

The Palms of Fiji and Tonga

CHRISTINE D. BACON
*Department of Biology
Colorado State University
Fort Collins, CO 80523 USA
cbacon@rams.colostate.edu*

1. *Pritchardia pacifica* in cultivation at University of the South Pacific, Fiji.



Although not the richest in the region, the palm floras of both Fiji and Tonga are very exciting and were the focus of a recent collecting expedition in November of 2009.

The islands of Fiji are home to about 25 palm species, at least 84% of which are endemic to the island nation. At the generic level, Fiji's palm flora shares its closest relationship with Vanuatu (60%), which is well above its shared

distributions with the Solomon Islands (27%), the Bismarck Archipelago (25%), and Samoa (15%; Watling 2005). For eight (75%) of Fiji's indigenous palm genera, Fiji is the southern or eastern limit of their ranges. Fiji has a native



2. *Pritchardia thurstonii* population at bottom center of coastal cliff in the 'Eua National Park, 'Eua Island, Tonga.

palm flora comprising 11 genera – *Alsmithia*, *Balaka*, *Calamus*, *Clinostigma*, *Cyphosperma*, *Heterospatha*, *Hydriastele*, *Metroxylon*, *Neoveitchia*, *Physokentia*, *Pritchardia* and *Veitchia*.

The islands of Tonga are mostly coralline in origin, rather than volcanic (Whistler 1992). Tonga has a very similar flora as its northern neighbor, Samoa, because of their geographic proximity and both are also part of the “Fijian Region” that extends from the Santa Cruz Islands and Vanuatu to Niue (Takhtajan 1969). *Veitchia joannis*, *Pritchardia pacifica* and *P. thurstonii* are the only native palms in Tonga. *Areca catechu*, *Cocos nucifera*, *Livistona chinensis*, *Metroxylon warburgii*, *Pinanga coronata* and *Ptychosperma macarthurii* are commonly cultivated in Tonga, as they are in Fiji.

Pritchardia

The primary goal of our expedition was to sample *Pritchardia pacifica* (Fig. 1) in both Fiji and Tonga. *Pritchardia pacifica* is an interesting species because it is known only from cultivation and appears to grow strictly around human activity. It is found from the Marshall

Islands in the northwest Pacific, south to the Solomon Islands, Vanuatu, Fiji and Tonga, and further east to Niue, Samoa and the Tuamotu Islands of French Polynesia. It is a spectacular palm with a rich history. Many legends surround the palm, but dispute about its origin remains, with Tonga as the most commonly cited origin (Watling 2005). We sampled individuals of *P. pacifica* from across the main island of Tonga, Tongatapu, as well as on the main island of Fiji, Viti Levu, to test the hypothesis of a Tongan origin. We also plan to gather samples from across the Pacific and use molecular phylogenetics to test the historical expansion of the species. One potential issue with testing hypotheses about *P. pacifica* is that it has most probably been transported from island to island by sea-faring Polynesians, therefore the molecular results would track human movement rather than range expansion from seed dispersal and island colonization. One way to address this would be to create alternative hypotheses of human movement through the Pacific and test whether the palms follow human movement and colonization.



3. *Balaka microcarpa* from Colo-i-Suva National Forest Park, outside of Suva, Fiji.

The second goal of our expedition was to collect *P. thurstonii* (Fig. 2) in its native habitat. Hodel (2007) recently recognized populations growing on 'Eua (Tonga), on the Sovu islets in the northern Lau island group (Fiji) and on Ogea and Vulaga of the Southern Lau group (Fiji) as belonging to this species. *Pritchardia thurstonii* is an interesting species because in a tribal-level analysis (Bacon et al., in prep.) it was resolved as sister to the Hawaiian radiation of approximately 26 currently recognized species (Hodel 2007). Study of *P. thurstonii* and other South Pacific *Pritchardia* species helps us understand what the historical distributions of the genus were and potentially what the Hawaiian colonizers looked like with respect to seed size and other morphological attributes.

Moreover, *P. thurstonii* was sampled in the field at the population level. Sampling at this level is important because populations on both Tonga and Fiji are not as severely affected by rat predation on seeds in comparison to Hawaii, where the Hawaiian species are barely able to self-replace due to the devastation of seed banks by rats. Our collections may help establish a baseline estimate of genetic

diversity held within and between populations and can further be compared to Hawaiian estimates to quantify endangerment and possibly identify populations of special conservation concern.

Morphological characters used to distinguish *P. pacifica* and *P. thurstonii* include the length of the inflorescences in comparison to the leaf petiole, the number of inflorescences that are born on the tree and their insertion in the crown, and presence of lepidia on the abaxial surface of the leaf (Watling 2005, Hodel 2007). Sampling both *Pritchardia* species is essential to test species boundaries using molecular evidence, which is one goal of my dissertation work.

In Tonga, *P. thurstonii* is found in the 'Eua National Park on the island of 'Eua, which is an easy excursion from the main island of Tongatapu, where the capital city Nuku'alofa is located. Either a three-hour boat ferry or an eight-minute flight gets one to 'Eua, where a four-wheel drive and National Park guide can be hired to access the populations. 'Eua is geologically different from the rest of the Tongan islands and it appears to be significantly older (Whistler 1992). The national park is located on the southeastern escarpment of the island. There are

4. *Veitchia vitiensis* from Colo-i-Suva National Forest Park, outside of Suva, Fiji.



approximately 250 *P. thurstonii* individuals, including juveniles, in two populations separated by steep cliffs and ocean. We were able to sample the largest population, but the other was largely inaccessible, and our guide flatly refused to help navigate to the population. The smaller population was seen from the southernmost end of the main population (Fig. 2) and was estimated to consist of approximately 85 individuals.

We found two individuals of *P. thurstonii* outside of the 'Eua National Park, one in the northern extreme of the island and the other in the southwest. Upon visiting both of these single trees, we observed that they were growing at the mouths of caves. In the north, the cave was small and near the top of the sea cliffs, whereas the tree in the southwest was growing near a large cave system that forms at the base of the sea cliffs. Human remains have been found in both the above-mentioned Tongan caves. In Hawaiian traditional culture, people placed the remains of their ancestors in caves on sea cliffs, an important detail because customs between islands in the Pacific are hypothesized to be related because of their common Polynesian ancestors. So why are these *Pritchardia* growing at the mouths of these caves that hold human remains? We speculated that *Pritchardia* was deliberately planted at the mouths of caves. But why? We asked a 'Eua shaman elder whether any traditional uses for *P. thurstonii* were known,

5. Flowers of *Physokentia petiolata* from the Tomaniivi Forest Reserve, near Navai village, on Viti Levu, Fiji.



6. *Balaka longirostris* flowers from the Tomaniivi Forest Reserve, near Navai village, on Viti Levu, Fiji.

and he explained that the stem of *P. thurstonii* was crushed and the liquid derived from it was drunk to keep "death spirits" away. Of course, much of the traditional meaning of local plant use can be lost in translation and through modernization of island peoples. We do not know if the traditional use of the palm accounted for its presence at the mouth of the caves. We can only report that the association between palms and sea caves seems to be more than just coincidental.

Due to economic misfortune, the national Fijian airline recently went out of business, so we were unable to visit the populations of *P. thurstonii* in the Sovu Islets of Fiji. The only current means of traveling there is a ferry that leaves once a month, although it has not been running reliably since September 2009. Instead of collecting *P. thurstonii* as we had originally planned, we turned our attention to collecting as many palm species on the main Fijian island of Viti Levu as possible.

Fijian palms

Our Fijian expedition focused on higher elevation palms found in the mountain range where the highest peak, Mt. Victoria, is located. Viti Levu, the largest island in Fiji, has the greatest number of species among all the islands of Fiji because larger islands harbor larger numbers of species and because the topographic variability provides for greater habitat diversity. Viti Levu has experienced a recent boom in tourism, and many forest tracks along the popular southern Coral Coast



7. Emergent *Clinostigma exorrhizum* population in the Tomaniivi Forest Reserve, near Navai village, on Viti Levu, Fiji.

area have been highly affected by development and deforestation. This human activity has caused populations of *Balaka longirostris*, *Cyphosperma* sp. nov. 'naboutini,' *Heterospathe phillipsii*, *H. vitiensis*, *Metroxylon vitiensis*, *Physokentia petiolata*, *Veitchia joannis* and *V. vitiensis* to decline and some to near extinction (Johnson 1996, Watling 2005). Forest usage is prevalent across the whole island, with local villages using the understory and forest edges for plantations of taro, sweet potato, manioc, banana and guava, amongst many others. In the northern areas, development is less severe because the King's Road is not paved in some areas and the coast is less desirable for resort speculators.

We spent a day northeast of the Fijian capital of Suva in the Colo-i-Suva National Forest Park. Established in 1872, the Colo-i-Suva is renowned for its easy access from Suva, its verdant rainforests and its bird diversity. The Colo-i-Suva has about 4.5 km of trails and a series of natural waterfalls formed by the Waisila Creek (upper Waimanu River). The park was planted with African mahogany in the 1940s and 1950s, destroying some areas of the park, but some areas are still very nicely

preserved. We were rewarded with two palm species there, *Balaka microcarpa* (Fig. 3) and *Veitchia vitiensis* (Fig. 4).

After two days of driving, we conducted field work from the Navai Village at the foot of Fiji's highest peak, Mt. Victoria. Near Navai, we saw the endemic *Cyphosperma tanga*, a critically endangered palm of which the Navai village is very proud (see Back Cover). Scattered *Veitchia vitiensis* individuals were found close to the *C. tanga* population. In assessing the *C. tanga* population, we recorded many seedlings and juveniles, so even though there is only one population remaining, it has apparently been able to maintain its numbers.

In the book, *Palms of the Fiji Islands*, Watling (2005) reported a legend about how *C. tanga* got to Navai, which we confirmed with many of the village elders. The story goes that two chiefs were traveling in the Navai area with a whale's tooth (*tabua*) wrapped in the leaves of the *C. tanga*, locally known as *taqwa*. They stopped to rest and decided to bury the wrapped sacred tooth. From that exact spot grew the *taqwa* palm, and today it is only found in that one locality. Traditionally in Fiji *tabua* was made from teeth from the upper

jaw of a sperm whale and are regarded as perhaps the most important cultural items in Fijian society. When the practice became more widely known in the early 1800s thousands of fake teeth made from ivory and walrus tusks came on the market, and mass-production led to the development of the European art of scrimshaw.

On the next day collecting from Navai village we set out to find the majestic *Clinostigma exorrhizum* populations. Scaling steep terrain in the upper montane forest of the Tomaniivi Nature Reserve, we were amazed by the skill of our guide and his dogs, which were able to hunt a wild piglet without any spoken words or weapons. Along the trail we collected *Physokentia petiolata* (Fig. 5), distinctive with its round and dark black fruits, and *Balaka longirostris* (Fig. 6), which the local Navai villagers use to make spears for hunting. Nearing the top of the ridge we came upon the beautiful *C. exorrhizum* (Fig. 7), as it usually found only above 700 m in elevation. This is the largest palm I had ever collected and stands around 20 m in height. None of the individuals we were able to collect had mature fruits, but it has been reported that one individual infructescence can produce up to 14,000 seeds (Watling, 2005).

Overall, the trip was a success and important collections were made for my dissertation research. My specific goals for the material collected from this field work are to discover not only the origin of the enigmatic *Pritchardia pacifica*, but also test species boundaries in the genus, as well as look at patterns of genetic diversity and how it is organized on the

landscape. It is from field work such as this, that biologists like myself get lots of ideas and I look forward to report more results in future reports. I also collected material for future projects on the biogeography of Pacific palms. The biogeography of this region is extremely interesting with respect to patterns of diversification and adaptive radiation, and there is still so much to uncover.

Acknowledgments

Work in Fiji was done in collaboration with Marika Tuiwawa and Alifereti Naikatini of the Pacific Regional Herbarium at the University of the South Pacific in Suva, Fiji. In Tonga, Liuaki Fusitu'a from the Ministry of Education and Leody Vainikolo from the Ministry of Agriculture facilitated the permitting process. Iliki from Navai village (Fiji), Jo from 'Eua (Tonga), and Geovanni Romero assisted with the field collections. This research was supported by the Montgomery Botanical Center.

LITERATURE CITED

- HODEL, D.R. 2007. A review of the genus *Pritchardia*. Palms Supplement to 51: S1–S52.
- TAKHTAJAN, A.L. 1969. Flowering Plants: Origin and Dispersal. Oliver & Boyd, Edinburgh.
- WATLING D. 2005. Palms of the Fiji Islands. Environmental Consultants Ltd., Suva, Fiji.
- WHISTLER, W.A. 1989. The unique flowers of Polynesia: Tonga. Bulletin of the National Tropical Botanical Garden 19: 81–84.
- WHISTLER, W.A. 1992. Vegetation of Samoa and Tonga. Pacific Science 46: 159–178.

PALM BOOK AND JOURNAL COLLECTION FOR SALE

An exceptionally complete private assemblage of books, journals and other materials is offered for private sale as a collection. It is comprised of 1,300 books in English and 20 foreign languages. Notable titles are the Barbosa Rodrigues *Sertum Palmarum Brasiliensium*, two-volume folio of 1903, with 174 chromolithograph plates; Kerchove de Denterghem's classic work *Les Palmiers* (1878); an fine copy of Seemann's *Popular History of the Palms* (1856) in its original binding; Martius's *Palmarum familias ejusque general* (1824) and Steck's 1757 study *Sagu*. Also included is a nearly complete collection of the palm publications of Odoardo Beccari. All the standard works on palms of the past century are in the collection, including palm floras and palm conference proceedings. Economic species books are a particular collection strength: coconut (254), oil (167), date (132), rattans (98) and sago (30). Among the 70 journals are full runs of *Principes/Palms*; *Palms & Cycads* (Australia) and *The Palm Journal* (California) and journal runs of economic palms. A third component consists of 800 items made up of journal reprints on palms, pamphlets, maps, microfiches, CD-ROMs and videos. The collection would be an ideal resource for any institution researching palms. A PDF file of the items in the collection is available. Contact Dennis Johnson; telephone 513-631-8766 or email djohn37@aol.com.