Tahina spectabilis: an Exciting New Discovery in Madagascar Ten Years On

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A decade after the extraordinary hapaxanthic Coryphoid palm was discovered on a remote peninsula in northwest Madagascar, a team from Kew revisited the site to see how successful conservation activities have been and were able to confirm a stunning discovery back on the mainland.

"Picnicking family stumbles on a suicidal monster palm tree," read the headline in The Times Online newspaper in January 2008. Thus, the attention of the world was focused on the remote location in Madagascar where *Tahina spectabilis* was discovered just a decade ago by Xavier Metz, the manager of the VERAMA cashew plantation on the Ampasindava Kely peninsula, whilst out walking with his family. Members of the palm community had a sneak preview in late 2006, when the first images of the unidentified spectacular fan palm up to 18 m tall, with leaves 5 m across and an enormous terminal inflorescence, were posted by Bruno Leroy on Palmtalk (the online forum of the International Palm Society). Kew's John Dransfield was intrigued by the photographs, which seemed to show either a member of the genus *Corypha* far, far away from any of its Asiatic relatives, or a taxon completely new to science. In January 2007, John's PhD student, Mijoro (Joro) Rakotoarinivo, managed to reach the site and, with Xavier Metz, collect herbarium material, a DNA sample for analysis, and more images. He sent them back to Kew, where he and John were able to confirm that the discovery represented an entirely new monotypic genus, *Tahina*, which was formally published in January 2008 with much

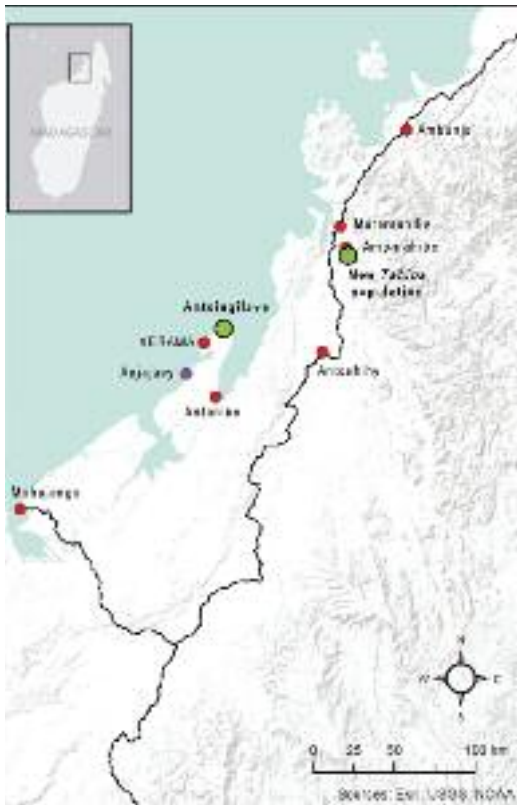
accompanying international media interest (Dransfield et al. 2008a, 2008b). John and Joro visited the site in September 2007, just missing anthesis of an individual, made further important herbarium collections and discussed with the Metz family conservation actions that would be appropriate.

With its combination of a basally cleft petiole and unarmed petiole margins, costa-palmate leaf with leaf splits reaching to different depths, a hierarchy of primary and secondary folds held at different levels relative to the costa, overlapping tubular rachillae bracts, solitary trunk, and enormous hapaxanthic terminal inflorescence, *Tahina spectabilis* was like no other palm. During the last ten years, no other populations of the species (or anything similar) have been found anywhere else.

Tahina spectabilis seed distribution around the world

The site where the *Tahina* was originally found is a fragment of vegetation in and around a limestone karst (*tsingy*) formation called Antsingilava, surrounded by grassland and rice paddy fields, with a nearby village called Antanamarina (Fig. 1). In September 2008, Alison Shapcott from the University of the Sunshine Coast, Australia visited the site hosted by Xavier Metz and undertook a full demographic survey of the species, collecting DNA samples in order to study the population genetics and diversity of the plants. The 2008 census showed that the known *Tahina* population was extremely small – just 29 trunked individuals were recorded, including two individuals slightly away from the main *tsingy* site. Microsatellite work undertaken by Alison and one of her students, Heather James, subsequently showed that the genetic diversity of the individuals at the site is extremely low (James 2010). There were signs that other populations of *Tahina* may exist: some rare genetic alleles were found in the population, and one of the outlier plants contained alleles not present in the main population. With such a small population size and tangible threats to its continued survival, Joro was able to assess the species using the IUCN Red List categories and criteria as Critically Endangered (Rakotoarinivo et al. 2012, 2014).

Controlled harvesting of a proportion of the many tens of thousands of seeds produced during flowering events in 2007 and 2008 was undertaken by local people under the guidance



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of Xavier and advice from John. Through a collaboration between the Kew's Millennium Seedbank, the Madagascan national seedbank (Silo National des Graines Forestières), the VERAMA Corporation and Tobias Spanner of RarePalmSeeds.com, *Tahina* seeds were distributed widely around the world to botanic gardens and private collectors. Today the species is certainly protected in *ex situ* conservation – although it should be noted that these plants all came from a very small genetic base. Funds from the seed sales went back to the community at Antanamarina to pay for a range of community-based conservation activities to protect *Tahina* in the future (including the creation and maintenance of a large firebreak around the site) and some much needed community development activities (including the renovation of the village school).

Journey to Antsingilava, ten years later

In September 2016, with the support of the Mohamed bin Zayed Species Conservation Fund, an international team set off overland from Kew's Madagascar base in the capital,

2. Adult *Tahina spectabilis* in the wild at Antsingilava, Madagascar (Photo by David Rabehevitra, KMCC).

Antananarivo, to attempt to reach Antsingilava a decade after the original discovery of the species. The team comprised Alison Shapcott (returning for the first time since her 2008 trip), Lauren Gardiner from the Conservation Science department of RBG Kew, UK, Rokiman Letsara from Parc Botanique et Zoologique de Tsimbazaza (PBZT) and the California Academy of Sciences Madagascar, and David Rabehevitra and Roger Rajaonarison from Kew Madagascar (KMCC). With one of Kew Madagascar's newly acquired Landrover Defenders, the expert driving of Roger, and a period of dry weather preventing the zebu tracks and rivers becoming impassable, the team reached VERAMA's base camp on the peninsula of Ampasindava Kely after two solid days of traveling, one day of which was entirely off-road. En route, the group traveled across rocky tidal zones, beaches and mangroves, dry (and some not so

3. Crowns of *Tahina spectabilis* in the setting sun at Antsingilava, Madagascar (Photo by Lauren Gardiner, RBG Kew).

dry) riverbeds, and swathes of recently burned land, with the ground sometimes still radiating heat from the fires that had swept through and the blackened vegetation still smoldering.

Resurveying Antsingilava

The first glimpse of *Tahina* in the wild was an unforgettable experience (Fig. 2). The route from the VERAMA plantation base to Antsingilava leads through the village of Antanamarina and along a six-meter wide strip of bare earth cutting through the grassland. A group of half a dozen young women with scythes and hoes were clearing the plants from this strip, which turned out to be the firebreak the local community had created around the *Tahina* site and were maintaining each year to protect the plants in the *tsingy*. Pulling up and pitching camp approximately 100 m from the dark green island of vegetation and light gray rock, as the sun was setting across the grassland sea, we marveled at the enormous light green leaves of individual *Tahina* crowns that shone out from the other vegetation as the last of the sun's rays turned the limestone rock orange-red (Fig. 3).

Over the next few days, the team was relieved to find the Antsingilava *Tahina* population in good condition, with lots of seedlings and young plants (Figs. 4–6), and plenty of evidence that the local people have been protecting the species in its natural habitat *in situ*. From local records, we learned that five adult plants at Antsingilava at least initiated flowering and died since the 2008 survey, and the remains of fallen, decomposing trunks and hollows showed where several of these adults previously stood. Five of the juvenile plants recorded in the 2008 census have grown large enough that they now have trunks and fit into the adult category, effectively replacing the five dead adults. There seems to be a gradual progression of individuals from juvenile to adult, complemented by the presence of many seedlings and young plants in and around the *tsingy* outcrop. These palms originated as seedling cohorts resulting from the various flowering and fruiting events that have taken place over the last decade.

Based on information previously provided by Xavier in 2010, we located another but much smaller *Tahina* site approximately 1.5 kilometers away from Antsingilava, at a place called Ambatosaromby (literally "place of the rocks that look like zebu"). Here, 170 seedlings were counted, and local people spoke of at least one adult tree that had flowered and died some years ago. The main Antsingilava population, the Ambatosaromby seedling population, and the two outlying individuals nearer to Antanamarina were demographically surveyed. DNA samples were taken for population genetic study and will be analyzed in conjunction with the 2008 data. As of the

4. Rokiman Letsara with seedlings of *Tahina spectabilis* at Antsingilava, Madagascar (Photo by David Rabehevitra, KMCC).

2016 census, the total known population of *Tahina spectabilis* on the peninsula is 740 individual plants.

Conservation activities and challenges in Antanamarina

An important part of the expedition was to find out what conservation actions had been implemented by Xavier and the local people to protect *Tahina*, whether or not these actions seemed to be working, and if there were any areas where they might need additional support to conserve the species. With VERAMA's support, the community at Antanamarina has formed a Community Based Organisation (COBA) with a subcommittee

5. David Rabehevitra with young juvenile plants of *Tahina spectabilis* at Antsingilava, Madagascar (Photo by Lauren Gardiner, RBG Kew).

called the Comité de Gestion de *Tahina* (CGT) that organizes the activities to protect the species. VERAMA manages the funds from the seed sales, allocates them to the COBA on an annual basis (a relationship that seems to have worked well) and has created an ongoing program of protection over the last decade. The COBA annually maintains the firebreak around the main population at Antsingilava to stop grassland fires threatening the plants. They also rebuild fences across the entrances to the *tsingy* canyons to prevent zebu trampling the seedlings and damaging the larger plants (Fig. 7). Attempts were previously

6. Alison Shapcott measuring young adult *Tahina spectabilis* plants at Antsingilava, Madagascar (Photo by Lauren Gardiner, RBG Kew).

made to transplant some of the seedlings from the *tsingy* to other sites – gardens and semi-natural habitats nearer the cashew plantation – but the transplanted individuals all died quickly after being moved. Plants grown from seed and planted near the plantation buildings and other villages nearby had a better survival rate. A proportion of the funds generated from the seed sales was allocated to two larger infrastructure projects: the construction of a new well for the village of Antanamarina and the refurbishment and expansion of the village

7. Fences built by local people to keep grazing zebu out of the *tsingy*, to stop them trampling *Tahina* seedlings at Antsingilava, Madagascar (Photo by Lauren Gardiner, RBG Kew).

school, with a new classroom created and new toilets provided for children. The COBA has also organized a system of agricultural development microloans for local people to purchase equipment such as plows, whereby the funds are paid back after first harvest.

Based on the findings of the expedition team, the COBA agreed to put more (and reinforced) fences around some of the seedlings near the edge of the *tsingy*, where there were signs of trampling damage, and to put a firebreak and fence around the seedling population at

Ambatosaromby. Representatives from the COBA and VERAMA were trained in carrying out a simplified demographic survey of *Tahina*, in the hope that annual records can be kept of the population. An interesting point to note is that at Antsingilava, the presence of ancestors' tombs inside the *tsingy* makes it *fady* (taboo) for people to collect or damage plants – the expedition team was accompanied at all times and received permission for all of their activities at the site. This *fady* ultimately offers the plants of the *tsingy* an important level of protection, as local people are generally uncomfortable even entering the *tsingy*.

Although the outlook for *Tahina* appears to be good at Antsingilava, the species is still Critically Endangered. With a hapaxanthic palm it is difficult to classify individuals as a "mature adult." By definition, those plants that are reproducing will shortly die, and we do not known how old a *Tahina* individual needs to be before it is able to reproduce. The team used the presence of a trunk as a proxy for classifying an individual as a "mature adult," yet even with such a liberal definition, the mature adult population is still very small, certainly fewer than the standard maximum of fifty mature individuals used by the IUCN Red List to define a Critically Endangered species. Even with the firebreak (Fig. 8), a major fire could breach the firebreak and severely damage the population. The local people reported the illicit collection of seeds and possibly seedlings and young plants from the *tsingy* by foreigners, actions which – as well as being illegal – could easily reduce the survival of such as small population.

Even more worryingly, most of the last five known flowering events do not seem to have produced viable seeds, and there are reports and photographs of inflorescences rotting and collapsing before seeds were set. The triggers for *Tahina* to initiate flowering are unknown but thought likely to be linked to environmental patterns. Flowering events are known to be infrequent, and there was no sign of any inflorescences developing in September 2016. A single successful flowering event can produce tens of thousands of seeds, but with such as small population and the death of each individual imminent once it has initiated flowering, whether or not the event is successful, we are highly concerned that plants are dying without reproducing. Insect larvae have been found in the collapsed inflorescences when cut open, and we observed evidence of holes bored by insects in the collapsed trunks and remains of inflorescences – although we cannot say conclusively that these happened post-mortem/collapse, or that they caused the abortion of seed production.

8. Young woman from the local village, Antanamarina, maintaining part of the firebreak around Antsingilava, Madagascar (Photo by Lauren Gardiner, RBG Kew).

A brief but beautiful respite at Anjajavy

After leaving Antsingilava and Antanamarina, the expedition took a detour to travel to the other side of the peninsula, to the luxury fly-in resort of Anjajavy, at the invitation of the proprietor, Cedric de Foucault, a passionate nature-lover and entrepreneur. Cedric has not only created with his team a stunning holiday paradise at this remote and biologically rich site, but he has protected seven hectares of pristine habitat including mangroves, dry deciduous forest, *tsingy*, and pristine white sand beaches, via a private projected area managed by Anjajavy. Cedric is now working with local people and the government to expand this area to encompass a much larger protected area managed for the benefit of both the plants and animals but also the local people, providing employment opportunities and resources for their needs. Cedric has taken

9. Local villagers at the new *Tahina* site, near Amparahibe, Madagascar Photo by David Rabehevitra, KMCC).

a keen interest in the discovery and conservation of *Tahina,* has led trips for his guests to visit Antsingilava and has experimented with purchasing and growing some plants from seed. There are suitable sites within the bounds of the Anjajavy site. We

hope that he can create a semi-natural *Tahina* population, a kind of "field gene bank," with seeds collected from future flowerings at the main site, again securing the species' survival within what may well have been the species original ecological distribution in the past.

A spectacular new discovery inland

The expedition had met, and exceeded, all of its objectives, so the final part of the trip was to investigate reports of a *Tahina*-like palm some 80 km northeast from the site on Ampasindava Kely and much further inland. Previous reports of an unusual fan palm that might be Tahina have always transpired to be *Borassus* or *Bismarckia*, but images taken on a mobile phone by co-author Theophile Rajaonilaza in November 2014 and sent to KMCC had been positively identified as *Tahina* by John, Joro, and Xavier, so the team went to try to find this new population. Ten kilometers off-road from the Route National 6, connecting Antananarivo with the northern town of Ambanja, in a fragment of humid forest in a valley, two hours' hike from the village of Amparahibe, the team found an entirely new population of *Tahina spectabilis* (Figs. 9 & 10). With one medium-sized (ca. 12 m high) adult and twenty-four smaller individuals from seedlings to one young adult with a short trunk, the population is far smaller than that as Antsingilava, but its presence at such a distance from the original site is highly significant. This region is subject to extreme pressures from humans, and the environment is highly degraded. Yet, as the expedition team found, there are still fragments of rich and important vegetation, often tucked into valleys and near water, so the vegetation has not been devastated by slash-and-burn agriculture and human-caused grassland fires (Fig. 11).

As on the Ampasindava Kely peninsula, there are two isolated individuals several kilometers away from the main population. Both are on exposed hillsides, vulnerable to burning. One site had recently been cleared and burned, and the stunted *Tahina* had leaves removed with a machete and signs of digging at its base. Local people reported that the heart (apical meristem) of the species is good to eat and that the broad, strong leaves are sometimes cut and used as mats for ceremonial purposes. At the main population, in humid forest near a watercourse in the valley, the plants are not nearly as exposed, but there were signs of people having cut leaves. Furthermore, a young adult that had been present a year before (and that was in the original

10. Rokiman Letsara with juvenile plants of *Tahina spectabilis*, near Amparahibe, Madagascar (Photo by David Rabehevitra, KMCC).

11. Remnants of vegetation and soils exposed to erosion after slash-and-burn activity near Amparahibe, Madagascar (Photo by David Rabehevitra, KMCC).

photographs sent from a mobile telephone) had been cut down at some point, probably for its edible heart. It was noted that at the Amparahibe site there are tombs of ancestors, as at Antsingilava, which affords the forest – and by extension species like *Tahina* – a special protection from deliberate destruction. The population was surveyed and DNA samples made, and a leaf from one of the larger juveniles was collected to make a permanent herbarium record for the site (Fig. 12).

The local people spoke of foreigners who had been in the area asking them to collect young plants, including palms, and they suggested that we might like them to uproot and sell us plants there and then. As with so many places around the world, it was a stark reminder the vendors and nurseries one sees operating by the side of the road are generally selling unsustainably – and illegally – collected plants straight from the wild.

Initial discussions with the local community at Amparahibe about the importance of *Tahina spectabilis* and the need to protect the species went well. Discussions took place about the experiences of the people at Antanamarina and the activities and opportunities that are dependent on the species being protected *in situ* by the local people. We discussed the specific threats to the species from illicit collection of plants (and seeds, when the first one flowers), cutting of the leaves and consumption of the heart – a completely catastrophic fate for the plants. A follow-up trip in October by another team from Kew reinforced and continued these initial discussions. They investigated the needs of the community and how conservation and development might be brought together at this new site. It is hoped that funding will soon be secured to help with the early stages of this work. A local COBA is being created, and the community is now signed up to work on (and benefit from) Kew's existing conservation and development projects on seed banking across Madagascar and Kew's Darwin Initiative project on the sustainable production of yams.

Future directions for *Tahina* conservation

The team returned to Antananarivo elated that not only had a second site for *Tahina* been confirmed but also that the original population was clearly being well looked after and was expanding rather than contracting, as had been feared. A species conservation management plan has been drafted for *Tahina spectabilis* and is currently being discussed with the main stakeholders. It is hoped that an

12. Lauren Gardiner preparing a herbarium specimen from a juvenile leaf of *Tahina spectabilis*, near Amparahibe, Madagascar (Photo by David Rabehevitra, KMCC).

action plan will be developed and implemented by the appropriate people for this charismatic, extraordinary palm. A full study of population genetics for the two sites and demographics of the two population censuses (2008 and 2016) is in preparation and will be published in due course. The species distribution models previously undertaken by Joro can now be improved based on the combined characteristics of the two sites. We hope it will be possible to target fieldwork to search for *Tahina* in other fragments of vegetation. At both sites, the local people will continue to be included in the conservation planning and activities, and both communities will receive some educational resources to help teach the local people more about the precious species of which they are guardians. Both communities have agreed to monitor the species for signs of illegal collecting or use, for the presence of pests and the initiation of developing inflorescences so that more seeds can be collected and dispersed and more funds generated to benefit the communities.

This article is dedicated to the memory of the late Xavier Metz, who with his family discovered *Tahina spectabilis* in the wild, brought this spectacular species to the world's attention, laid the groundwork for its conservation and continued to have a deep interest in the palm until his death in January 2017.

Acknowledgments

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