

# A Synopsis of the Genus *Balaka*

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*Balaka* is a relatively little known genus comprising eight or perhaps nine species of small to moderate, pinnate-leaved, understory palms of moist to wet forests in Fiji and Samoa. Although sometimes difficult to grow, most species make handsome ornamentals because of their attractive foliage and showy, red fruits. Until recently, little was known of their taxonomy, distribution, ecology, landscape culture and conservation status.

In the most recent classification of the palm family, *Balaka* is in the Ptychospermatinae subtribe of the Areceae tribe in the Arecoideae subfamily (Dransfield et al. 2008). Pinnae with praemorse (irregularly toothed) apices, symmetrical staminate flowers, bullet-shaped in bud and with a conspicuous pistillode, numerous stamens and often ridged or angled seeds, sometimes prominently so, characterize the Ptychospermatinae. *Balaka* is likely most closely related to *Solfia*, a genus endemic in Samoa, which differs in its terete (in cross-section) seeds. *Veitchia* and *Ptychosperma* are also closely related to *Balaka*, but the former genus also differs in its terete seeds while the latter differs in its generally much shorter peduncle and its peduncular bract included in the prophyll.

This paper, part of a larger, long-term project on Pacific Island palms, summarizes *Balaka*, including its description, taxonomy and nomenclature, identification, distribution and ecology, conservation status, ethnobotany and landscape culture. It is based on the examination of wild-growing plants in Fiji and Samoa, cultivated plants in Fiji and Hawaii and herbarium specimens. I examined herbarium specimens at SUVA, BISH, HAW, CAS and UC and high-resolution digital images of specimens in other herbaria.

*Balaka* Becc., Ann. Jard. Bot. Buitenzorg 2: 91. 1885. Type: *Balaka perbrevis* (H. Wendl.) Becc. (*Ptychosperma perbreve* H. Wendl., Fiji. Vanua Levu, U. S. South Pacific Explor. Exped. (lectotype GH!) = *B. seemannii* [H. Wendl.] Becc.).

*Balaka* are small, solitary, unarmed, pleonanthic, monoecious, understory tree palms. Stems are slender, 4–10 cm in diameter, conspicuously ringed, and mostly to 8 m tall although in *B. microcarpa* they can be up to 15 m tall. The erect to spreading, pinnate leaves range from about 1.5 to 2 m long although in *B. streptostachys* they can be 3 m long. Leaves are typically arching but those of *B. microcarpa* are recurved, especially in higher light. Leaf sheaths are 30 to 50 cm long, tubular, and form a crownshaft while petioles range from nearly lacking to 50 cm long. Pinnae are elongate (margins more or less parallel or even slightly tapering towards apex) and sigmoid or falcate, or they are cuneate (wedge-shaped, margins diverging towards apex), and range in number from 5 to 15 on each side of the rachis, although *B. streptostachys* has 18 to 22 pinnae on each side. Distal terminal pinnae are typically much broader than the others. Pinnae have a prominent midrib and several conspicuous or obscure primary nerves on either side while apices are obliquely or

transversely truncate and praemorse (irregularly toothed).

Inflorescences are mostly infrafoliar, branched to one to three orders, spreading, and have peduncles ranging from 10 to 60 cm long. Prophylls are short, slender, two-keeled, and somewhat beaked at the tip. Peduncular bracts are attached well away from and are much longer than the prophylls, but both typically fall away before anthesis. Rachises range from short to 45 cm long but are shorter than the peduncle. Rachillae are spreading and range from short to 30 cm long, and are typically as long as or longer than the rachis.

Flowers are in triads composed of a center, later-opening pistillate flower flanked on each of two sides by earlier-opening staminate flowers. Triads are typically arranged throughout the length of each rachilla, nearly to the apex, where they may be replaced by a few paired or solitary staminate flowers. However, in *Balaka macrocarpa* the distal one-third to one-half of a rachilla has only staminate flowers, meaning pistillate flowers and especially fruits are somewhat tightly clustered together in the proximal portions of

the rachillae. Flowers do not vary much and may be of little value in identification. Staminate flowers are symmetrical, bullet-shaped in bud, and have three imbricate sepals, three, valvate, long-ovate petals, numerous stamens (15–50) and a conspicuous pistillode. The pistillode is typically exerted, usually about twice as long as the stamens, but in *B. diffusa*, *B. microcarpa*, *B. samoensis* and *B. streptostachys* it is only about as long as the stamens. Pistillate flowers are symmetrical, ovoid, and have three imbricate sepals and petals, six small staminodes and an ovoid gynoeceium with a short stigma.

Fruits are variously ovoid, range from 1.4 to 4.8 cm long, and orange-red when mature. Endocarps are distinctive and peculiar, often prominently sculptured, typically elongate, have mostly four to six longitudinal ridges, making them variously angled in transverse section, and often have a conspicuous beak or rostrum (Fig. 1). Germination is adjacent ligular, and eophylls are bifid.

Indumentum, mostly hairs and scales, variously covers stems, leaf sheaths, petioles, rachises, and inflorescences of *Balaka*. When newly emerged or uncovered, the indumentum is mostly light colored but it weathers or ages to dark colored, including browns, red-browns and black.

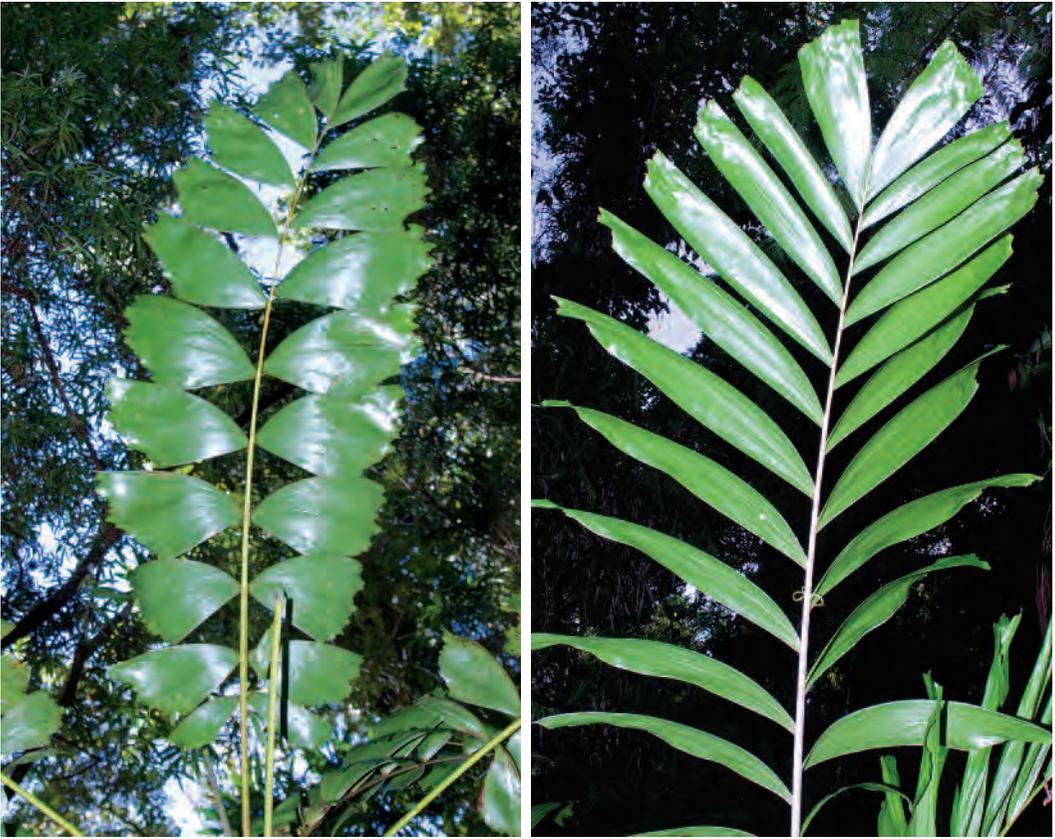
### Identification

The shape of the pinnae, whether cuneate (Fig. 2) or elongate (Fig. 3), and fruit size (length) and length of the fruiting perianth (sepals and petals) (Fig. 4) have been the primary characters used to distinguish species of *Balaka*. The two Samoan species recognized here, *B. samoensis* and *B. tahitensis*, have elongate pinnae as do four of the six Fijian species. However, care should be taken when relying on the shape of the pinnae because sometimes, especially in juvenile and near adult plants, cuneate pinnae can be only weakly wedge-shaped while elongate pinnae may have margins that diverge very slightly towards the apex (Fig. 5).

Generally, fruits of *Balaka* can be classified as short (less than 2.5 cm) or long (more than 2.5 cm) while fruiting perianths can be classified as short (6 mm or less) or long (10 mm or more) although there are a few instances, primarily in the literature and especially in the two Samoan species, where fruit and perianth length are somewhat intermediate.

1. Endocarps of *Balaka* are distinctive and peculiar, often prominently sculptured, have mostly four to six longitudinal ridges, making them variously angled in transverse section, and often have a conspicuous beak or rostrum. Top, *B. diffusa*; middle, *B. microcarpa*; bottom, *B. seemanii*.





2 (left). *Balaka seemannii* has cuneate pinnae. Somosomo, Taveuni, Fiji. 3 (right). *Balaka samoensis* has elongate pinnae. Matavanu, Savaii, Samoa.

A survey of all mature fruits of the two Samoan species, *Balaka samoensis* and *B. tahitensis*, at BISH and HAW showed that there is a general linear relationship between fruit length and

fruiting perianth length; thus, fruit length and perianth length are positively correlated: larger fruits having longer perianths (Fig. 6). The survey also showed that fruit and perianth

4. Fruit length, length of the fruiting perianth, and the ratio of the two are useful characters for distinguishing species of *Balaka*. *B. diffusa* has long fruits and a conspicuous, long fruiting perianth. Viti Levu, Fiji.





5. Sometimes, especially in juvenile and near adult plants, cuneate pinnae can be only weakly wedge-shaped, as here with *Balaka longirostris*. Galoa, Viti Levu, Fiji.

length and the ratio of fruit length to perianth length were statistically different for the two Samoan species; thus, these are useful characters for distinguishing the two species (Table 1). Like pinnae shape, though, fruit characters can still sometimes be somewhat tricky to employ for identification.

It may be difficult to distinguish sterile specimens of the Samoan taxa from their Fijian counterparts with elongate pinnae, such as

*Balaka diffusa*, *B. macrocarpa* and *B. microcarpa*. Generally, though, the Samoan taxa have thinner pinnae with a prominent midrib and several conspicuous primary nerves, while the Fijian taxa have thicker pinnae where only the midrib is prominent and the primary nerves are mostly obscure. If seeds are available, those of the Fijian taxa are generally more prominently and sharply longitudinally ridged or angled and typically have a more conspicuous or developed beak or rostrum than those of the Samoan taxa.

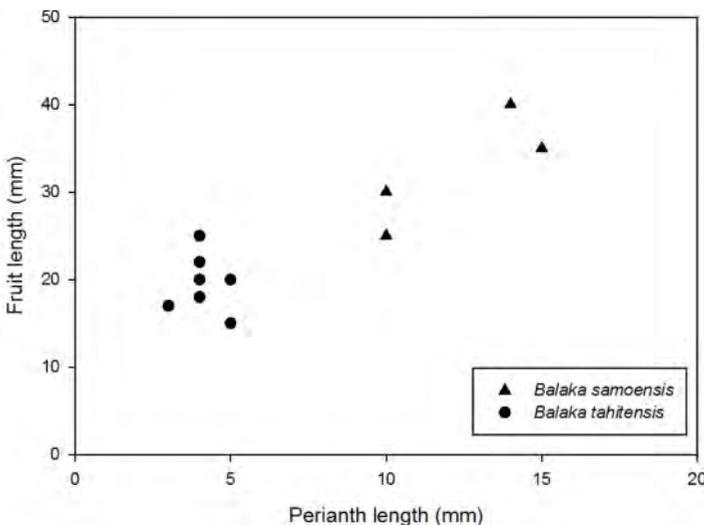
Also useful in identification are the manner in which the floral triads are arranged, specifically whether pistillate flowers are distributed throughout the rachilla or whether they are restricted to proximal portions of the rachillae, and the shape of the seeds.

#### Distribution and Ecology

*Balaka* is restricted to Fiji (6 or 7 spp.) and Samoa (2 spp.), where they mostly inhabit shady places in wet, humid forests from near sea level to 1000 m altitude.

#### Ethnobotany

The vernacular name in Fiji for members of the genus is *mbalaka* or *balakwa*, from which the botanical name is derived (Moore 1979, Watling 2005). The precise meaning of the name is unclear. Other vernacular names include *mbelako*, *niu mbalaka* and *niuniu*. In Samoa the vernacular name is *maniuniu* (Christophersen 1935, Whistler 1992). While no uses are recorded for *Balaka* in Samoa, in Fiji the straight stems have been traditionally used for spears, walking sticks and clothesline props, while immature fruits were infrequently eaten (Moore 1979, Watling 2005). Watling



6. Correlation of fruit length and perianth length in *Balaka samoensis* (n=6) and *B. tahitensis* (n=15).

Measurements taken of dried herbarium specimens at BISH and HAW. Correlation Coefficient = 0.88,  $P=0.0075$ . Correlation Procedure, SAS (v.9.2, SAS Systems, Cary, NC).

Table 1. Comparison of mean fruit and perianth length and fruit length/perianth length ratio of *Balaka samoensis* (n=6) and *B. tahitensis* (n=15). Measurements taken of dried herbarium specimens at BISH and HAW. Mean lengths (mm) and ratios followed by different letters are significantly different, P<0.0001. ANOVA calculated using General Linear Model Procedure, SAS, (v.9.2, SAS Systems, Cary, NC). Overall error rate for means comparison was controlled using Bonferroni adjustment and no violations of assumptions of equal variance or normality were detected.

	Fruit Length	Perianth Length	Fruit Length/ Perianth Length Ratio
<i>B. samoensis</i>	30a	10a	2.6b
<i>B. tahitensis</i>	20b	4b	5.0a

(2005), in his superb and handsomely illustrated account of Fijian palms, also reported medicinal uses for *B. seemannii* in Fiji, including the use of the pseudobark to treat headaches and the pericarp of the fruit to treat venereal disease.

**Landscape Culture**

*Balaka* are handsome landscape ornamentals, especially those species with cuneate pinnae or, like some forms of *B. macrocarpa*, where the leaf blade is mostly undivided and bifid for many years. The infructescences, held below the leaves and heavily laden with showy, brightly colored, orange-red fruits, add to their attractiveness. Their mostly small habit and slender stems make them ideally suited for the ever-diminishing small garden or landscape. Unfortunately, most *Balaka* can be somewhat difficult to grow and seem rather exacting in their cultural requirements. They need shade, protection from wind, constantly warm temperatures, high humidity, well drained soil with abundant organic matter and regular, good quality water or rain water, all conditions found in moist, humid, tropical areas. They are even difficult to grow under controlled, greenhouse conditions in subtropical or temperate regions. The use of mulch and periodic applications of organic or controlled-release, palm-special fertilizers are beneficial. However, Watling (per. comm.) noted that *B. seemannii*, which seems hardier than other Fijian species, sometimes occurs in moist, rather than wet forests, and grows easily in his Suva garden, even in full sunlight. *Balaka* are sparingly cultivated in favorable sites in Fiji, Hawaii, southern Florida, Australia, Thailand and perhaps elsewhere.

**Key to the Species of *Balaka***

Pinnae generally cuneate, margins weakly to strongly diverging toward apex.

Fruit  $\geq(2.5-)$ 3.0 cm long, fruiting perianth  $\geq 10$  mm long; seed with prominent rostrum 10 mm long . . . . . *B. longirostris*

Fruit  $\leq 2.5$  cm long, fruiting perianth  $\leq 6$  mm long; seed with short rostrum 5 mm long . . . . . *B. seemannii*

Pinnae generally elongate, margins slightly converging or  $\pm$  parallel toward apex.

Leaves (2.5-)3 m long, 18-22 pinnae per side; inflorescences  $\geq 1$  m long . . . . . *B. streptostachys*

Leaves  $\leq 2.2$  m long, 16 or fewer pinnae per side; inflorescences  $\leq 75$ cm long.

Pinnae papery, midrib and several primary nerves raised adaxially; seeds with obscure, not or slightly angled, longitudinal ridges.

Fruits  $> 2.5$  cm long, fruiting perianth  $\geq 10$  mm long, fruit length to perianth length ratio less than 3.0; pistillode ca. equaling stamens . . . *B. samoensis*

Fruits  $\leq 2.5$  cm long, perianth  $\leq 6(-8)$  mm long, fruit length to perianth length ratio more than 4.0; pistillode twice as long as stamens . . . . . *B. tahitensis*

Pinnae thick-papery or even leathery, only midrib and sometimes submarginal nerves raised adaxially; seeds with prominent, angled longitudinal ridges.

Fruits  $\leq 2$  cm long, fruiting perianth  $\leq 6$  mm long.

Rachillae  $\geq 12$  cm long, triads borne nearly to apex of rachillae . . . . . *B. microcarpa*

Rachillae  $\leq 12$  cm long, triads not borne to apex of rachillae . . . . . *B. pauciflora*

Fruits  $\geq 4$  cm long, fruiting perianth  $\geq 10$  mm long.

Inflorescence 1-branched, 20–40 cm long, rachillae 10–20 cm long, triads borne only in proximal one-half to two-thirds of rachillae. . . . .  
 . . . . . *B. macrocarpa*

Inflorescence 2-branched, to 75 cm long, rachillae 30–40 cm long, triads borne nearly to apex of rachillae . . . . .  
 . . . . . *B. diffusa*

**Balaka diffusa** Hodel sp. nov. *Balaka macrocarpa* Burret affinis sed inflorescentiis longioribus (75 vs. 40 cm), paniculis duplicato-ramosis expansis, rachillis diffusis longioribus (30–40 vs. 10–20 cm), floribus femineis dispositis apici rachillae differt. Type: Fiji. Viti Levu. Namosi Prov.: 9 kms northwest of Queen’s Highway inland toward Waisoi [along Namosi Road], Nabukavesi Creek drainage, alt. 200 m, 1 February 1996, Fuller et al. 315 (holotype CAS!, isotype SUVA!). Figs. 1, 4, 7–10.

Solitary, small, slender, unarmed, pleoanthic, monoecious, understory palm to 5(–10) m tall (Fig. 7). Trunk 5 cm diam., internodes 2–2.5 cm, nodes 1 cm wide. Leaves 4 or 5, erect-

spreading, arching, to 2.1 m long; sheath 28–33 cm long, obliquely open distally, covered with reddish brown tomentum; petiole ca. 45 cm long; rachis to 1.25 m long; pinnae 10–12 per side (Fig. 7), elongate, to  $46 \times 13$  cm, margins gradually diverging from base to about  $\frac{3}{4}$  distally then  $\pm$  parallel or slightly converging in distal  $\frac{1}{4}$  (Fig. 8), apex 13.5 cm wide, obliquely truncate, praemorse, thick-papery, adaxially only midrib raised and this prominent and knife-like,  $1 \pm$  prominent but not raised primary nerve on either side of midrib, other primary nerves obscure, several unequally spaced secondary nerves, numerous unequally spaced tertiary nerves, abaxially nerves with reddish brown, scale-like hairs, apical pair wider and transversely truncate and toothed, to  $33 \times 20$  cm. Inflorescences 1 or 2 (or 3), infrafoliar, to 75 cm long, 2-branched; peduncle 12–30 cm long, 4–5 cm wide at base, tapering to 3 cm wide at prophyll, flattened, 1 cm thick; prophyll attached 1 cm distally of peduncle base, 29 cm long, bicarinate, covered with reddish brown tomentum, 1st peduncular bract attached 2 cm distally of prophyll, to 32 cm long, just exceeding prophyll, rudimentary 2nd peduncular bract attached 3 cm distally of 2nd peduncular bract, long-triangular,  $2 \times 1$  cm;

7. Like most other species in the genus, *Balaka diffusa* is a small, slender, solitary understory palm. Nabukavesi, Viti Levu, Fiji. 8. Pinnae of *Balaka diffusa* are elongate. Nabukavesi, Viti Levu, Fiji.





9. Floral triads of *Balaka diffusa* are distributed for the entire length of the rachillae, as shown by the fruits at the rachillae tips. Nabukavesi, Viti Levu, Fiji.



10. Endocarps of *Balaka diffusa* have four, prominent, sharp, longitudinal ridges and a conspicuous rostrum. Nabukavesi, Viti Levu, Fiji.

rachis 18–25 cm long, 3 proximal branches branched or forked, subpeduncle to 8 cm long, subrachis to 3 cm long, rachillae 12–15, 30–40 cm long, 5 mm diam., 3-sided or -angled and slightly flexuous from floral pits, spreading, diffuse. Flower triads for entire length of rachillae (Fig. 9), 1 cm distant and in 2 spiraling rows proximally to 5 mm distant and in 2 distichous rows distally, triads in clefts 8 mm long, 5 mm wide, 1 or 2 mm deep, 1 bracteole to 2 mm long subtending proximal side of triad and forming a multi-lobed lip, pistillate flower completely enclosed by 2 imbricate bracteoles, these to 1.75 mm long, 4–5 mm wide, nerved adaxially, with 3 or 4 broadly rounded lobes, each staminate flower with 1 bracteole on outer side, this 1–1.5 mm long; staminate flowers in bud just prior to

anthesis 11 × 5 mm, bullet-shaped, opening to 15 mm wide; calyx cupular, 2.5–3 × 5 mm, sepals 3 × 5 mm, cupular, imbricate nearly to truncate apex; petals 9 × 4.5 mm, valvate, acute, petals and sepals densely covered with silvery tan to reddish brown tomentum; stamens ca. 50, 6–7 mm long, adnate to base of pistil and slightly above it, filaments 4 mm long, anthers 3 mm long, dorsifixed just below middle; pistillode to 6 mm long, style slender; pistillate flowers 10 × 8 mm, densely covered with silvery tan to reddish brown tomentum; calyx 5 × 8 mm, triangular-cupular, sepals cupular, broadly rounded and imbricate nearly to apex, faintly nerved adaxially, the 3 sepals of unequal sizes and successively and progressively more cupular, smallest 5 × 5 mm and semi-cupular, middle 6 × 6 mm, largest 6

× 7 mm and strongly cupular; petals 9 × 5 mm, boat-like with short, acute, mucronate apex, densely nerved; pistil 9 × 4 mm, spindle-shaped to club-like, perched on 3 mm tall dark stalk, apex trifid, blunt; staminodes lacking or few and tooth-like, 1 mm long, or connate in a ring nearly encircling pistil. Fruit 4.0–4.2 × 1.6–1.7 cm, ellipsoid-ovoid, orange-red (Fig. 4); fruiting perianth 1.0–1.2 cm long; endocarp 3.8–4.0 × 1.5 cm, with 4 prominent, sharp, longitudinal ridges and a rostrum 1 cm long (Fig. 10).

**Distribution and Ecology:** *Balaka diffusa* is known from only one, small population straddling the boundary of Serua and Namosi Provinces along the southeastern coast of Viti Levu, Fiji, where it is mostly an understory palm in wet forest at about 200 m altitude on steep slopes near creeks and streams. In a few instances along streams where there is a canopy break, it is an emergent plant with arching leaves. Little is known about its natural history. In 2008 I observed all age sizes but none in a great number, and regeneration was only fair. Pinnae were typically heavily damaged or skeletonized by an unknown insect pest while infructescences appeared heavily foraged. Fuller (1997), in his excellent and comprehensive account of Fijian palms, reported (as *B. macrocarpa*) that spatial arrangement was clumped, with mature trees closely arranged, regeneration was fair, and infructescences foraged. Flowering and fruiting probably occur nearly year around, but mature fruits are rarely encountered. Watling (2005) reported (as *B. macrocarpa*) that the masked shining parrot, *Prosopeia personata*, is the likely forager and gathers large fruits before they are fully ripe. Not a seed disperser but a predator, it opens the seed with its powerful bill and extracts the endosperm.

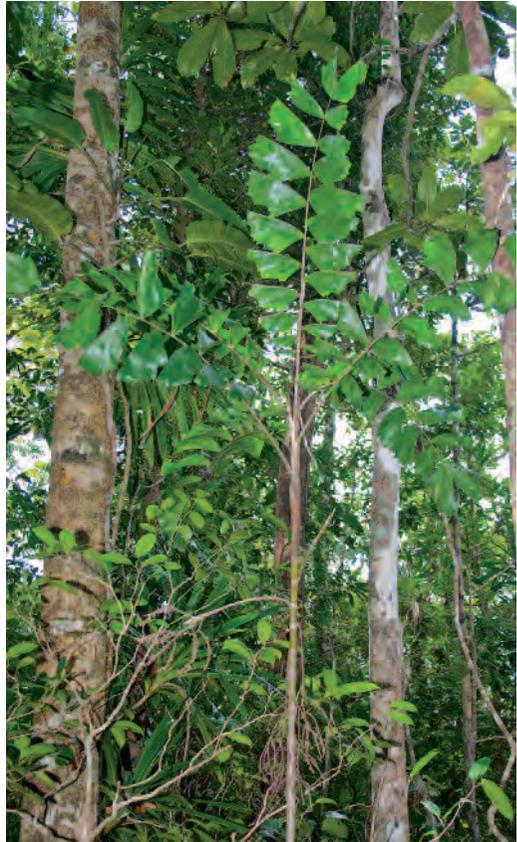
**Notes:** The elongate pinnae, relatively large inflorescence, expanded, 2-branched panicle with long, spreading, diffuse rachillae, flower triads along the entire length of the rachillae and large fruit distinguish *Balaka diffusa*. Moore (1979), Fuller (1997) and Watling (2005) included the Nabukavesi Creek population (*B. diffusa*) as *B. macrocarpa*. However, the latter species is restricted to Vanua Levu and differs in its much smaller inflorescence, more compact, mostly simply branched panicle, shorter rachillae and flower triads restricted to the proximal one-half to two-thirds of the rachilla, resulting in the fruit appearing tightly clustered together. The endocarp Watling

(2005, p. 69) illustrated as *B. macrocarpa* is actually *B. diffusa*.

**Conservation Status:** *Balaka diffusa* currently has no risk assessment designation (IUCN 2010). However, it should be considered Critically Endangered according to IUCN criteria because of its small population size of only about 200 mature plants in a somewhat disturbed site with encroaching mahogany plantations. Its narrow, restricted range increases susceptibility to a single, disruptive event, like a hurricane, and to potential damage from invasive weeds, animals, pests and disease. Low seedling recruitment and small population size suppress regeneration. Because it is readily and easily accessible on Fiji's main island, fruits and/or small plants have occasionally been gathered, and *B. diffusa* is now cultivated in Fiji, Hawaii and perhaps elsewhere although it is usually misidentified as *B. macrocarpa*. Nearly all cultivated specimens identified as *B. macrocarpa* are actually *B. diffusa*.

**Additional Specimens Examined.** FIJI. Viti Levu. Namosi Prov.: 9 kms northwest of

11. *Balaka longirostris* is a small, slender, solitary understory palm. Galoa, Viti Levu, Fiji.



Queen's Highway inland toward Waisoi [along Namosi Road], Nabukavesi Creek drainage, 200 m, Fuller 314 (CAS), 330 (SUVA). Serua Prov.: Nabukavesi, *Damanu D94* (SUVA).

***Balaka longirostris*** Becc., *Webbia* 4: 270. 1914. TYPE: Fiji. Viti Levu, *Yeoward s. n.*, April 1894 (holotype K!).

*Balaka leprosa* A. C. Sm., *J. Arnold Arbor.* 31: 146. 1950. Type: Fiji. Viti Levu. Ba Prov.: hills E. of Nadala Creek, ca. 3 miles S. of Nadarivatu, 850–970 m, *Smith 6219* (holotype A, isotypes BISH!, K!, NY!, US!).

To 12 m tall (Fig. 11). Stem to 6 cm diam. Leaves (4–)6 or 7(–10), ascending-spreading, (1.0–)1.5–2.1 m long; sheath 20–30 cm long, petiole 5–30 cm long; blade (0.6–)1.2–1.5 m long; pinnae 7–14 per side, cuneate, margins slightly to markedly diverging, to 30 cm long, to 16 cm wide at apex and there transversely to obliquely truncate and toothed, moderately papery, midrib conspicuous, other nerves mostly obscure, apical pair broader. Inflorescences 2 or 3 per plant, infraxillary, 50–70 cm long, 1- or 2-branched (Fig. 12); peduncle 15–30 cm long; rachis 15 cm long; rachillae 8–12, these 15–25 cm long, thick, spreading; triads to apex of rachilla. Staminate flowers with 25–45 stamens, pistillode twice as long as stamens, slightly flexuous (Fig. 13). Fruit (2.5–)3.0–4.0 × 1.1–1.6 cm, fusiform-ellipsoid, bright red (Fig. 14); fruiting perianth

to 1.4 cm long; endocarp (2.4–)2.8–3.7 × 0.8–1.4 cm, with 4, sharp, prominent longitudinal ridges and a prominent rostrum 10–13 mm long.

Distribution and Ecology: *Balaka longirostris* is restricted to Viti Levu (and, apparently, its offshore island Ovalau), Fiji, where it is a locally common understory palm in wet forest from near sea level to 1000 m altitude. Little is known about its natural history, although I observed all age sizes, and regeneration appeared good in many localities. Flowering and fruiting probably occur nearly year around.

Notes: The typically strongly cuneate pinnae and large fruit with a long fruiting perianth distinguish *Balaka longirostris*. It occurs over a large area of the ecologically and geographically diverse Viti Levu, where it is one of the most variable species of the genus. This variability is apparent in overall size of the plant and its various organs, including stems, leaves, inflorescences, and fruits and seeds. Leaves are especially variable. Petioles can be very short, nearly lacking, to as long as 30 cm. Pinnae can number as few as seven to as many as 14 on each side of the rachis. Although pinnae are typically strongly cuneate, with margins markedly diverging toward the apex, in some collections pinnae margins are nearly parallel, scarcely diverging toward the apex.

12. Inflorescences of *Balaka longirostris* are infraxillary and one- or two-branched. Galoa, Viti Levu, Fiji.





13 (left). Staminate flowers of *Balaka longirostris* have a pistillode about twice as long as the stamens. Galoa, Viti Levu, Fiji. 14 (right). These nearly full-size fruits of *Balaka longirostris* will turn red when ripe. Note the long fruiting perianth. Jeff Marcus nursery, Mt. View, Hawaii.

Sterile plants with such pinnae can be rather easily confused with young plants of the sometimes co-occurring *Veitchia vitiensis*. In plants with a very short or nearly lacking petiole the most proximal pinnae can be swept back across the stem.

Only one collection, *Fuller 274*, tentatively documents *Balaka longirostris* from Ovalau although it is mired in controversy. This sterile collection at CAS, from the hills near Lovoni Village, Ovalau, has the strongly cuneate pinnae typical of *B. longirostris*, yet Fuller (1997) listed its duplicate at SUVA as *Veitchia vitiensis*. Another collection at CAS in the same *Balaka* folder but from a cultivated plant outside SUVA at the University of the South Pacific, *Fuller 174*, has a note on it stating that it may be a mixed collection and to see *Fuller 274*. Leaves of *Fuller 174*, unlike those of *Fuller 274*, are of *Veitchia*, likely *V. vitiensis*. Still another collection at CAS and also in the *Balaka* folder, *Fuller 256*, from Lovoni Village, Ovalau, has pinnae identical to those of *Fuller 174*.

Conservation Status: Widespread and locally common, *Balaka longirostris* is designated as

Least Concern (IUCN 2010). The primary potential threats are habitat loss and disturbance due to encroaching urbanization, agriculture, timber harvesting and introduction of invasive weeds and pests. It is cultivated in Fiji, Hawaii and Australia.

Additional Specimens Examined. FIJI. Viti Levu. Ba Prov.: Nadarivatu, Mt. Lomalangi, *Koroiveibau (DA) 14711, 14712 (SUVA)*; Nadarivatu, Vunimarasa, trail to Dromodromo, *Moore 9362 (SUVA)*; Tholo North, Navai, Vuniatambua, 800 m, *Degener 14764 (BISH, UC)*. Nandroqua and Navosa Provs.: Baravi, logging rd. above Busa Bay toward Mt. Gordon, Aug. 1995, *Phillips s. n. (SUVA)*. Namosi Prov.: Veivatuloa, 8 km NW of Navua, 18° 10.361' S, 178° 6.603' E, 150–200 m, *Fuller 298 (CAS, SUVA)*. Rewa Prov.: Visari, *Langlois (DA) 14713, 14714, 14715 (SUVA)*. Serua, Prov.: inland from Galoa, 270 m, *Smith (DA) 16564 (BISH, SUVA)*, *Smith 16565 (SUVA)*; Pacific Harbor, 30–50 m, *Fuller 238 (CAS), 328 (CAS, SUVA), 329 (CAS, SUVA)*; Galoa, Vatutavathe, 0–150 m, *Degener 15174 (BISH, UC)*; between Galoa and Wainiyambia, between Waininggere and Waisese Creeks, 50–100 m, *Smith 9387 (BISH,*

SUVA, UC). Tailevu Prov.: *O'Connor 11829* (SUVA). Ovalau: E. of Lovoni Village, 200 m, *Fuller 274* (CAS).

***Balaka macrocarpa*** Burret, *Occas. Pap. Bernice P. Bishop Mus.* 11(4): 5. 1935. Type: Fiji. Vanua Levu. Thakaundrove Prov.: Natewa Peninsula, Uluingala, 600–800 m, *Smith 2007* (holotype, BISH!; isotypes BO!, UC!, US!).

*Balaka* "Bulitavu" Fuller, *Cons. Status Divers. Syst. Indig. Palms Fiji.* 36. 1997.

To 10 m tall (Figs. 15 & 16). Stem to 6 cm diam. Leaves 5 or 6, ascending-spreading, 1.3–2.2 m long; sheath 30 cm long; petiole 10–15 cm long; blade 1.0–1.8 m long; pinnae (1–)5–7(–12) per side, elongate, slightly sigmoid or falcate, margins converging toward base and slightly converging toward apex and there obliquely truncate and toothed, to 45 cm long, to 11 cm wide, thick-papery, all nerves obscure adaxially except for prominent and raised midrib, all nerves more conspicuous

15. *Balaka macrocarpa* is a small, slender, solitary understory palm. Note the leaves with relatively few pinnae. Mt. Sorolevu, Vanua Levu, Fiji.



abaxially but only midrib raised, apical pair much wider and transversely truncate and toothed. Inflorescences 1 or 2 per plant, infralobar, 20–40 cm long, 1(–2)-branched (Fig. 17); peduncle 8–20 cm long; rachis 5–8 cm long; 4–6 rachillae, these 10–20 cm long, thick, stiffly spreading; triads mostly only in proximal one-half to two-thirds of rachillae. Staminate flowers with ca. 40 stamens, pistillode twice as long as stamens, flexuous. Fruit 4.0–4.8 × 1.5–2.3 cm, ovoid-ellipsoid (Fig. 18), orange-red; fruiting perianth 1.2 cm long; endocarp 3.7–4.2 × 1.4–1.8 cm, with 4, prominent, sharp longitudinal ridges and rostrum 8–15 mm long.

**Distribution and Ecology:** *Balaka macrocarpa* is restricted to Vanua Levu, Fiji, in the center of the island near Mt. Sorolevu and on Natewa Peninsula, where it is a locally common understory palm in wet forest from 50 to 800 m altitude. Watling (per. comm.) noted that it has also been seen at Saqani in northeastern Vanua Levu. Unfortunately, the type locality at Uluingala on the Natewa Peninsula has apparently not been refound. Little is known about the natural history of *B. macrocarpa*, although I observed all sizes, and regeneration

16. *Balaka macrocarpa*, habit. Natewa Peninsula, Vanua Levu, Fiji.



appeared good in the Natewa Peninsula population. Mt. Sorolevu, which receives well over 3000 mm of rain annually (Watling 2005), is rich in palms, including the co-occurring *B. seemannii*, *B. streptostachys* and *Heterospathes longipes*. Nearby are *Physokentia thurstonii*, *Gulubia microcarpa* and *Clinostigma exorrhizum*.

**Notes:** The elongate, obscurely nerved pinnae, short, 1-branched, compact inflorescence with few, stubby, thick, stiffly spreading rachillae having triads only in the proximal one-half to two-thirds and large fruits distinguish *Balaka macrocarpa*. The short, compact, mostly simply and few-branched inflorescence and infructescence are distinctive because the floral triads are mostly restricted to the proximal one-half to two-thirds of each rachilla, resulting in a tight clustering of the large fruits (Fig. 18).

*Balaka macrocarpa*, presently known from the three populations, Mt. Sorolevu, the Natewa Peninsula and Saqani, in Vanua Levu, has been confused taxonomically and nomenclaturally. Until recently, it was known only from the obscure type locality at Uluingala on the Natewa Peninsula. However, Fuller (1997) and Watling (2005) were referring to *B. macrocarpa* when they described and/or illustrated *B. "Bulitavu"* (named for its discoverer Timoci Bulitavu) from the Mt. Sorolevu area of Vanua Levu. The endocarp Watling (2005, p. 69) illustrated as *B. "Bulitavu"* is actually *B. macrocarpa* while the one he illustrated as *B. macrocarpa* is actually *B. diffusa*, which see.

Watling (2005) referred to the Natewa Peninsula population as *Balaka "Natewa,"* and his description and illustration of a juvenile plant are clearly *B. macrocarpa*. Fuller (1997), Moore (1979) and Watling (2005) referred to another population at Nabukavesi Creek in southern Viti Levu, Fiji as *Balaka macrocarpa*, but this population actually is the new species *B. diffusa*.

*Balaka macrocarpa* is rather variable in leaf size and division. Seedlings and small juvenile plants, especially in the Natewa Peninsula population, commonly have simple and bifid or unevenly divided leaf blades one to two meters long with one to five pinnae per side. Such plants, about one to two meters in overall height and with a stem 50 to 100 cm tall, are especially striking and attractive. Also, adult plants from Natewa Peninsula typically have a few more pinnae than those from Mt. Sorolevu (Figs. 15 & 16).



17 (top). Inflorescences of *Balaka macrocarpa* are small, infrafoliar, and one-branched. Pistillate flowers here are swollen, green, and nearly at anthesis. Staminate flowers are mostly just past anthesis and have already fallen away from the rachillae tips but are persisting where paired with pistillate flowers. The bare rachillae tips show that floral triads, and hence pistillate flowers and then fruit, are restricted to the proximal one-half to two-thirds of each rachilla. Natewa Peninsula, Vanua Levu, Fiji. 18 (bottom). These immature fruits of *Balaka macrocarpa* are not yet full size. They will turn orange-red when mature. Natewa Peninsula, Vanua Levu, Fiji.

Conservation Status: *Balaka macrocarpa* is designated as Critically Endangered (IUCN 2010), but because of the recent taxonomic confusion surrounding this species, an

appropriate, current reassessment of its conservation status is needed. Watling (2005) reported that the Mt. Sorolevu population, comprising 100 to 200 mature plants, is in an

area subject to logging and mahogany planting. I observed mostly larger plants with little regeneration there in October, 2008.

In apparent contrast, the Natewa Peninsula population is larger and more extensive. Although precise numbers are unknown, I observed all sizes, and regeneration appeared good in October, 2008. However, this area of the Natewa Peninsula is also vulnerable to logging and other activities that could threaten this population. Thus, *Balaka macrocarpa* should probably be considered Endangered according to IUCN criteria (IUCN 2010). It does not appear to be cultivated; plants cultivated as such are usually *B. diffusa*.

Additional Specimens Examined. Fiji. Vanua Levu. Thakaundrove Prov.: track to Nasorolevu, 650 m, *Koroiveibau (DA) 17134, 17137* (SUVA); SE of Lambasa, above Nakoroutari Village below ridge above Matani Creek, 370 m, *McClatchey 1095* (SUVA), *Fuller 339* (K).

***Balaka microcarpa*** Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 89. 1940. Type: Fiji. Viti

Levu, Naitasiri, Colo-i-Suva, *Meebold 16418* (holotype BISH [on loan and destroyed at B?], lectotype K!).

*Balaka microcarpa* var. *longicuspis* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 90. 1940. Type: Fiji. Viti Levu, Naitasiri, Colo-i-Suva, 200 m, *Bryan 207* (holotype BISH!, isotypes K!, UC!, US!).

To 15 m tall. Stem to 8 cm diam. Leaves 5–10, ascending-arching, slightly recurved, stiffly ascending in open areas with higher light (Fig. 19), 1.6–2.2 m long; sheath 30–40 cm long, sometimes dark colored (Fig. 20); petiole lacking or to 5 cm long (Fig. 20); blade to 1.2–1.8 m long; pinnae 9–16 per side, elongate-sigmoid, margins converging toward base and apex and there obliquely truncate and toothed (Fig. 21), to 55 cm long, to 11 cm wide, thick-leathery, distinctly forward-pointing, midrib prominent adaxially. Inflorescences 2 or 3 per plant, infraxillary, 60–85 cm long, 2- or 3-branched (Fig. 22); peduncle to 30–35 cm long; rachis 15–20 cm long; up to 25 rachillae, these 12–30 cm long, spreading; triads nearly to apex of rachilla. Staminate flowers with 20–30

19 (left). In open areas with higher light leaves of *Balaka microcarpa* are stiffly ascending. Mt. Nakobalevu, Viti Levu, Fiji. 20 (right). Leaf sheaths of *Balaka microcarpa* are sometimes dark colored, nearly black, and petioles are short or even lacking. Cultivated, Garden of the Sleeping Giant, Nadi, Viti Levu, Fiji.





21. Pinnae of *Balaka microcarpa*, as here on a juvenile plant, are elongate, with margins converging toward base and apex and there obliquely truncate and toothed. Colo-i-Suva, Viti Levu, Fiji.



22. Inflorescences of *Balaka microcarpa* are infrafoliar and 2- or 3-branched. Mt. Nakobalevu, Viti Levu, Fiji.

stamens, pistillode ca. equaling stamens or exceeding them, thick, stubby, flexuous (Fig. 23). Fruit 1.4–2.0 × 0.7–1.0 cm, ovoid, bright red (Fig. 24); fruiting perianth 5 mm long; endocarp 1.3–1.8 × 0.6–0.9 cm, with 4, prominent, sharp longitudinal ridges and very short rostrum 3 mm long (Fig. 1).

**Distribution and Ecology:** *Balaka microcarpa* is known only from one, relatively small area straddling the boundary of Naitasiri and Rewa Provinces along the southeastern coast of Viti Levu, near Suva, Fiji, where it is a locally common understory palm in wet forest from 50 to 300 m altitude. Watling (2005) reported that annual rainfall is about 4000 mm with no dry season. Ash (1988), in a three-year

demographic study, showed that *B. microcarpa* fruits throughout the year and is unusually slow growing, producing one (juvenile palms) to two (tall palms) leaves annually and attaining maturity at about five meters in height after 45 years. The oldest palms are estimated to be 85 years old. However, cultivated plants grow more quickly. Fuller (1997) reported that regeneration is high.

**Notes:** The ascending to arching leaves with short petioles, elongate, thick-leathery, strongly forward-pointing, obscurely nerved pinnae, and small fruits distinguish *Balaka microcarpa*. Seedlings and small, juvenile plants have handsome, simple, bifid leaves until they attain about a meter in overall height and have



23 (left). Staminate flowers of *Balaka microcarpa* have 20–30 stamens and a pistillode about equaling or slightly exceeding the stamens. Mt. Nakobalevu, Viti Levu, Fiji. 24 (right). Fruits of *Balaka microcarpa* are bright red when mature and ripe. Mt. Nakobalevu, Viti Levu, Fiji.

a short stem about 30 cm tall. The unusually short petioles and stiffly ascending leaves trap and collect falling litter from the forest canopy, channeling it into the center of the plant.

In disturbed areas where the forest is more open or in areas with a naturally low canopy, *Balaka microcarpa* is an emergent species and its leaves are frequently stiffly ascending. In these instances, the stiffly ascending leaves and thick-leathery, forward-pointing pinnae immediately conjure up images of a New Caledonia *Basselinia pancheri* or *B. gracilis*.

Moore (1979) designated a lectotype of *Balaka microcarpa* at K and of *B. microcarpa* var. *longicuspis* at BISH.

Conservation Status: *Balaka microcarpa* is designated as Endangered (IUCN 2010). It has a limited distribution in an area of about 10 square kilometers, about half of which is under planted mahogany and thus subject to timber harvesting and severe disturbance despite being in forest parks or protected areas. However, Watling (2005) argued persuasively that the conservation status should be

upgraded to Critically Endangered due to current mahogany harvesting and agricultural land clearing. It is cultivated in Fiji, Hawaii and Australia.

Additional Specimens Examined. FIJI. Viti Levu. Naitasiri Prov.: Colo-i-Suva, *Nand (DA) 9853* (BISH, SUVA), *Parham 91* (SUVA); near Suva, Savura Creek, *Anderson DA69-210* (BISH, HAW), *Anderson 69-125* (HAW), *Anderson L-64.2159* (HAW), *Moore 9359* (SUVA). Rewa Prov.: Savura Reserved Forest, Veikau Road, N. of Suva, *Fuller 309* (CAS, SUVA); track to Mt. Korobaba, *Koroiveibau (DA) 17213* (SUVA).

***Balaka samoensis***, Becc., *Webbia* 4: 267. 1914. Type: Samoa. *Whitmee 4*, January 1875 (holotype K!; isotype [fragments] FI!). *Vitiphoenix samoensis* (Becc.) Burret, *Notizbl. Bot. Gart. Berlin-Dahlem* 13: 600. 1935.

*Balaka burretiana* Christoph., *Bernice P. Bishop Mus. Bull.* 128: 32. 1935. Type: Samoa. Savaii: Matavanu Crater, 900 m, *Christophersen 2260* (holotype BISH!; isotypes UC!, US!)



25. *Balaka samoensis* can grow up to 5 m tall and has elongate pinnae. Matavanu, Savaii, Samoa.

*Balaka siliensis*, Christoph., Bernice P. Bishop Mus. 128: 34. 1935. Type: Samoa. Savaii: above Sili, 300 m, *Christophersen 3260* (holotype and isotype BISH!; isotypes UCI, US!).

To 5 m tall (Fig. 25). Stem to 5 cm diam. Leaves 6–8, ascending-spreading, 1.3–2.25 m long; sheath 25–30 cm long, with a triangular ligule to 2 cm long at apex; petiole to 25–45 cm long; blade 0.8–1.5 m long; pinnae 8–13 per side,

elongate (Fig. 3), slightly sigmoid or falcate, margins converging toward base and slightly converging toward apex and there truncate to obliquely truncate and toothed, to 49 cm long, to 8 cm wide, papery, midrib and several nerves prominent adaxially, apical pair broader and transversely truncate. Inflorescences 2 or 3(4) per plant, infrafoliar, 55–75 cm long, 1- or 2-branched (Fig. 26); peduncle 25–35 cm long; rachis 15–20 cm long, rachillae 10–15, these 15–25 cm long, moderately slender, spreading; triads nearly to apex of rachilla. Staminate flowers with pistillode ca. equaling stamens. Fruit 2.5–4.5 × 1.1–1.3 cm, ovoid-ellipsoid, orange-red (Fig. 27); fruiting perianth 1.0–1.4 cm long (Fig. 27); fruit length to perianth length ratio 3.0 or less; endocarp 1.5–2.8 × 0.6–0.7 cm, with 4, obscure, not angled, longitudinal ridges and no rostrum.

**Distribution and Ecology:** *Balaka samoensis* occurs on Upolu and Savaii in Samoa, where it is a locally common understory palm in moist and wet forest to about 800 m altitude. It has been collected more often on Savaii than on Upolu. I have observed all age sizes of plants, and regeneration appears adequate in some but not all areas.

**Notes:** Elongate, papery pinnae with a prominent midrib and several primary nerves and large fruits with a long fruiting perianth distinguish *Balaka samoensis*. Fruit size and especially length of the fruiting perianth have long been critical characters for distinguishing Samoan *Balaka* because there are few or no other obvious character differences. Indeed, the differences between *B. samoensis* and *B. tahitensis*, the two taxa here recognized from



26. Inflorescences of *Balaka samoensis* are infrafoliar and 1- or 2-branched. Matavanu, Savaii, Samoa.



27. These fruits of *Balaka samoensis* are not yet full size but the long fruiting perianth is clearly evident. Matavanu, Savaii, Samoa.

Samoa, are mainly in fruit length and fruiting perianth length and the ratio of fruit length to perianth length. Fruits of *B. samoensis* generally are 2.5–4.5 cm long, perianths are 10–15 mm long, and, at least in specimens at BISH and HAW, the ratio of fruit length to perianth length is 2.6. In contrast, fruits of *B. tahitensis* are 1.5–2.5 cm long, fruiting perianths are 4–6(–8) mm long, and the ratio of fruit length to perianth length is 5.0 (Table 1). There are a few nearly intermediate collections but, for the most part, these fruit characters can clearly and neatly identify or categorize the two Samoan taxa. Nonetheless, further study may be able to make a case for only one, variable species of *Balaka* in Samoa.

**Conservation Status:** Although currently with no risk assessment designation, *Balaka samoensis* should be considered Least Concern, Near Threatened or perhaps even Vulnerable according to IUCN criteria (IUCN 2010). Widespread and locally common, the primary threats are habitat loss and disturbance due to encroaching urbanization, agricultural development, timber harvesting and introduction of invasive weeds and pests. It may not be cultivated.

**Additional Specimens Examined.** SAMOA. Savaii: Gataivai, 400 m, *Bristol 2291, 2293* (BISH); Maliolio Stream, 280 m, *Whistler 8316* (HAW); Matavanu Crater, 750 m, *Christophersen 2000* (BISH, UC); above Ologogo, 750 m, *Whistler 495* (BISH, HAW); above Sili, 300 m, *Christophersen 3266* (BISH); inland from Vaialia, Sasina, *Cox 240* (BISH, UC). Upolu: Fale o le Fee, 450 m, *Whistler 4751* (BISH, HAW); Fale o le Fee, Vaisingano River, 300 m, *Uchiyama 169* (BISH); Lotofaga, Lafulemu Ranch, W. of Fagatoloa River, 0.5 km NW of bridge, *Teraoka 57* (HAW); Solosolo, 300 m, *Whistler 10153* (HAW).

***Balaka seemannii*** (H. Wendl.) Becc., Ann. Jard. Bot. Buitenzorg 2: 91. 1885. *Ptychosperma seemannii* H. Wendl., Bonplandia 10: 192. 1862. Type: Fiji. Vanua Levu. *Seemann 664* (holotype K!). *Saguaster seemannii* (H. Wendl.) Revis. Gen. Pl. 2: 735. 1891. *Drymophloeus seemannii* (H. Wendl.) Becc. ex Martelli, Nuovo Giorn. Bot. Ital. n. s., 41:711. 1935. *Vitiphoenix seemannii* (H. Wendl.) Becc. ex Martelli, Nuovo Giorn. Bot. Ital. n. s., 42: 87. 1935.

*Balaka perbrevis* (H. Wendl.) Becc., Ann. Jard. Bot. Buitenzorg 2: 91. 1885. *Ptychosperma perbreve* H. Wendl., Bonplandia 10: 193. 1862. Type: Fiji. Vanua Levu. U. S. South



28. *Balaka seemannii* can grow up to 8 m tall. Mt. Sorolevu, Vanua Levu, Fiji.

*Pacific Explor. Exped.* (lectotype GH!). *Saguaster perbrevis* (H. Wendl.) Kuntze, Revis. Gen. Pl. 2: 735. 1891.

*Balaka gracilis* Burret, Repert. Spec. Nov. Regni Veg. 24: 274. 1928. Type: Fiji. Taveuni. *Weber 113* (holotype B, destroyed).

*Balaka cuneata* Burret, Occas. Pap. Bernice P. Bishop Mus. 11(4): 6. 1935. Type: Fiji. Vanua Levu. Thakaundrove Prov.: hills between Vatukawa and Wainigio Rivers, Ndrekeniwai Valley, 200–500 m, *Smith 577* (holotype BISH!; isotypes BO!, NY!, UC!, US!).

To 8 m tall (Fig. 28). Stem to 5 cm diam. Leaves 7–9, ascending-spreading, 1.3–2.0 m long; sheath 30–40 cm long with a long-triangular ligule to 3 cm long at apex; petiole 25–45 cm long; blade 0.8–1.3 m long; pinnae (7–)10–12 per side, cuneate (Fig. 2), margins slightly to markedly diverging, to 25 cm long, to 10 cm wide at apex and there obliquely truncate and conspicuously toothed, papery, midrib and several primary nerves conspicuous adaxially and abaxially, apical pair wider and

transversely truncate and toothed (Fig. 28). Inflorescences (1–)2 or 3 per plant, infrafoliar, (35–)50–75 cm long, 1- or 2-branched (Fig. 29); peduncle 8–30 cm long; rachis 6–25 cm long, rachillae 8–10, these 20–30 cm long, slender, spreading; triads to apex of rachilla. Staminate flowers with 15–20 stamens, pistillode twice as long as stamens, flexuous (Fig. 30). Fruit 1.4–2.5 × 0.5–1.3 cm, curved-ellipsoid, bright red (Fig. 31); fruiting perianth to 6 mm long; endocarp 1.3–2.4 × 0.4–1.1 cm, with 4, prominent, slightly angled, longitudinal ridges with inconspicuous rostrum to 5 mm long (Fig 1).

**Distribution and Ecology:** *Balaka seemannii* occurs on Vanua Levu and Taveuni in Fiji, where it is a locally common, even abundant, understory palm in moist to wet forest from near sea level to 1000 m altitude. Little is known about its natural history, although I observed all sizes, and regeneration appeared good in many localities. Flowering and fruiting probably occur nearly year around.

**Notes:** The typically strongly cuneate pinnae and small fruit with a short fruiting perianth distinguish *Balaka seemannii*. It occurs over a large area of Vanua Levu and Taveuni, where, like *B. longirostris*, it is one of the most variable species of the genus. This variability is most apparent in overall size of the plant and its

various organs. Although pinnae are typically strongly cuneate, with margins markedly diverging toward the apex, in some collections of juvenile or near adult plants pinnae margins are nearly parallel, scarcely diverging toward the apex. Sterile plants with such pinnae can be rather easily confused with juvenile plants of the sometimes co-occurring *Veitchia filifera* and *V. simulans*.

Moore (1977) designated the lectotype of *Ptychosperma perbreve* (*Balaka perbrevis*) at GH. Beccari (Webbia 4: 154. 1913.) misapplied the name *Kentia kersteniana* to *B. seemannii*.

**Conservation Status:** Widespread and locally common, *Balaka seemannii* is designated as Lower Risk/Least Concern (IUCN 2010). The primary potential threats are habitat loss and disturbance due to encroaching urbanization, agriculture, timber harvesting and introduction of invasive weeds and pests. Fuller (1997) noted that it was one of the most common, indigenous palms of Fiji. It is cultivated in Fiji, Hawaii and Australia.

**Additional Specimens Examined.** FIJI. Taveuni: trail to Crater Lake, 300 m, *Anderson DA69-192* (BISH, HAW), *Anderson DA69-192* (HAW), 250 m, *Anderson 69-202* (HAW), *Gillespie 4778* (BISH), 200 m *Fuller 336* (CAS), *Koroiveibau L26190* (SUVA), *Moore 9356* (SUVA), 450 m,

29. Inflorescences of *Balaka seemannii* are infrafoliar and 1- or 2-branched.





30 (left). Staminate flowers of *Balaka seemannii* have 15–20 stamens and a pistillode twice as long as the stamens. Somosomo, Taveuni, Fiji. 31 (right). Mature, ripe fruits of *Balaka seemannii* are bright red. Somosomo, Taveuni, Fiji.

*Parham 14375* (BISH, SUVA); Qeleni Rd., *Koroiveibau 15853* (SUVA). Vanua Levu. Bua Prov.: Koroba Forest, Wairiki, *Koroiveibau 15136* (SUVA); near Nasarowaqa, *Parham 14309* (BISH, SUVA); near Mt. Seatura, *Koroiveibau 15172* (BISH, SUVA); Mt. Korotubunibogi above Oriti Village, 250 m, *McClatchey 1104, 1106* (SUVA); between Korovou and turn-off to Mt. Kasi Mine, *McClatchey 1091* (SUVA). Macuata Prov.: Natua, Seaqaqa pine forests, *Koroiveibau 15347, 15349* (SUVA), *15351* (BISH, SUVA), *15353* (SUVA), *16664* (BISH, SUVA), *16670, 16671* (SUVA); E. of Lambasa, S. slopes of Mt. Numbuiloa, 100–350 m, *Smith 6334* (BISH); Seaqaqa Plateau, Korovuli River drainage near Natua, 100–200 m, *Smith 6674* (BISH), *Koroiveibau 12857* (SUVA); Kumbulau, *Keppel 374* (SUVA); Koroutari, Korovuli River, *Koroiveibau 12879* (SUVA), *15240* (BISH, SUVA); Naliuniga, Seaqaqa, *Koroiveibau 10493* (SUVA). Thakaundrove Prov.: Natewa Peninsula, 7 miles E. of Cacao Experiment Station, *Anderson DA69-166* (BISH, HAW); S. of Natewa, *Smith 1950* (BISH); Saivou Rd. to Savusavu, *Vodonaivalu 18513* (SUVA); Latiki, track to

Nasorolevu, 550 m, *Koroiveibau 17163, 17166, 17167, 17170, 17171, 17173, 17175, 17179* (SUVA); E. drainage of Yanawai River, 20–260 m, *Degener 14075* (BISH, UC); Nayarabale-Vanua Rd., 270 m, *McClatchey 1131* (SUVA); Vesanigoti, *McClatchey 1121, 1122* (SUVA). CULTIVATED. Indonesia. Bogor Botanical Garden. *Hort. Bog. 258* (FI).

***Balaka streptostachys*** D. Fuller & Dowe, *Palms 43: 10*. 1999. Type: Fiji. Vanua Levu. Thakaundrove Prov.: above Nakorutari Village, below ridge above Matani Creek along Raciba Road, 23 Feb. 1996, *Fuller 338* (holotype BRI, isotypes K!, SUVA!).

To 7 m tall (Back Cover). Stem to 10 cm diam. Leaves 7–10, ascending to drooping, 2.5–3.0 m long; sheath 30–50 cm long, frequently obscured with persistent, decaying old sheaths, apical margin lacerate-fibrous; petiole 30–50 cm long; blade 2 m long; pinnae 18–22 per side, elongate-falcate (Back Cover), to 95 cm long, to 8 cm wide, margins converging toward base and apex and there truncate to obliquely truncate and toothed, thick-papery, midrib and

several primary nerves prominent adaxially, apical pair wider and transversely truncate and toothed. Inflorescences 2 or 3 per plant, infrafoliar becoming infrafoliar, 1.0–1.2(–1.5) m long, 3-branched (Fig. 32); peduncle 40–60 cm long; rachis 30–45 cm long; rachillae 25–30, these 15–30 cm long, intermittently twisted (Fig. 33); triads to apex of rachilla. Staminate flowers with 20–30 stamens, pistillode ca. equaling stamens (Fig. 33). Fruit 1.8–2.5 × 0.8–1.4 cm, ovoid, orange-red (Fig. 34); fruiting perianth to 3 mm long; endocarp 0.8–1.5 × 0.5–1.0 cm, with 4, prominent, angled, longitudinal ridges with a very short rostrum 1.5 mm long.

**Distribution and Ecology:** *Balaka streptostachys* is known only from one, small population south of Labasa on the logging road to Mt. Sorolevu on Vanua Levu, Fiji, where it is an understory palm in wet forest at about 300 m altitude on somewhat boggy soils on gently sloping or undulating terrain. Little is known about its natural history. I observed only a few large plants during my visit in 2008. Flowering and fruiting probably occur year around.

**Notes:** The large overall size of the plant and its various organs, including its long leaves with at least 18 pinnae per side, make *Balaka streptostachys* the most distinctive species of

the genus. Indeed, without flowers and fruits, *B. streptostachys*, at first glance, might be easily confused with the co-occurring *Heterospathe longipes* or even suspected of belonging to another genus.

The old, senesced, persistent leaf sheaths, which obscure the crownshaft, and the intermittently twisting rachillae are unique in *Balaka*. Timoci Bultavu discovered this species and brought it to the attention of the late Dick Phillips, long a grower and champion of Fijian palms.

**Conservation Status:** Surprisingly, *Balaka streptostachys* currently has no risk assessment designation (IUCN 2010). However, it should be considered Critically Endangered according to IUCN criteria because of its small population size of only about 60 mature plants in a severely disturbed site that has already been heavily logged and is subject to further timber harvesting. Its narrow, restricted range increases susceptibility to a single, disruptive event, like a hurricane, and to potential damage from invasive weeds, animals, pests and disease. Low seedling recruitment and small population size suppress regeneration. Fuller (1997, as *B. "robusta"*) and Watling (2005) also argued that it should be designated Critically Endangered. It is sparingly cultivated in Hawaii and perhaps Fiji.

32. Inflorescences of *Balaka streptostachys* are 1.0–1.5 m long. Mt. Sorolevu, Vanua Levu, Fiji





33 (left). Rachillae of *Balaka streptostachys* are intermittently twisted and staminate flowers have 20–30 stamens and a pistillode about equaling the stamens. Mt. Sorolevu, Vanua Levu, Fiji. 34 (right). Mature, ripe fruits of *Balaka streptostachys* are orange-red. Mt. Sorolevu, Vanua Levu, Fiji.

Additional Specimens Examined. Fiji. Vanua Levu. Thakaundrove Prov.: toward Mt. Sorolevu, *Phillips s. n.*, (DA) 26472, 26471 (SUVA), *Fuller 188, 189* (SUVA).

***Balaka tahitensis*** (H. Wendl.) Becc., *Webbia* 4: 271. 1914. *Ptychosperma tahitensis* H. Wendl., *Bonplandia* 10: 196. 1862. Type: Samoa. *U. S. South Pacific Explor. Exped.* (holotype GH!; isotype [fragments] FI!). *Saguaster tahitensis* (H. Wendl.) Kuntze, *Revis. Gen. Pl.* 2: 735. 1891.

*Balaka reineckei* (Warb.) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 276. 1928. *Drymophloeus reineckei* Warb., *Bot. Jahrb. Syst.* 25: 590. 1898. Type: Samoa. Upolu: *Reinecke 205* (lectotype US!; isolectotypes BO!, WRS!, FI [fragments]!).

*Balaka minuta* (Rech.) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 278. 1928. *Drymophloeus reineckei* subsp. *minutus* Rech., *Denkschr. Kaiserl. Akad. Wiss. Math.-Naturwiss. Kl.* 85: 237. 1910. Type: Samoa. Savaii: *Rechinger 5300* (holotype W [destroyed]?). *Vitiphoenix minuta* (Rech.) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 278. 1928.

*Balaka brachyclamys* Burret, *Repert. Spec. Nov. Regni Veg.* 24: 276. 1928. Type: Samoa. Upolu: *Reinecke s. n.* (holotype B [destroyed]).

*Balaka polyclada* Burret, *Repert. Spec. Nov. Regni Veg.* 24: 278. 1928. Type: Samoa. Upolu: *Reinecke s. n.* (holotype B [destroyed]). *Vitiphoenix polyclada* (Burret) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 279. 1928.

*Balaka rechingeriana* Burret, *Repert. Spec. Nov. Regni Veg.* 24: 275. 1928. Type: Samoa. Upolu: *Reinecke s. n.* (holotype B [destroyed]).

*Balaka tuasivica* Christoph., *Bernice P. Bishop Mus. Bull.* 128: 36. 1935. Type: Samoa. Savaii: Aopo-Ngangamalae, 1200 m, *Christophersen 3453* (holotype and isotype, BISH!).

To 5 m tall (Fig 35). Stem to 5 cm diam. Leaves 6–8, ascending-spreading, 1.5–1.9 m long; sheath 25–30 cm long, with a short, broad ligule to 1 cm long at apex; petiole to 25–45 cm long; blade 1–1.2 m long; pinnae 8–13 per side, elongate, slightly sigmoid or falcate, margins converging toward base and slightly converging toward apex and there truncate to



35. *Balaka tahitensis* can grow up to 5 m tall and has elongate pinnae. Mt. Vaea, Upolu, Samoa.

obliquely truncate and toothed, to 40 cm long, to 6 cm wide, papery, midrib and several nerves prominent adaxially, apical pair broader and transversely truncate. Inflorescences 2 or 3 per plant, infrafoliar, 45–75 cm long, 1- or 2-branched (Fig. 36); peduncle 15–30 cm long; rachis 20 cm long, rachillae 10–15, these 10–30 cm long, moderately slender, spreading; triads nearly to apex of rachilla. Staminate flowers with ca. 50 stamens, pistillode twice as long as stamens (Fig. 37). Fruit 1.5–2.5 × 1.0–1.2 cm, ovoid-ellipsoid, orange-red (Fig. 38); fruiting perianth 4–6(–8) mm long (Fig. 38), fruit length to perianth height ratio 4.0 or more; endocarp 1.3–2.2 × 0.8–1.0 cm, with 4–6(–10),

rather obscure, not angled, longitudinal ridges and no rostrum.

**Distribution and Ecology:** *Balaka tahitensis* occurs on Upolu and Savaii in Samoa, where it is a locally common understory palm in moist and wet forest to about 800 m altitude. It has been collected more often on Upolu than on Savaii. I have observed all age sizes of plants, and regeneration appears adequate in some but not all areas.

**Notes:** Elongate, papery pinnae with a prominent midrib and several primary nerves and small fruits with a short fruiting perianth distinguish *Balaka tahitensis*. The holotype of



36. Inflorescences of *Balaka tahitensis* are infrafoliar and 1- or 2-branched. Mt. Vaea, Upolu, Samoa.

*B. tahitensis* at GH bears a U.S. South Pacific Exploring Expedition "Sandwich Islands" label but the "Sandwich" has been crossed out and "Tahiti" handwritten on an adjacent, supplemental label. Nonetheless, *B. tahitensis* is not from Tahiti or the Sandwich Islands (Hawaii). Indeed, nothing even resembling *Balaka* has ever been found in Hawaii or Tahiti. Moore (1979) noted that many of the collections resulting from the U.S. South Pacific Exploring Expedition have "scrambled labels," which casts doubt on the origin of some its collections. Beccari, in his work published posthumously by Martelli (1934), was the first to recognize that *B. tahitensis* was from Samoa, not Tahiti.

The length of the fruiting perianth was used for distinguishing the various taxa here included as synonyms of *Balaka tahitensis*. Warburg based *Drymophloeus reineckei* on two syntypes, Reinecke 205 and 631 [Zona (1999) designated Reinecke 205 as the lectotype]. Burret, who transferred *D. reineckei* to *Balaka*, felt that the two Reinecke syntypes were heterogeneous and difficult to correlate with Warburg's original cited numbers and description. Thus, Burret erected two new species, *B. brachychlamys* and *B. rechingeriana*, basing them on fragments of the two original

Reinecke collections, and he distinguished the three taxa mainly on minute and unimportant differences in the length of the fruiting perianth (*B. reineckei* 8 mm long, *B. brachychlamys* 4 mm long, and *B. rechingeriana* 6 mm long). Later, Christophersen named and described *B. tuasivica*, stating it differed from *B. brachychlamys* in its larger, more slender seeds and slightly longer fruiting perianth (4–5 mm vs. 4 mm). These differences in the length of the fruiting perianth seem insignificant and generally fall within the expected natural range of variation of *B. tahitensis*.

Whistler (1992) recognized four species in Samoa. He felt, like Burret, that the two Reinecke syntypes comprising *Drymophloeus reineckei* represented at least two taxa, *B. tahitensis* (including *B. reineckei* pro parte and *B. rechingeriana*) and *B. brachychlamys* (including *B. reineckei* pro parte). He distinguished these two taxa by the length of the fruiting perianth. He stated that in *B. brachychlamys* the fruiting perianth was more than 7 mm long, despite the fact that Burret noted in his protologue for this species that it was only 4 mm long, while in *B. tahitensis* the fruiting perianth was less than 7 mm long. He distinguished *B. brachychlamys* from *B. samoensis*, the other species with a fruiting



37 (left). Staminate flowers of *Balaka tahitensis* have about 50 stamens and a pistillode twice as long as the stamens. Mt. Vaea, Upolu, Samoa. 38 (right). These immature fruits of *Balaka tahitensis* are nearly full size and the short fruiting perianth is clearly evident. Mt. Vaea, Upolu, Samoa.

perianth more than 7 mm long, by the larger fruits of the latter.

Whistler (1992) also recognized *Balaka tuasivica*, distinguishing it from *B. tahitensis* by the number of longitudinal ridges on the endocarp. He stated that endocarp of *B. tuasivica* has up to 10 irregular longitudinal ridges, despite the fact that Christophersen's original drawing showed and the protologue stated the endocarp has six ridges. Nonetheless, the number of longitudinal ridges on the endocarp is a variable character and probably not of much value in distinguishing *Balaka* species.

Although fruit and fruiting perianth length and the ratio of fruit length to perianth length are different between *Balaka tahitensis* and *B. samoensis* (see discussion under *B. samoensis*), further study may make a case for one, variable species of *Balaka* in Samoa.

Conservation Status: Although currently with no risk assessment designation, *Balaka tahitensis* should be considered Least Concern, Near Threatened or perhaps even Vulnerable according to IUCN criteria (IUCN 2010).

Widespread and locally common, the primary threats are habitat loss and disturbance due to encroaching urbanization, agriculture, and timber harvesting, and introduction of invasive weeds and pests. It is cultivated in Hawaii and probably Australia.

Additional Specimens Examined. SAMOA. Upolu: *Reinecke 631* (excluded syntype of *Drymophloeus reineckei*) (BO, K, US, WRSL); *Whitmee 113* (FI); Lake Lanotoo, 740 m, *Whistler 2027* (BISH, HAW); floor of Lua O Fafine Crater above Lolomanu, 180 m, *Whistler 8085* (HAW); Malololelei, 670 m, *Christophersen 6* (BISH); Moa Moa, 200 m, *Eames 128* (BISH); Mt. Le Pue, 100 m, *Cox 221* (UC); inside crater of Mt. Mariota, 600 m, *Whistler 822* (HAW); Mt. Sigale, 700 m, *Whistler 346* (HAW); Mt. Tafuaupolu, 450 m, *Whistler 10124* (HAW); O le Pupu coast, *Whistler 4173* (BISH, HAW), 275 m, *Whistler 11955* (HAW); Tanumalala, 200 m, *McKee 2997* (BISH); Tapatapao, 750 m, *Cox 55* (BISH, UC), *300* (BISH, UC); Tiavi, 650 m, *Whistler 3508* (BISH, HAW), 500 m, *Christophersen 962* (BISH, UC); Tonitoniga, 400 m, *Whistler 728* (HAW). Savaii: Aopo, 550 m, *Whistler 5004* (HAW), 910 m, *Whistler 11727* (HAW); Patamea, 375 m, *Bristol 2324* (BISH).

**Uncertain or Dubious Species**

**Balaka pauciflora** (H. Wendl.) H. E. Moore, *Gentes Herb.* 8: 535. 1957. *Ptychosperma pauciflorum* H. Wendl., *Bonplandia* 10: 193. 1862. Type: Fiji. Ovalau: U. S. South Pacific Explor. Exped. (lectotype GH!). *Saguaster pauciflora* (H. Wendl.) Kuntze, *Revis. Gen. Pl.* 2: 735. 1891. *Vitiphoenix pauciflora* (H. Wendl.) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 270. 1928. *Drymophloeus pauciflorus* (H. Wendl.) Becc., *Atti. Soc. Tosc. Sci. Nat. Pisa, Mem.* 44: 151. 1934.

Height unknown, but probably about 2–3 m tall. Stem 2.5 cm diam. Leaves ca. 60 cm long; sheath ca. 12 cm long; petiole 12 cm long; blade 35 cm long; pinnae 6 per side, elongate, 10 × 1–1.5 cm, margins converging toward base and parallel or slightly converging or even diverging toward apex and there obliquely truncate and toothed, end pinnae broader. Inflorescence 2-branched, 40 cm long; peduncle 8 cm long; rachis 20 cm long; 19 rachillae, these 6–12 cm long, very slender, slightly flexuous; flower nodes few, remote, 2 cm distant, typically at an “elbow” or bend in the flexuous rachillae, triads only in proximal 2–5 flower nodes. Fruit 15 × 9 mm; fruiting perianth 6 mm long.

*Balaka pauciflora*, an enigmatic species known only from the meager lectotype that Moore (1957) designated, was originally collected during the U. S. Exploring Expedition to the South Pacific, purportedly on Ovalau Island, which has some areas of moist and wet forest, near Viti Levu, Fiji. Because many collection labels from the U.S. South Pacific Exploring Expedition have been scrambled and mixed (Moore 1979), *Balaka pauciflora* may not even be from Ovalau or even from Fiji. The lectotype bears the typical U.S. Exploring Expedition “Feejee Islands” label but also has handwritten on it “Upolu,” which is in Samoa, and is annotated by Wendland. Moore searched for it on Ovalau without success in 1980, and Fuller (1997) conducted an extensive search there in 1995, also to no avail. However, there are collections of *Veitchia vitiensis*, which is somewhat similar in general habit to *Balaka*, and, apparently, even one collection of *B. longirostris* (which see) from Ovalau, raising the possibility of a mixed collection. The anomalous inflorescence of *B. pauciflora*, with its slender, slightly flexuous, remotely and few-flowered rachillae, is distinctive and unusual for the genus and also raises the possibility of a mixed collection. Perhaps the lectotype is actually from Upolu, Samoa, which would

make it conspecific with *B. tahitensis* (which see). Fuller (1997) speculated that *B. pauciflora* may be “an early collection of *B. microcarpa*,” but the leaf and especially the inflorescence seem not to depict this latter species. Fuller concluded that *B. pauciflora* was a dubious species.

**Excluded Names**

*Balaka spectabilis* Burret, Bernice P. Bishop Mus. Bull. 141: 13. 1936. = *Veitchia vitiensis* (H. Wendl.) H. E. Moore, *Gentes Herb.* 8: 514. 1957.

*Balaka kersteniana* (Sander) Becc. ex Martelli, *Nuovo Giorn. Bot. Ital., n. s.*, 42:30. 1935. = *Ptychosperma kerstenianum* (Sander) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 263. 1928. *Kentia kersteniana* Sander, *Gard. Chron.* 1898(2): 357. Fig. 113. 1898. Type: Fig. 113 holotype (Sander 1898). *Actinophloeus kerstenianus* (Sander) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 263. 1928. *Drymophloeus kerstenianus* (Sander) Burret, *Repert. Spec. Nov. Regni Veg.* 24: 263. 1928.

Zona (1999) referred this taxon to *Ptychosperma*. Indeed, the pinnae, clearly depicted in the type illustration with praemorse, profoundly concave apices, immediately call to mind *Ptychosperma*. The epithet has been occasionally misspelled “kirsteniana.”

**Acknowledgments**

I am extremely grateful and pleased for the assistance numerous individuals, institutions and organizations provided during the course of this study. They all have my sincere thanks. The following herbaria (and their staff) facilitated my visit, responded to queries and/or photographed specimens for me: B (Robert Vogt), BISH (Napua Harbottle, Clyde Imada), BO (Ary Prihardhyanto Keim), CAS (Debra Trock), FI (Piero Cuccuini, Egildo Luccioli), GH (Carolyn Beans), HAW (Cliff Morden, Tom Ranker), K (William Baker, Martin Xanthos, Lauren Gardiner), NY, SUVA (Marika Tuiwawa), UC (Andrew Doran), US, W (Rainer Heimo) and WRS� (Krzysztof Swierkosz). Maren Mochizuki statistically analyzed fruit length and perianth length of the Samoan taxa. Michael Grayum provided information about type specimens and translated several key passages from German. Ray Baker of Lyon Arboretum, University of Hawaii and nurseryman Jeff Marcus of Mt. View, Hawaii showed me cultivated *Balaka* in their gardens. Art Whistler provided

information about Samoa. Afi Afi, Ian Edwards and Kerry Morris in Samoa and Jim Valentine and Sakiusa Masitoqi in Fiji were admirable field companions. Robert Stone and Dick Watling in Fiji showed me cultivated *Balaka* in their gardens. Dylan Fuller, Dick Watling and Scott Zona reviewed the manuscript and offered valuable suggestions. Ann Harlow of Inter-Library Loans, University of California, Riverside and Danielle Rudeen of the Huntington Library, Art Collections and Botanical Gardens, San Marino, California located and provided many obscure publications concerning *Balaka*. The International Palm Society, Audrey and Philip Keeler and the Carl & Roberta Deutsch Foundation partially supported travel to Samoa and/or Fiji. Finally, I thank my supervisor Rachel Surls for the many years of support of my research and educational programs.

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