lower right). *Basselinia pancheri*, crownshaft, Col de Yaté, 350 m, southeastern New Caledonia. In the gum-oak forest (*Arillastrum gummiferum*, Myrtaceae) of Col de Yaté, in the very south of New Caledonia, exists a surprisingly polymorphic population of *Basselinia pancheri*. The most diminutive individuals have pencil-thin, barely self-supporting trunks, small, bifid leaves and reduced inflorescences while the largest ones can reach 8 m tall, with a trunk of 5 cm in diameter and with irregularly to regularly pinnate leaves. The crownshaft in this population is black outside, but is bright golden-yellow inside. Many New Caledonian palms have attractively colored crownshafts, either on the outside or inside or both parts.

As a result, the flora and fauna of New Caledonia is primarily composed of organisms that evolved there during a long period of isolation, and relicts of groups extinct elsewhere. This is especially true for palms since not only are all 37 native species endemic, but also 15 out of the 16 genera to which they belong are also endemic. Only *Cyphosperma* is shared with Vanuatu and Fiji, but with different species on each island. Among the other genera, *Pritchardiopsis*, the only Coryphoid palm of the island, can well be regarded as a relict, while two groups of Arecoid palms have diversified – the Archontophoenicinae (with three genera and eight species) which have male flowers with numerous stamens (15 to 55) and endocarps laking an operculum, and the Iguanurinae (12 genera and 28 species), with male flowers having six or 12 stamens and endocarps distinctly operculate. The Archontophoenicinae include *Actinokentia*, *Chambeyronia* and *Kentiopsis* which have diversified on the island from a single ancestor (Pintaud 1999). Among the Iguanurinae, most if not all of the 12 New Caledonian genera have probably a single origin as well, but this still needs to be confirmed by further phylogenetic studies.

The endemism of New Caledonia palms is also remarkable at the level of their distribution within the Territory, most species being restricted to a very small area or even known from a single population. This is sadly exemplified by *Pritchardiopsis jeanneneyi*, presently known from a single adult individual serendipitously found by a hunter in 1980, most probably in the forest visited by Charles Moore one century before. Many other species are hardly more abundant, including *Cyphophoenix nucele*, *Kentiopsis pyriformis*, *Lavoixia macrocarpa*, *Actinokentia huerlimannii*, *Burretiokentia grandiflora*, which are all known from less than 100 mature plants. Several species have a very small area of occurrence (less than five sq. km), but are extremely abundant where they grow, such as the astonishing *Kentiopsis piersoniorum* which dominate the vegetation in a small area of Mont Panié. In fact, only three or four species are found more or less commonly throughout the main island, including *Basselinia gracilis*, *Burretiokentia vieillardii* and *Chambeyronia macrocarpa*.

Figs. 6–9, p. 135.
6. (upper left) *Basselinia gracilis*, Plateau de Dogny, 1000 m elevation, west-central New Caledonia.

7 (upper right). *Chambeyronia macrocarpa*, closeup of rachilla with staminate flowers and unusual tetrads of flowers. Cultivated, Noumea, New Caledonia.

8 (lower left). *Cyphophoenix elegans*, photographed in late afternoon light, Lower Parari river, 150 m elevation, Ouegoa, north New Caledonia.

9 (lower right). *Moratia cerifera*, showing the white-waxy crownshafts and inflorescences, Col d'Amos, 550 m elevation, northeastern New Caledonia

Polymorphism and geographical variation.

The most widespread species are usually structured in morphologically distinct populations, often corresponding to geographical forms. This simple pattern is well illustrated by *Burretiokentia vieillardii* and *Chambeyronia macrocarpa*, but is very complex in the genus *Basselinia*, in which several distinct forms of the same species can occur together, while some populations are extremely polymorphic and interspecific hybrids not rare (Figs 2–5).

Everyone who is familiar with the cultivation of *Chambeyronia macrocarpa* is well aware of the morphological variation within the species, and with some experience, it is often easy to tell from which part of the island come a given cultivated plant. The southern populations are very tall palms (reaching easily 25 m in height or more) with an elongated, solid green crownshaft, divaricate inflorescences and shortly ovoid, pruinose fruits. The "watermelon" types, with a striped, green and yellow crownshaft, are characteristic of the central-western region. Among them, a population at Katrikoin never produces red new leaves, and should be known by growers, at least to avoid it! Several very distinctive and highly ornamental forms are locally distributed along the east coast. The former *Chambeyronia hookeri*, with a pale yellow crownshaft and broad, spreading leaflets is known from the Ba River valley and adjacent areas near Houailou. Another form with a yellow crownshaft, but otherwise very different, exists a few kilometers farther south at Poro. Unlike any other form of *C. macrocarpa*, it has arching leaves, with stiff, erect leaflets, inflorescences with scarcely diverging branches, and staminate flowers with a prominent pistillode (Fig. 10). Another very distinctive eastern form is located at the base of the Panié massif. It is a stout, massive form, with a whitish-tomentose crownshaft and elongate, 5.5 cm long fruits, the largest for the species, distinctive also by the dense, short, erect, inner mesocarp fibers. The exact pattern of variation within *Chambeyronia macrocarpa* is still not fully understood, and more studies are needed before a reliable infraspecific treatment can be made.

Morphology, architecture and growth

At first sight, many New Caledonian palms are puzzling, as they all look so similar. Most species

are indeed medium-sized, solitary palms (10–15 m tall), with rather slender trunks, a prominent crownshaft, short-pedunculate infrafoliar divaricate inflorescences, pinnate leaves with a recurved rachis and stiff, erect leaflets, as illustrated by *Cyphophoenix elegans* (Fig. 8). One needs to look more closely at characters such as the aspect of the trunk (smooth or indented with leaf scars – Fig. 11), the indument of the crownshaft (glabrous, waxy or variously tomentose – Figs. 3, 5, 9) or the ramenta (scales) underneath the leaflets, for a proper identification. A few species escape this general pattern and are instantly recognizable. *Cyphosperma balansae* is striking with its numerous (up to 18), long-pedunculate inflorescences projected outside the crown of leaf. *Campecarpus* is noteworthy for its stilt roots which can reach 2 m in height (Fig. 13). Three species of *Basselinia* (*B. gracilis*, *B. deplanchei* and *B. vestita*) are small cespitose palms of the forest understorey. This morphology, so common is the rainforests of Asia, Madagascar and the Americas, is very rare in Pacific islands east of New Guinea.

Most of these palms are very slow growing. Measurements of growth rate of forest palms showed that most of them produce one or two leaves per year in their natural environment, and increase trunk height by 5 to 20 cm in the same time. *Actinokentia divaricata*, which has a crown of only 3 to 5 leaves, produces less than a leaf per year, each lasting about 7 years. The stilt roots of *Campecarpus fulcitus* have a growth rate of 25 cm per year, which means that the longest ones (2 m) can take 8 years to reach the ground (Fig. 13) (Pintaud 1999). The only really fast growing species is *Chambeyronia macrocarpa*.

Ecology

All New Caledonia palms are rainforest species. They grow in environments receiving from 1500 to 4000 mm of rain annually. The absence of palms adapted to rather dry environments such as those of the western lowlands in noteworthy.

The richest palm communities are located at low to medium elevation (150–900 m), and include six to ten species. These communities are usually stratified, with small clustering palms (e.g. *Basselinia gracilis*), solitary, sub-canopy species (the vast majority) and a few emergent species (*Basselinia* spp., *Chambeyronia*, *Kentiopsis*). Most communities also have a spatial structure, with some species having a distinctive gregarious behaviour such as *Kentiopsis* (Pintaud & Hodel 1998a), others preferring to grow in valley bottoms where they can be very abundant and line steams and gully bottoms (*Burretiokentia vieillardii*, *Chambeyronia macrocarpa*, *Alloschmidia glabrata*), while others prefer ridges and upper slopes (*Moratia*, *Clinosperma*), or rocky habitats (*Campecarpus*, *Actinokentia*).

Above 1000 m elevation, where the temperature can occasionally drop to 0°C in winter, the palm diversity decreases rapidly. Only a few species of *Basselinia* grow above 1400 m elevation and reach the summits, Mont Humboldt (1618 m) in the south (*B. deplanchei*), Mé Maoya (1508 m) in the central part (*B. sordida*) and Mont Panié (1628 m) in the North East (*B. gracilis* and *B. velutina*).

The most unusual biotas in New Caledonia are those on ultramafic rocks. These rocks originating from the seafloor covered the island entirely during a major geological event called obduction that took place between 43 and 38 million years ago. These rocks were much eroded subsequently but still cover one-third of the island, including most of the southern part. Soils derived from ultramafic rocks are very poor in essential nutrients and contain high levels of phytotoxic heavy metals such as nickel, chromium, cobalt and manganese. These soils carry a highly endemic flora adapted to this peculiar environment and some very distinctive vegetation types such as *maquis minier*, a heath-like vegetation composed of sedges and sclerophyllous shrubs, including the clustering *Basselinia deplanchei*. Fifteen species of palms are restricted to ultramafic rocks. *Basselinia pancheri* is very typical of this habitat; it occurs on nearly all ultramafic outcrops of the island and is never found on other soil types. *Campecarpus fulcitus* is a very distinctive component of rainforests on ultramafic rocks in southern New Caledonia. It is mostly found in rocky habitats where it becomes established by means of its long stilt roots (Fig. 13).

Outside ultramafic areas, the rocks are mostly schistose and carry an essentially different palm flora, including 13 species restricted to soils derived from schists. In fact, only eight species are to be found on both ultramafic and schistose

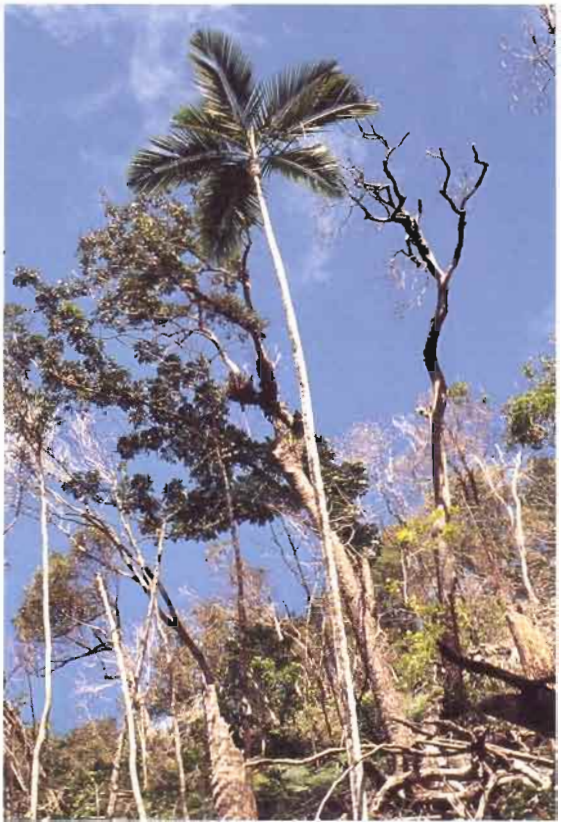
Figs. 10–13, p. 138.

10. (above left) *Chambeyronia macrocarpa*, form from Poro, Cultivated, Poindimié, New Caledonia.

11 (above right). *Burretiokentia vieillardii*, Mandjelia, 600 m elevation, Puébo, northeastern New Caledonia

12 (lower left). *Kentiopsis pyriformis*, growing in disturbed habitat, mouth of Kuébini river, 50 m elevation, Goro, southeastern New Caledonia.

13 (lower right). *Campecarpus fulcitus*, showing aerial root system, Rivière Blanche, 150 m elevation, Yaté, southern New Caledonia.



soils, including the common *Basselinia gracilis*, *Burretiokentia vieillardii* and *Chambeyronia macrocarpa*.

Natural history

Natural history is certainly the aspect of New Caledonia palms which is the least known. No precise studies of fruit dispersal nor of pollination have been made. The largest pigeon able to fly, called *notou* (*Ducula goliath*), endemic to the rainforests of New Caledonia is well known to eat and disperse the large fruits of *Chambeyronia macrocarpa*, and hunters often look for *Chambeyronia* stands in order to find the notous. Smaller fruits are eaten and dispersed at least by a species of parakeet, *Cyanoramphus novaezelandiae* subsp. *saisseti* (MacKee et al. 1985). It would be interesting to know if there is a correlation between some morphological traits such as the small, spherical black fruits of most *Basselina* species (Fig. 6) or the bright red, oblong ones of *Kentiopsis* species and dispersal. Since the introduction of the Pacific rat, however, this rodent interferes much with dispersal and predation of fruits by native animals. Another question still unanswered is the significance of the strange sculptured endocarps found in several genera. Although sculptured endocarps are not very rare in palms, their occurrence is nowhere else as high as in the New Caledonian flora, where *Burretiokentia*, *Cyphosperma*, *Veillonia*, *Lavoixia* and *Pritchardiopsis* (in all 9 species) display this feature. The last two genera, although completely unrelated, share large (4–5 cm), spherical fruits, dull-colored, with thick fleshy-fibrous mesocarp and bony, compressed, sculptured endocarps. Both *Lavoixia* and *Pritchardiopsis* are at the verge of extinction, and known from a single population. Their fruits are not dispersed, they fall on the ground and germinate there. Those of *Lavoixia* germinate with extreme difficulty and even in the wild, very few seedlings are encountered. It is thus tempting to follow the hypothesis of Dransfield and Beentje (1995) for *Satranala* and *Voanioala*; they invoked the role of a giant extinct bird in the dispersal of these palms from Madagascar with similarly sculptured large fruits lacking present means of dispersal. A giant megapod bird, *Sylviornis neocaledoniae*, is indeed known as subfossil bones, but its diet is unclear (Balouet 1991).

Floral biology is another aspect of great interest in New Caledonian palms, yet so far not investigated. In all Arecoid species, the fall of the peduncular bract occurs a long time prior to anthesis, exposing flower buds sometimes during months prior to it. Petals are consequently very hard and thick, and protect flower buds from predation (Fig. 7). Related palms elsewhere in Australasia such as *Rhopalostylis*, *Archontophoenix*, *Clinostigma*, have flowers which open immediately after bract fall and are very soft and generally white. This duality of flowering pattern is common in Arecoid palms, but has not received explanation. All the New Caledonian species are also monoecious and protandrous, with the staminate flowers opening sometimes weeks before the pistillate ones. The timing of anthesis of the staminate, and subsequently the pistillate flowers is variable and often of taxonomic significance. Anthesis of both flower types is simultaneous in *Burretiokentia*, and the inflorescences are spectacular at staminate anthesis, being entirely covered by flowers which attract insects and even birds. Anthesis is progressive and random in *Brongniartikentia*, *Lavoixia* and *Clinosperma*, three very closely related genera with small flowers opening one after another anywhere along the rachillae. Anthesis is progressive but basipetal in *Kentiopsis piersoniorum* and *K. pyriformis*, with flowers begining to open at the tips of the rachillae, and opening progressively toward the base in a sequence lasting about one to two weeks. Other distinctive floral characteristics are prominent, nectariferous pistillodes in staminate flowers, and raphides intermixed with pollen grains, an adaptation against pollen-feeding insects.

Another remarkable trait of some New Caledonia palms, is the red color of the newly expanded leaf. Many small understorey tropical palms are known to produce red leaves, such as some species of *Geonoma*, *Pinanga* and *Calyptrocalyx*. In New Caledonia such leaves are produced by large species, and a massive burst of new red leaves of *Chambeyronia* above the forest canopy is an unforgettable sight. This character is not completely consistent, even within a species, and the actual color can vary from reddish-brown or purplish to bright red. However, it is a diagnostic character in some cases. For example, *Actinokentia divaricata* always produces a new red leaf, while *A. huerlimannii* never does so. *Burretiokentia dumasii* and *Burretiokentia koghiensis* are the only species producing such red leaves in the Iguanurinae group, although those of *Brongniartikentia* and *Lavoixia* can occasionally be pinkish.

Uses and conservation

Native palms have very few uses in New Caledonia. The coconut traditionally provided nearly all palm resources needed by Melanesian inhabitants. Uses have been essentially destructive, such as harvest of palm heart and building material, resulting in endangerment of

Pritchardiopsis and *Kentiopsis pyriformis* (Fig. 12). Other causes of endangerment are loss of habitat due to forest clearing for agricultural purpose, bush fires and mining, practices which have a strong detrimental effect on palm species which are essentially rare and unable to survive in disturbed environments. Nineteen of the 37 palm species are considered of conservation concern in New Caledonia (Pintaud et al. 1999). However, rain forests are still extensive with a growing network of protected areas, and it is to be hoped that they will ensure the conservation of this unique palm flora.

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