Notes on the Conservation Status of Mauritian Palms

NICOLE LUDWIG
P.O. Box 6,
97429 Petite Île,
La Réunion, France
nicole.ludwig@wanadoo.fr

CHRISTOPHE LAVERGNE
5 allée des Azalées,
97429 Petite Île,
La Réunion, France
christophe.lavergne@univ-reunion.fr

AND

JEAN-CLAUDE SEVATHIAN
Mauritian Wildlife Foundation,
Vacoas, Mauritius
jcsevathian@mauritian-wildlife.org

1. Blue latan savannah on Round Island; photo by C. Lavergne.

Mauritius, the uninhabited Round Island and several smaller islets are part of the Republic of Mauritius. These islands, with La Réunion and Rodrigues, constitute the Mascarene archipelago located in the Indian Ocean, off the east coast of Madagascar. They have a unique flora and fauna. Many Mauritian palms are more common in cultivation elsewhere in the world than they are in the wild. This paper investigates the precarious state of the palms of Mauritius in their natural habitat (Fig. 1).

Table 1. The nine native palm taxa described in Mauritius.

Scientific name	Local name	Endemic range
Acanthophoenix rubra (Bory) H. Wendl.	Palmiste rouge	Mauritius & Reunion
Acanthophoenix sp. Florin	Palmiste piquant	Mauritius
Dictyosperma album (Bory) H. Wendl. et Drude ex Scheff. var. *album*	Palmiste blanc	Mauritius & Reunion
Dictyosperma album var. *conjugatum* Moore et Guého	Palmiste de l'Île Ronde	Round Island
Hyophorbe amaricaulis Mart.	No local name recorded	Mauritius
Hyophorbe lagenicaulis (L.H. Bailey) H.E. Moore	Palmiste bonbonne	Round Island
Hyophorbe vaughanii L.H. Bailey	No local name recorded	Mauritius
Latania loddigesii Mart.	Latanier bleu	Round Is., Gabriel Islet, Gunnar Coin
Tectiphiala ferox H.E. Moore	Palmiste bouclé	Mauritius

The Mauritian palm flora consists in nine taxa (see Table 1), including seven endemic taxa and two (*Acanthophoenix rubra* and *Dictyosperma album* var. *album*) that are native to both Mauritius and Réunion. This total is subject to change, as there may be more than one species of *Acanthophoenix* present in the wild in Mauritius (see below). The conservation status of these palms in their natural environment is extremely critical, with the exception of *Hyophorbe lagenicaulis* and *Latania loddigesii*, both species endemic to Round Island, where action to restore the ecosystem was taken with the eradication of goats and rabbits (Bullock et al. 2002). This *in situ* rescue was accompanied by culture *ex situ*, and both *H. lagenicaulis* and *L. loddigesii* are grown widely as ornamental species, in the Mascarene Islands as well as throughout the Tropics.

These notes are the result of two surveys conducted in March/April 2006 (Lavergne 2007), and in June 2008. These missions made it possible to evaluate the state of conservation of the endemic and indigenous palms in Mauritius and to study protective measures implemented in the wild, especially on Round Island. On our itinerary we visited the Botanical Garden in Curepipe, the Black River National Park, state forests of Gouly Père and Declerc, l'Étoile private Estate on the northern slope of Montagne Bambou, Île aux Aigrettes near Mahébourg, and in the north of Mauritius, Round Island, Flat Island and Gabriel's Islet.

The single specimen of *Hyophorbe amaricaulis* in the Curepipe Botanical Garden

Located at 550 m above sea level, the Curepipe Botanical Garden is home to the only known specimen of *Hyophorbe amaricaulis* (Fig. 2). The species was first described in the 18th century by French naturalist Commerson on Mount Pieter Both, where the species was reputed to be abundant in the past. Nowadays, it must be regarded as extinct in the wild, since it survives only in Curepipe garden, and we do not know if that specimen was planted or is a remnant wild palm that was incorporated into the garden's collection. In the late 1970s, when H.E. Moore took the photograph that illustrates Flore des Mascareignes (Moore & Guého 1984), this *Hyophorbe amaricaulis* was approximately 6 m tall and not yet caged in an ugly protecting frame (Fig. 3). Almost 30 years later, it is just over 8 m tall, suggesting that this specimen grows very slowly.

The species is closely related to *Hyophorbe indica* or "*palmiste poison*" from Réunion; it differs in inflorescences branched to two orders and large sub-globose fruit (3.8 × 3.3–3.5 cm), orange-red to dark red when mature. Although it produces many fruits and seeds, no successful germination occurs. The protandry of this unique specimen might cause pollination problems although, of 20 fruits dissected, 18 had apparently normal embryos (Wyse Jackson et al. 1990). In 1987, G.C.

2. The single specimen of *Hyophorbe amaricaulis* in the Curepipe Botanical Garden; photo by N. Ludwig.

Douglas attempted *in vitro* cultivation of embryos on Murashige and Skoog medium with charcoal added. After culturing 15 embryos for four months, three developed roots, and two produced shoots. One germinated embryo produced a true leaf. Unfortunately transfer to soil was not achieved (Douglas 1987). More recently another attempt was made under the control of the Mauritian Ministry of Agriculture. From ripe fruits

3. *Hyophorbe amaricaulis* inflorescence (left) and erect young inflorescence enclosed in the prophyll (right); photo by N. Ludwig.

cropped in 2007, five embryos were collected for *in vitro* cultivation. They all germinated and produced seedlings, developing rootlets, and the experimentation is still in progress. The prospect for an *in extremis* rescue is not completely excluded; attempts at seed germination on sterilized medium should be carried out since it is difficult to understand why mature seeds with normal embryos do not germinate. See also Sarasan et al. 2002.

Black River National Park: a sanctuary for critically threatened palms

The remaining natural vegetation (primary forest) in Mauritius occupies only 2% of the available land surface and is subject to protection under the management of the Forest Services within the framework of the National Park. Pétrin, Mare Longue, Florin and Montagne Cocotte are the spots which we visited in the National Park. State forests Gouly Père and Land Declerc are Nature Reserves under the administration of Forest Department.

The Gouly Père and Land Declerc Nature Reserves cover a 200 ha surface of upland wet forest (600–680 m elev.), between Grand Bassin and Montagne Cocotte, in southwestern Mauritius. Some 40 years ago, the area was reforested with exotic species of trees for wood production, including *Cryptomeria japonica, Eucalyptus robusta* and *Pinus elliottii*. Invasive exotic plants also threaten the environment; in addition to *Psidium cattleianum*, we should list *Ardisia crenata, Clidemia hirta, Ligustrum robustum, Rubus alceifolius* and *Ravenala madagascariensis*.

With an average annual rainfall of over 4000 mm, Gouly Père and Land Declerc are very humid. The native remnant vegetation consists of a wet thicket ecosystem or "upland marshes" (Vaughan & Wiehe 1937). In an enclosure where eradication of *Psidium cattleianum* (goyavier) by manual uprooting is all but completed, we observed 5 adults of *Tectiphiala ferox* (possibly 40–50 years old). The stems are 1.6–4.2 m tall, with basal circumference up to 40 cm. The crownshaft is swollen and covered with a dense thorny coating, characteristic of the species. The palms (Fig. 4) grow in a swampy environment, on acid soil (low humic gley), as indicated by the presence of many *Sphagnum* patches. In late March, the beginning of the fruiting season, some infrutescences developed abortive fruits.

4. *Tectiphiala ferox* in the wet thicket ecosystem at Land Declerc; photo by N. Ludwig.

The best specimens of *Tectiphiala*, including the one used by H.E. Moore to describe the genus, are found on Land Declerc and were first discovered by Marc d'Unienville in 1969. In late June, they show bright orange inflorescences with staminate flowers bearing lemon yellow anthers (Figs. 5 & 6). In 1994, the inventory carried out on the spot numbered 14 adult specimens. Now this *Tectiphiala* population does not exceed nine specimens. The reasons for this drastic reduction in the *Tectiphiala* population are not understood, but may include poaching of palm cabbage despite forest agent supervision. Also, in the same location, we observed a few *Acanthophoenix rubra* specimens.

On its southern edge, Gouly Père and Land Declerc plateau extends onto a grassy slope toward Trou Mille Pieds. Obviously this area has been deforested to create grazing land. It would not be of major interest without the presence of around twenty *Acanthophoenix*

specimens gathered on a sloping ledge, some 50 m below the rim. More or less of the same size and same age (35–45 year old?), with no seedlings under the palm trees, they do not look like a wild population. It seems that seeds were planted on this spot a few decades ago. Although these *Acanthophoenix* resemble *A. rubra* in overall morphology, the characteristics of the infrutescence, fruit and seed make it appear distinct. The infructescence is infrafoliar, pendulous, 60–85 cm long, branching to two orders, with 18–27, green rachillae bearing globose fruit (10–12 × 9–11 mm); mature fruit are black with persistent green perianth and the stigmatic scar is slightly off-center.

On Montagne Cocotte, three other specimens of *Tectiphiala ferox* were seen. This area culminates at an elevation of 744 m above Gouly Père and Land Declerc. The vegetation is a remnant mossy forest where fog develops from late morning and maintains high humidity.

The Pétrin Information Center (600 m elev.) is located at the main entrance to the National Park and Plateau de Mare Longue. This is a very humid area with an average annual rainfall of 3500–4500 mm. Behind the office grow five small *Tectiphiala ferox* planted 10 years ago from seeds collected in Florin. The palms are currently less than one meter high.

The Florin Conservation Management Area or CMA (650 m elev.) was established on Plateau de Mare Longue in 1996; it covers a 2.5-ha enclosure where the vegetation consists of

5. A *Tectiphiala ferox* specimen bearing two young infructescences; photo by N. Ludwig.

6. A rachilla segment of *Tectiphiala ferox* densely covered with flowers; photo by N. Ludwig.

7. An *Acanthophoenix* population on a grass slope at Land Declerc; photo by N. Ludwig.

different palms and other endemic species. Within the CMA limits the fence protects the vegetation against deer and wild pigs. The invasive alien species, mainly *Psidium cattleianum* and *Wikstroemia indica*, have been manually removed, twice a year at first, then once a year, and finally one intervention every two years. Among the endemics, a few specimens of several hundred year old *Sideroxylon puberulum (*manglier rouge) are the only trees being present.

The palms recorded are *Acanthophoenix rubra, Dictyosperma album* var. *album, Hyophorbe vaughanii* and *Tectiphiala ferox*.

Another *Acanthophoenix* (Figs. 7 & 8) is present with two adult specimens (along with two juvenile specimens near the fence, outside the CMA.). It was reported as *A. rubra*, and a description of the palm was made 40 years ago on a specimen (Fig. 9) conserved in the Mauritius herbarium (*Guého and Vaughan 13151*, MAU, 11 July 1968). On our second visit in 2008, we had the opportunity to see inflorescences and flowers in situ and to study dry material at the Mauritius Herbarium in order to prepare a description of the Florin *Acanthophoenix*. The Florin *Acanthophoenix* is not *A. rubra*; it is closer to *A. crinita* (staminate flowers very similar) but differs by several characteristics: stem apex armed with persistent strong black spines at the adult stage, crownshaft armed with strong erect black spines, especially on leaf sheath median axis. Inflorescence is short, with 5–11 rachillae, branching approximately from the same point, and fruits and seeds are globose. It combines some characteristics of *A. crinita* (general morphology, staminate flowers) and some of *Tectiphiala ferox* (black spines, inflorescence structure); this emphasizes the phylogenetic link between *Acanthophoenix* and *Tectiphiala* (Lewis 2002). Should this *Acanthophoenix* be considered as a distinct species despite its dramatically small population?

It is quite interesting to compare the measurements given by Guého (1968) with ours, concerning the same specimen's growth over 40 years. In 1968, the height was 1.52 m and the trunk diameter was 8 cm. Lavergne (2007) reported the trunk to be 2.20 m tall and 10 cm in diameter. These measurements point out the very slow growth of this palm, also confirmed by the close prominent leaf scars on the trunk; the harsh environmental conditions could explain this slow growth.

Within the CMA limits, five specimens of *Tectiphiala ferox*, including three adults, are present, and 15 young plants were planted there in 1998. On the same site, and in their natural habitat, three wild *Hyophorbe vaughanii*

8 (left). Land Declerc *Acanthophoenix*: close up on rachillae bearing unexpected blueberry like fruits; photo by N. Ludwig. 9 (right). Herbarium specimen of Florin *Acanthophoenix* collected in 1968 by R.E. Vaughan and J. Guého; photo by N. Ludwig.

remain, their stems respectively 2.00 m, 1.80 m and 1.70 m tall and 6–7 cm in diameter. This species is close to *H. amaricaulis* but differs by the widely spaced insertion of leaflets on the rachis, orange staminate flowers and globose fruits (4–4.5 × 4.4 cm) with cork-like pericarp (Fig. 10). A young *H. vaughanii* coming from a seed collected in Florin was planted in the reserve in 1994 (Fig. 11). It grows very slowly compared to other specimens of the same age planted in the Mare Longue CMA, which already bear fruit.

In conclusion, the Florin CMA includes, in a small area, a significant number of Mauritian endemic species, including rare palms. However, this floristic richness should not obscure the fact that the majority of the plants are scraggy, are sometimes in poor health, grow very slowly and do not regenerate. It seems that the drastic eradication of *Psidium cattleianum* caused an important modification of the soil. Perhaps organic components were washed away during cyclones. In spite of significant rainfall, the ground does not retain moisture and dries quickly. Humus is rare and confined at the foot of old *Sideroxylon* trees and at the base of palm stems, forming ringlike deposits. The scarcity of humus and the probable lack of trace elements combine to create harsh conditions for the palms surviving inside the Florin CMA.

10. *Hyophorbe vaughanii* globose fruits with characteristic corklike pericarp; photo by C. Lavergne.

11. Forestry agent Mario Allet shows a specimen of *Hyophorbe vaughanii* he planted 15 years ago in the Florin CMA; photo by N. Ludwig.

On the Mare Longue plateau, outside the Florin CMA, the shrubby vegetation is denser, mainly because of the presence of *Psidium cattleianum*. This is a wet thicket ecosystem on low humic gley substrate, with sedges, *Dicranopteris* ferns, lycopods and many hollows

colonized by *Sphagnum*. In this environment we have noticed several *Acanthophoenix* whose characteristics suggest *A. rubra*; but we saw neither the inflorescences nor the fruit, only one dry spiny infrutescence collected under one palm tree.

Closer to Mare Longue Reservoir in a section of upland wet forest, Mario Allet of the National Forest Commission planted a group of ten *Hyophorbe vaughanii* between 1994 and 1996. The seedlings were grown from seeds of the last three wild specimens from Florin. Nowadays, some *H. vaughanii* bear abundant fruits.

L'Etoile Private Estate: the domain of *Acanthophoenix rubra*

L'Etoile Private Estate is located in southeastern Mauritius on the northern slope of Montagne Bambou, between Grande Rivière Sud-Est and the mountain ridge. This estate covers 1200 ha and is owned by CIEL Group. Farming lands on the north bank of Grande Rivière Sud-Est are covered with sugar cane. In recent years the south bank and the mountain slope were developed into a green leisure center and a deer hunting land. On the lowest slopes the forest is heavily invaded by exotic species.

The trail to Pic Grand Fond (521 m elev.) leads to a grade A (70% natives and endemics; 30% exotics), intermediate sub-humid forest (average annual rainfall 2500 mm) that covers the slopes of Montagne Gingembre (200–250 m elev.). In this forest ecosystem the rate of endemic and native species is quite high and the presence of *Acanthophoenix rubra* is of note (Figs. 12 & 13). We counted some 50 adult specimens either emerging from the canopy or alongside the trail. In two different places we have seen juveniles whose thorns and spines are an efficient protection against deer.

In Vallée de l'Est, on a location near L'Etoile, the wild population of *Acanthophoenix rubra* has been re-enforced by the recent planting of 80 young specimens in a program initiated by the Mauritian Wildlife Foundation. Another estimated population of 75 individuals of *A. rubra*, both adults and juveniles, has been located on deer hunting land in Midlands. The palm is present also in the Curepipe Botanical Garden and in private gardens; the species is also grown in Réunion.

Île Ronde: a sanctuary for palms and reptiles

Located 24 km off Cap Malheureux, northeast of Mauritius, Round Island or Île Ronde covers a surface of 219 ha and is 276 m at its highest point. The island is the result of recent volcanic activity (100,000–25,000 years ago). The foliate volcanic substrate constituted by aphyric hawaiites is often visible (Big Slab) due to severe erosion. The soil was partly cleared of its vegetation cover by goat and rabbit overgrazing before their eradication; then the heavy rains finished the job and washed away much of the soil to the ocean, though the average annual rainfall is less than 1000 mm.

There are three palms endemic to Round Island, a fact which, given the small size of the island, is remarkable. These species were close to extinction after goats and rabbits were introduced onto the island during the course of the 19th century. Goat eradication was carried out between 1975 and 1979, and rabbits were eradicated in 1986. By the time the exotic animals were eradicated, only one wild specimen of *Dictyosperma album* var. *conjugatum* remained, along with three original *Hyophorbe lagenicaulis* (Fig. 14) and a few *Latania loddigesii* over 90 year old, whose extinction was expected around year 2010 if nothing was done.

Twenty five years after the rabbit eradication was completed, the blue latans are the main element of a wooded savannah landscape ("open palm-rich forest" of Bullock et al. 2002). On the windward side of the island the latans colonize stepped ledges going down to the sea; they grow as well on pyroclastite or in hollows with organic matter deposits. The blue latans grow in colonies with an average of five males, five females and two sub-adults in a grassy environment. Seedlings are numerous under the palm trees with an average of five per m^2. The dead fronds attract many decomposer insects and lizards such as the Telfair's skink (*Leiolopisma telfairii*) whose color resembles dry palm fronds; some marine birds such as the Pacific puffin (*Puffinus pacificus*) nest under the palms. Thus, the presence of latans generates an important biological niche. They also play a major role in the ecosystem: creating micro-habitats, interactions between species, producing organic matter, preserving moisture on the ground, aiding anti-erosive action. On the slopes exposed to the spray (windward side), the vegetation is dominated by blue latans and some *Pandanus vandermeeschii*; trees, once present, have completely disappeared from the landscape. Some blue latans get protection from the wind in the gullies excavated by erosion, especially near the field station.

12 (top). A wild population of *Acanthophoenix rubra* on the slope of Montagne Gingembre (L'Etoile Private Estate); photo by N. Ludwig. 13 (bottom). Close up on immature infrutescences of *Acanthophoenix rubra* at L'Etoile; photo by N. Ludwig.

Above the camp, at around 250 m, are the three oldest *Hyophorbe lagenicaulis*, the last to survive the pressure of the herbivores. Trunks are 2.3–3.0 m tall with circumference 1.7–1.9 m and sheaths are 60–80 cm long. The stem bulges in the direction of the slope and thus stabilizes *H. lagenicaulis*. This species seems to do better in the wind than blue latan since it is particularly resistant in the windy zone just below the summit. The presence of lichens on trunks testifies to their age. Abundant seedlings (Fig. 15) and juveniles 10–50 cm tall are present under the remnant population. Geckos (*Phelsuma guentheri* and *Phelsuma ornata*) and the skink *Leiolopisma telfairii* are very abundant and take part in the pollination of the palm trees.

There is but one specimen of *Dictyosperma album* var. *conjugatum* which survives on the island. It is located on the leeward side (19°50.590′ S, 57°47.020′ E) in a savannah. Its stem is approximately 7 m tall and 13 cm diameter. The individual is very old and does not show any flowering or fruiting. An old infructescence found on the ground bears about 120 marks of fruit on rachillae.

14. One of the 3 original specimens of *Hyophorbe lagenicaulis* which resisted predators before their eradication from Round Island; photo by C. Lavergne.

Obviously this palm is directly threatened by erosion or future cyclones; its survival is a matter of a few years at the most.

Îlot Gabriel and Île Plate: a ruined coastal ecosystem

Fifteen kilometers off Cap Malheureux in northern Mauritius, Îlot Gabriel is a 42 ha coral islet connected to Flat Island, or Île Plate, by a channel through the reef. On Flat Island little of the original habitat remains, following a lazaret installation (leprosy hospital) in 1807. Currently the major problem is the presence of *Leucaena leucocephala* which occupies much of the 253 ha surface of the island.

Compared to Flat Island, the conservation status of the ecosystem on Îlot Gabriel is much better. In the southwest of the islet, on less than one hectare of sandy soil grow a few *Latania loddigesii* (Fig. 16) in a thicket overrun with *Psiadia arguta* (baume Île Plate) and *Lantana camara*. This blue latan population consists of five males and three females, all 6 m tall and probably over 50 years old. The stems exhibit close leaf scars. There are abundant seedlings under the female individuals, but surprisingly no juveniles (< 2.5 m tall); two other specimens lie on the ground, probably hit by cyclone winds. Many hermit crabs live in the litter of dry fronds; they seem to consume the fruit pericarp. The observation of a seed obviously eaten by a rodent shows that there are still rats on Îlot Gabriel despite official eradication. The reintroduction of rats must be due to tourist activity on the island, with many boats coming every day on picnic cruises with no guarantee of quarantine! The only other palms present on Îlot Gabriel are date palms (*Phoenix dactylifera*), relics of a palm plantation dating back to the lazaret period.

Île aux Aigrettes: a totally restored coastal ecosystem

This is a 25 ha low coralline island of the Mahébourg lagoon where the Mauritian Wildlife Foundation (MWF) completed a remarkable restoration of the coastal forest ecosystem. All 45 endemic or native species grown locally, in the plant nursery, were intended for further plantation on Île aux Aigrettes and Round Island. The restoration started in 1986, and rats were eradicated by 1991.

Early Dutch visitors reported that Île aux Aigrettes was covered with palm trees. The MWF collected seeds of *Dictyosperma album*

Table 2. Conservation status of the Mauritian palms.

Species name	Site locations	Natural population	IUCN Red List Categories & Criteria proposed*	Population trend	Conservation	Remarks
Acanthophoenix sp.	Florin	4 individuals	CR B1+2ab(iii), D, E	Decreasing	Very urgent	Only 2 adult specimens
Acanthophoenix rubra	L'Étoile, Gouly Père NR, Midlands	> 200 individuals	EN A4c, B1+2abc, C2ai	Increasing	Urgent	Reinforcement of populations in progress
Dictyosperma album var. *album*	Florin	Unknown	DD	Unknown	Not urgent ?	
Dictyosperma album var. *conjugatum*	Round Is.	1 individual	CR B1+2ab, C1+2ab, D, E	Decreasing	Very urgent	
Hyophorbe amaricaulis	Curepipe Bot. Gard.	1 individual	EW	Decreasing	Very urgent	Individual planted or original?
Hyophorbe lagenicaulis	Round Is.	ca. 100 individuals	EN B1+2, D, E	Increasing	Not urgent	Reinforcement of populations achieved on Round Island
Hyophorbe vaughanii	Florin	3 individuals	CR D, E	Increasing	Urgent	And 11 other specimens planted (reinforcement)
Latania loddigesii	Round Is., Flat Is., Gabriel Is., Gunner Coin, Ambre Is.	Several populations	EN B1+2a	Increasing	Not urgent	Main population on Round Island
Tectiphiala ferox	Gouly Père and Land Declerc NR, Florin, Plaine Champagne, Montagne Cocotte	ca. 21 individuals	CR D, E	Decreasing	Very urgent	

**IUCN Red List Categories & Criteria version 3.1,* applied at regional levels: Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN) and Data Deficient (DD). Additional criteria are explained in IUCN (2001, 2003).

15. Seedlings under a female specimen of *Hyophorbe lagenicaulis* on Round Island; photo by C. Lavergne.

var. *conjugatum* from Round Island and sowed them in the MWF nursery. Twelve years later, about 20 individuals of *Dictyosperma album* var. *conjugatum* are planted on Île aux Aigrettes (Fig. 17); they grow slowly and barely exceed one meter in height. Initially MWF considered transplanting some of these specimens to Round Island in order to re-establish a population there. This palm transfer appeared doubtful, due to technical and quarantine requirements. It seems more realistic to wait until the Île aux Aigrettes population bears fruits, in order to launch a large scale program of multiplication, including a nursery unit on Round Island to produce the young palm trees that would achieve the restoration of the Île Ronde ecosystem.

Current assessment and new prospects

The results summarized in Table 2 show that, after four centuries of deforestation and over-exploitation, the introduction of invasive plant species and the extinction of some animals, the conservation status of Mauritian palms in their specific ecosystems is very critical. Of course, the restoration work undertaken on Round Island, the rescue of *Hyophorbe lagenicaulis* and that of *Latania loddigesii* (Fig. 18) are impressive and also very encouraging. Nevertheless, the problem of *Dictyosperma album* var. *conjugatum* survival remains. It is not yet resolved, though the young plants cultivated on Île des Aigrettes offer the possibility, in a decade or so, of the re-introduction of this palm to its homeland.

Among the threatened taxa, there are *Hyophorbe vaughanii*, *Tectiphiala ferox* and atypical *Acanthophoenix*, all confined to the central plateau. With limited fruiting, malformed seeds, almost no regeneration and, for the young subjects which were planted, very slow growth, the few palm trees seem ill-adapted to the actual environmental conditions. On suitable medium *H. vaughanii* seeds germinate easily. Quite recently, Jean-Marie Sauzier, who owns a nursery at Cap Malheureux, initiated the cultivation of the Land Declerc *Acanthophoenix* for further re-introduction in the wild; from about 30 seeds sown on a mixed medium of bagasse, clinker, fly ash and horse manure, he obtained 12 seedlings with V-shaped eophyll and successive leaves pinnate. This is an excellent start.

16. The remnant *Latania loddigesii* population on Îlot Gabriel; photo by C. Lavergne.

17. One of the juvenile *Dictyosperma album* var. *conjugatum* grown on Ile aux Aigrettes from seeds cropped on the last Round Island wild specimen; photo by N. Ludwig.

Tectiphiala ferox seeds are often parasitized by mites, insects or fungi; precautions of culture are necessary (sterilization of germinating boxes, medium and seeds) in order to obtain a better germination rate (see Appendix).

Whatever the causes of this extreme scarcity, it is necessary to constitute for these palm species, including *Dictyosperma album* var. *conjugatum*, a reserve of several thousand young plants, to be subsequently re-introduced in the wild, as well as in private estates or gardens. This necessitates the creation of a modern propagation facility. Such a structure exists in Robinson, close to Curepipe, (Native Plant Propagation Centre), but the palms were not included in that program! The MWF nursery on Île aux Aigrettes is a creditable initiative that works successfully for the restoration of the islet ecosystem. However, the lack of space and sufficient water supply, as well as local climatic conditions and insular isolation, do not permit large scale multiplication of the most threatened palm species. The establishment of another nursery site must be considered, but we think that it is also necessary to favor a low altitude location like Pamplemousses to avoid the need for germination in a heated greenhouse in winter.

An early attempt at cultivating *Latania loddigesii* on Île Plate was doomed from the start. The idea was to up-root by hand the acacia bush (*Leucaena leucocephala*) that chokes the island and then plant young latans in the landscape. For that purpose 10,000 latan seeds were sown in very tight rows on a shaded sandy bed… and then forgotten. In March 2006, the dense crop of seedlings looked like a short grass prairie, making transplantation all but impossible. Obviously the operation was established in total ignorance of the remote tubular germination of latan seeds. The seed produces a rather long white tube which sinks deeply into the soil prior to the emergence of the eophyll; in such conditions, any attempt at transplantation breaks the tube, killing the seedling.

On the same site some seeds were put in plastic bags to germinate but, with no water and no weeding, there was practically no chance of success. These failures illustrate that setting up a propagation unit in the field requires qualified people and minimum equipment. It also shows that eradication of an invasive species from a protected area does not mean automatic restoration of a palm population; it is merely a complementary measure.

For *Hyophorbe amaricaulis*, it is almost too late. If there is still a future for the Curepipe Botanical Garden palm, it is in the hands of the scientists who manage the *in vitro* reproduction techniques. However, at best, this project results in a single small, genetically homogeneous population.

The rescue of threatened Mauritian palms is a long-term undertaking. NPCS and MWF have been working on the project for several decades and, in some respects, the results are quite impressive. However, much still has to be implemented without delay to avoid complete extinction of some species. Private nurseries could participate in the rescue, at least for palms having ornamental qualities.

Acknowledgments

These notes are the result of two surveys led in March/April 2006 and in June 2008. These missions to Mauritius and islets would have not been possible without the assistance of the National Forest Commission and the National Park & Conservation Services in Mauritius, the Mauritian Wildlife Foundation and the Mauritius Herbarium (MSIRI). We want to express thanks to the editors who accepted our manuscript and gave useful advice. Special thanks to Claudia Baider of the Mauritius Herbarium. We are grateful to Mario Allet of the National Forest Commission and Marc d'Unienville for the assistance they provided in the field. We also thank all the persons who helped and the contribution of Clément Duret, Luc Gigord, Lauricourt Grosset and Lucas Reichsteiner who participated to the first mission. Thanks are also due to Steve Swinscoe who proof-read the English manuscript.

Literature Cited

Bullock, D.J., S.G. North, M.E. Dulloo and M. Thorsen. 2002. The impact of rabbit and goat eradication on the ecology of Round Island, Mauritius. pp. 53–63, In C.R. Veitch and M.N. Clout (Eds.), Turning the tide: the eradication of invasive species. Proceedings of the International Conference on Eradication of Island Invasives. IUCN, Switzerland.

Douglas, G.C. 1987. Embryo culture of a rare plant, *Hyophorbe amaricaulis* Martius (Palmae). J. Plant Phys. 130: 73–77.

Appendix: Germination of *Tectiphiala* seeds

The germination of *Tectiphiala* seeds is reported to be very tricky by the very few who have attempted it. Three different techniques are compared here.

The first method consisted in sowing seeds on a rough, non-sterilized medium of 60% small grade volcanic scoria and 40% crumbled cow manure. The result: 10% of seedlings (about 30) germinated within 3 months and were repotted upon emergence of the second eophyll to 4/5 garden soil and 1/5 crumbled cow manure. All but one dried and died within a week after they were repotted. Three years later, of 300 seeds sown, only a single young palm, 40 cm tall, remains.

Another non-sterilized medium, which is commonly used for sowing *Acanthophoenix* seeds, consists of 1/3 perlite and 2/3 peat (TKS1™ – a peat-based medium, with added nutrients and lime). This medium has been tested on *Tectiphiala*. Of seven seeds, three germinated and produced seedlings. Eighteen months later only two *Tectiphiala* remain, 30 cm tall and growing fast.

A much more elaborate technique can be used successfully for *Tectiphiala* as well as for other palm species whose seed germination might be difficult. Fruit pericarp is removed before seeds are treated with miticide and fungicide solutions for 15 minutes. The germination container is disinfected with sodium hypochlorite (bleach). The medium is moistened fine vermiculite sterilized 15 minutes in microwave oven and sprayed with fungicide and miticide. The seeds are put on the medium surface and the container hermetically closed with tape. The container is placed in a heated room whose day temperature reaches 30–35°C while night temperature is maintained at 20–25°C. The first seedlings will develop within few days or few weeks.

18. *Latania loddigesii* is a dioecious palm; however, this specimen shows male inflorescences ending with immature fruits (*pommes latanier*). Photo by C. Lavergne.

IUCN. 2001. Red List Categories and Criteria: Version 3.1. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.

IUCN. 2003 Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. Ii + 26 pp.

Lavergne, C. 2007. Les Palmiers Menacés de Maurice et de ses Îlots – Rapport de mission 22 mars au 2 avril 2006. Unpublished report, 36 pp.

Lewis, C.E. 2002. A phylogenetic analysis of the palm subtribe Oncospermatinae (Arecaceae) based on morphological characters. Brittonia 54: 78–91.

Moore, H.E., Jr. and J. Guého. 1984. Famille 189. Palmiers. In: T.L. Bosser, J. Cadet, J. Guého and W. Marais (eds.), Flore des Mascareignes. The Sugar Industry Research Institute, Mauritius, ORSTOM, Paris, and the Royal Botanic Gardens, Kew.

Sarasan, V., M.M. Ramsay, and A.V. Roberst. 2002. In vitro germination and induction of direct somatic embryogenesis in 'Bottle Palm' [*Hyophorbe lagenicaulis* (L. Bailey) H.E. Moore], a critically endangered Mauritian palm. Plant Cell Reports 20: 1107–1111.

Wyse Jackson, P.S, Q.C.B. Cronk and J.A.N. Parnell. 1990. Notes on a critically endangered palm from Mauritius, *Hyophorbe amaricaulis* Mart. Botanic Gardens Conservation News 1: 24–26.