Tahina – A New Palm Genus from Madagascar

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1. Soejatmi Dransfield provides scale for the flowering individual of *Tahina spectabilis*.

Tahina, the most massive fan palm in Madagascar, has recently been described and named as a new genus with the single species, _T. spectabilis_ (Fig. 1). The story of its discovery follows.

The first intimation that there was a new and quite extraordinary palm in northwest Madagascar reached members of the International Palm Society in December 2006, when pictures of a strange fan palm were posted on the IPS Bulletin Board, PalmTalk.

The discovery

The discovery of a new palm genus in north-western Madagascar has come as a complete surprise. The area where this palm was found is a very remote part of north-western Madagascar, northeast of the port of Mahajanga. The area is very difficult to access by land. It would take at least three days from Mahajanga by four-wheel drive during the dry season. During the wet season would probably be next to impossible. The human population in the area is very sparse for Madagascar, with a thin scattering of villages.

In the area are three fly-in beach resorts and a prawn hatchery. The prawn hatchery and rearing ponds produce Madagascar Tiger Prawns that are shipped out on a regular basis to supply the supermarkets of Europe. The tiger prawn company, UNIMA, has recently established a cashew nut plantation in the area as a method of re-forestation with the potential to play a significant role in carbon-trading, as well as providing a high quality cash crop. The manager of the plantation is Xavier Metz, a Frenchman born in Madagascar, who lives on the plantation in a house perched on the cliff overlooking the Mozambique Channel, together with his wife, Nathalie, and daughters, Marie-Nirina, Anne-Tahina and Léa-Mirana. In this remote part of Madagascar, opportunities for weekend family outings consist of boat trips and picnics on land. In 2005 on one such family outing, the Metz family came across a low limestone hill to the northeast of the plantation where they saw interesting vegetation and old cliff graves. At the foot of the limestone hill they saw several huge palm trees. In the absence of flowers or fruit they assumed this to be a palm called locally *dimaka* (*Borassus madagascariensis*, a palm restricted to the west of the island where it is never very common) .

In September 2006 they revisited the hill and were astonished to see one of the palms in spectacular flower, with the flowers being borne in a huge pyramidal bunch above the leaves of the palm. The Metz family had never seen anything like it, so they photographed it. Later that year, Xavier Metz met an old friend of his, Bruno Leroy, in the Madagascar capital, Antananarivo. Bruno is a palm enthusiast. Xavier shared his photographs with Bruno and neither of them could say what it was. Bruno posted the pictures on the interactive bulletin board, PalmTalk, of the International Palm Society (www.palms.org) on 6 December 2006.

Within 24 hours there was already a rapidly developing discussion on what the spectacular palm might be. Several people suggested it was *Borassus*, or even *Bismarckia* (both native fan palms in Madagascar) while others pointed out that the flowers were completely wrong and resembled the Asian genus *Corypha*, the Talipot palm. On 7 December, Matt Patricelli of San Diego, a frequent contributor to the message board, alerted John Dransfield, to the mystery palm. John looked at the images, amazed. The palm looked incredibly like Asiatic *Corypha* from a distance. Could the palm have been introduced? However, the palm was unlikely to be planted as it occurs so far from anywhere and it was growing apparently on inhospitable karst limestone. Unfortunately details on the pictures were at too low a resolution to allow proper diagnosis. John posted his comments and also contacted Bruno directly. In January 2007, Bruno emailed a Google Earth reference point for the locality and amazingly palm crowns are actually visible in Google Earth, so enormous is the palm. It is also fortunate that there is relatively good resolution in Google Earth for this bit of Madagascar.

John made arrangements with Bruno for his PhD student Mijoro Rakotoarinivo, to go in January 2007 to see the palm and to make scientific collections. Mijoro was successful and took further photographs, emailed to Kew, in which the palm looked significantly different from Asiatic *Corypha*.

The mystery palm has a massive trunk to 18 m tall with huge fan leaves up to 5 m in diameter, making it the biggest fan palm in Madagascar. John made a preliminary conclusion that the palm was almost certainly not only a new species but probably also belonged to a new genus. He then had to wait impatiently until the material of the palm reached Kew. At the same time, John and his co-authors, were putting the final touches to the manuscript of the second edition of *Genera Palmarum*, with the plan to hand in the manuscript to the publisher at the end of March 2007.

Meanwhile, Mijoro arrived in Kew to continue his work for his PhD, and then at the end of March, the material of the mystery palm finally reached Kew. John and Mijoro opened the parcels of material, once they had passed through the Herbarium quarantine process of freezing, and it was immediately obvious that the palm was not *Corypha* nor was it even related to *Corypha*, but instead had features clearly showing it to be a new genus, and suggesting a relationship with the tribe Chuniophoeniceae that includes three other genera – *Chuniophoenix* in China and Vietnam, *Kerriodoxa* in southern Thailand and *Nannorrhops* in Arabia, Afghanistan and Pakistan.

Faced with this, John had to down tools and immediately draw up a description of the new genus, even though this would have to be based on incomplete material (mummified flowers and ripe fruit) and then incorporate the description in the manuscript of Genera Palmarum. This involved a great deal of renumbering and changing of cross references. Kew artist Lucy Smith prepared analytical drawings to go with the description. Finally the manuscript of *Genera Palmarum* was ready for the publisher, about one month late.

At the same time leaf material was sent off to colleagues Jack Fisher and Jay Horn in Fairchild Tropical Botanic Garden in Miami for anatomical study and further leaf samples were handed over to the Jodrell Laboratory in Kew for analysis of DNA by Ross Bayton. Ross's molecular analysis confirmed the position of the genus in tribe Chuniophoeniceae of subfamily Coryphoideae. This palm group has a highly paradoxical distribution pattern, very difficult to understand, but morphology and DNA are unequivocal – the new genus has to belong to this group.

How could such a spectacular and enormous palm have been missed in previous surveys, despite the great deal of attention given to the palms of Madagascar? The answer must be that the palm grows in an extremely remote part of Madagascar, an area which is otherwise very species poor in palms, and if the palm had been seen and not in flower it would probably have been overlooked as *Borassus* or *Bismarckia*.

In June 2007, another individual of the palm showed signs of coming into flower – a giant asparagus-like shoot appeared above the leaves. Xavier Metz followed the development of the palm over the next few months, once the flower-bearing branches had emerged, collecting small samples into alcohol and photographing progress. As the huge compound inflorescence began to develop, it looked increasingly likely to be in flower in September, just when John Dransfield planned to visit Madagascar, to supervise Mijoro's research. John and Mijoro thus planned to spend a few days at end of the trip to see the new palm.

2. Anne-Tahina Metz, for whom the palm is named, standing at the foot of a tall individual of *Tahina spectabilis*.

In the meantime a full description of the palm was submitted to the Botanical Journal of the Linnean Society, naming the palm *Tahina spectabilis*. *Tahina* in Malagasy means blessed or to be protected, and is part of the given name of the Metz's second daughter, Anne-Tahina Metz (Fig. 2). The name has local meaning rather than being an unpronounceable Greek or Latin-based name of no obvious meaning to local people. The paper was finally published on 17 January 2008 (Dransfield et al. 2008).

In mid September, John and his wife, Soejatmi, and Mijoro visited the cashew plantation and

3 (top). View over the dry rice field to the *tsingy* and the flowering individual of *Tahina spectabilis*. The close proximity of the inflorescence to the limestone hill made sampling of the flowers unusually easy for such a big palm. 4 (bottom) The crown of *Tahina spectabilis* showing the deep triangular cleft at the base of the petiole.

5. The leaf of *Tahina spectabilis* viewed from beneath showing the major and minor folds.

stayed with the Metz family. The flowering individual of the palm was about six days away from flower opening so they just missed the event. Nevertheless they were able to collect more material and made copious notes on the population (Figs. 3 & 4). They had extensive discussions with the Metz family and met people from the nearby village. The major topic of discussion was how to conserve the palm population for the future and how to harvest and distribute seed fairly worldwide without damaging the wild population but at the same time providing potential income to the village to act as an incentive to the conservation of the palm.

Six days after they left the palm came into full flower, producing vast quantities of nectar that dripped off the flowering branches. Bees and wasps circled the inflorescence in huge numbers, and the Greater Vasa Parrot did some

damage, ripping off flowering branches to get at the nectar. Xavier and Nathalie continued to make observations and collect further samples of the flowers. Their close observations have added greatly to our understanding of the morphology of the palm. We now know that each bract on the flowering branches of the inflorescence (rachillae) has the potential to produce three flowers, although towards the tips of the rachillae only two or even one flower is produced. Flower opening seems to come in three waves, each one with massive production of nectar. It also seems that fertilisation is sporadic and the resulting fruit may originate from any of the three waves of flowering. Fruit seems to take about three to three and a half months to reach maturity.

When the palm was in flower in September the flat land surrounding the limestone hill was bone dry and the soil surface cracked. By the end of December most of this land was under water, including the base of the palms at the foot of the limestone hill. Much of this seasonally flooded flat land was cleared long ago for rice cultivation and any semi-natural vegetation survives only at the foot of the limestone hill.

The Palm

Tahina spectabilis is a solitary massive hapaxanthic hermaphroditic fan palm. The stem reaches about18 m tall and is about 50 cm in diameter at breast height, with internodes 8–10 cm long, the nodal scars conspicuous. There are about 12–18 huge leaves in the crown; they are induplicate, costapalmate, and marcescent in immature individuals, tending to fall under their own weight in trunked individuals. The leaf sheath is about 80–100 × 52–58 cm and has a conspicuous triangular cleft below the petiole, with the margins tending to erode into broad tattered lobes. The petiole is massive, about 5 m long in juvenile palms, but shorter in adults and is covered with white wax; it is 10–12 cm wide near the base and is deeply grooved on the upper surface and rounded beneath, and has smooth margins, completely lacking in spines. At the tip of the petiole is a well developed triangular hastula on the upper surface and a low ridge-like hastula on the undersurface. The costapalmate leaf blade is approximately 3.5–5 m in diameter in well grown adult palms, but in exposed individuals and juveniles it is much less; the blade is divided to ca. 1/2 its radius into multi-fold segments, these in turn more shallowly divided into a total of 110–122 single-fold segments, themselves shallowly divided along the abaxial folds, the blade between each fold being up to 10 cm wide; the main abaxial (lower) ribs of the blade are very conspicuous, very crowded at the base of the blade, with some much more robust than others, the less robust ribs tending to be inserted in a more adaxial (upper) position compared with the robust ribs – this curious arrangement of folds seems to be unique to this genus and would be a very useful character for distinguishing the palm when sterile (Fig. 5). There are abundant transverse veinlets between the main ribs. The whole leaf texture is surprisingly thin when compared with that of *Bismarckia* or *Borassus*. The inflorescence is held above the leaves and

6. Close up of a rachilla of *Tahina spectabilis* with flower buds.

is a huge compound structure to 6 m tall, composed of numerous (to ca. 45) lateral inflorescences, each branched to 3 orders, all branches ending in rachillae. The tubular inflorescence bracts are conspicuous throughout, and are generally covered in thick white indumentums. The rigid rachillae are 10–15 cm long and ca. 0.5 cm in diameter and are covered with conspicuous chestnut brown bracts that subtend the flower clusters (Fig. 6). the flower clusters consist of up to three flowers with their attendant bracteoles. The flowers are hermaphroditic, approximately 8 × 2.5 mm in bud and are exerted from the rachilla bracts. Flower opening (anthesis) seems to proceed in up to three waves, as the flowers of the flower cluster reach maturity sequentially. The thin membranous calyx is tubular with three rounded lobes and splits irregularly. The corolla has a basal solid stalk and three green lobes that become strongly reflexed when the flower opens, with the base of the lobes appearing to be nectar producing. The stamens are 6 in number and have free rod-like filaments and bright yellow anthers attached at their middles and versatile on the filaments. The gynoecium consists of three completely fused carpels, each with an anatropous basally attached ovule, and a common style ending in three minutely divide stigmas that appear not to reflex at anthesis. The fruit is green at maturity and is broadly ellipsoid to obovoid, 25–30 × 20–22 mm, borne on the stalk-like corolla base, 5–7 × 2 mm. Each fruit contains a single seed and has apical stigmatic remains; the epicarp is smooth and glabrous, the mesocarp is moderately thick, spongy, with few longitudinal fibers and the endocarp thin, 13–17 × 17–22 mm, crustaceous, with a pronounced longitudinal groove and a short apical beak, and irregularly anastomosing grooves. The seed is globose, 1.8–2.2 × 1.4–1.8 cm, laterally attached with an elongate hilum, and with deep grooves corresponding to the rapheal bundles; the endosperm is strongly ruminate, without a central hollow and the embryo is sub-basal. Germination is remote-ligular with a palmate eophyll.

The population

During a complete census of the palm in September 2007, Xavier Metz counted 92 individuals, of very mixed ages, from small rosette palms to huge non-flowering adults. As well as these established plants, there are several hundred one or two-leaved seedlings resulting from the 2006 flowering event. As far as can be seen, these seedlings are restricted to the base of dead trunk and to areas perhaps a few meters away. All the palms are restricted to the northern end of the narrow north-south

7. Three massive individuals of *Tahina spectabilis* at the foot of the limestone hill.

8. Using ecological parameters the possible potential distribution of *Tahina spectabilis* can be calculated using the GIS program MAXENT. The red marked areas are areas where the palm should be sought.

orientated limestone hill (Fig. 7), except for a single individual – a well established juvenile palm with a very short trunk, which occurs about 0.5 km away from the limestone hill at the edge of the nearby village and at the edge of the seasonally flooded flat lands.

The Habitat

When news first came through about the palm, we assumed that it grew on limestone. This is, however, not the case. All individuals grow in deep soil at the very foot of the limestone. This habitat is dry during the dry season but may be flooded up to 50 cm deep with freshwater during the rainy season. The palms thus grow with their feet in water during this wet period. That they should be confined to the very foot of the limestone hill is perhaps a reflection of the fact that this part of the seasonal swamp is not under rice cultivation and is also hardly affected by seasonal fires – the limestone protects the palm in the narrow areas between the outcrops. As mentioned above, there is one individual growing about a half kilometer away from the limestone hill at the edge of a nearby village, at the edge of the seasonally flooded area, adding evidence that the palm is perhaps only secondarily associated with limestone.

We speculate that the palm was perhaps a dominant plant of seasonally flooded wetlands in this area and now survives only where it has some protection from fire. One can imagine how spectacular a swamp filled with gigantic palm may have been before the arrival of man.

Are there likely to be any other populations of the palm? Given that this population has only just been discovered, it seems not impossible that there may be other populations. Mijoro carried out a prediction based on the ecological parameters of the site as we know them and concluded that there is a limited predicted distribution as shown in Fig. 8. Unfortunately, most of the predicted areas have rather poor resolution in Google Earth so the prospect of scanning through image after image to look for the distinctive gray-green crowns and finding anything seems unlikely. Furthermore blue green Bismarckias are abundant throughout the predicted range and could easily be confused with *Tahina* in satellite imagery. We suggest that the palm is almost certainly a great rarity.

What we know of its natural history

None of the villagers has any recollection of the palm ever flowering before 2006 when the first individual flowered. It is very difficult to imagine that the villagers who live so near to the limestone would miss such a spectacular event as the palm producing the giant compound inflorescence. Furthermore there are no signs of dead trees with decaying inflorescences apart from the tree that flowered in 2006. This all seems to suggest that flowering has been a very rare event. Thus we have absolutely no idea how long it takes for a seedling to grow to adulthood and flowering and we cannot estimate how old the magnificent trees that tower over the nearby juveniles are.

As mentioned above it seems to take about three months from the first appearance of the inflorescence to full expansion of the rachillae and flower opening and a further three to three and a half months for fruit to reach maturity. With up to three flowers per rachilla bract produced sequentially there are three waves of flower opening. Throughout flower opening there is production of copious nectar, apparently from the petal bases. This attracts large numbers of bees, wasps and flies, and also parrots.

The Future

The key to the survival of *Tahina spectabilis* in its natural habitat lies with the villagers who

live nearby. Under current Malagasy Government legislation the people of the two villages nearby have control over the exploitation of the natural resources under COBA. This legislation empowers the villagers to make decisions affecting the survival of local biodiversity. To us, the best way of ensuring that the villagers protect the palm is if they understand that there is benefit to be had from maintaining the palm population in good health. Unfortunately, the locality is so far off the beaten track that it is very unlikely that a significant number of tourists will visit to view the palm, so the potential for income from tourism seems negligible. On the other hand, palm enthusiasts world wide are highly likely to want to grow the palm. Even if it may take decades to reach flowering size, and even if most amateur growers are unlikely to have the space to grow the palm in the ground, there is no doubting the appeal of the palm, especially as seedlings and young juveniles. In order to satisfy this potential demand, we have proposed a controlled harvest of seed from the individual that flowered in 2007. A substantial number of seeds will be allowed to fend for themselves without human intervention. A further proportion will be sown on site, and further seeds grown in a nursery at the cashew plantation, with progeny being plated on site where suitable. A proportion of seed will be distributed to botanic gardens and arboreta within Madagascar and, finally, seed will be harvested specifically for distribution overseas, gratis to suitable botanic gardens, and the rest sold with a significant proportion of the profit being returned to the village committee to be used for village development (such as improvements to the water supply). It is hoped in this way the village will appreciated the benefit of the palm and that this will provide an incentive to protect it.

Already to this end the villagers have set up a parrot patrol to scare away the birds from the palm and prevent damage to the flowers and developing fruit. The palms have now been fenced by the villagers to prevent zebu cattle from damaging the young plants of the palm. A village committee has been set up to take control of the conservation of the palm and conspicuous signs placed outside the fenced area prohibiting access.

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