A New Species of *Metroxylon* (Arecaceae) from Western Samoa

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**ABSTRACT.** *Metroxylon paulcoxi* sp. nov., from the islands of 'Upolu and Savai'i in Western Samoa, is described, illustrated, and compared to *M. warburgii* (F. Heim) Beccari, which is also present in Samoa. *Metroxylon paulcoxi* is differentiated from *M. warburgii* by the presence of three autopomorphic characters: shorter mid-rachis leaflets, pendulous or variable rachillae, and terminal (distal) rachillae more than twice as long as lateral (proximal) rachillae. In addition, the ambiguous name *M. upoluense* Beccari is discussed.

While surveying the palms of Samoa in 1996 with Scott Zona of Fairchild Tropical Garden, Miami, specimens of *Metroxylon warburgii* (F. Heim) Beccari were collected from the islands of 'Upolu and Savai'i in Western Samoa. During the course of collecting, Samoan colleagues and guides indicated that two entities existed. Further discussions with elderly Samoans confirmed that two ethnovarieties (culturally recognized taxa) of *Metroxylon* traditionally were recognized and collectively called “niu Lotuma.” Although recognized by some informants, the two ethnovarieties do not appear to have separate Samoan names. The leaves of the trees are used by Samoans as leaf thatch, and recently some individuals have learned that the stem pith can be used as a source of edible starch. Some informants indicated that the leaves of one of the two ethnovarieties were not useful for thatch. Throughout both islands, we encountered and collected herbarium specimens from isolated and mixed stands of both ethnovarieties, which appear to be sympatrically and symp-ecologically distributed. Detailed taxonomic studies, as outlined below, support the conclusion that the two entities are specifically distinct, one representing the widely distributed *Metroxylon warburgii*, and the other a Samoan endemic, here described as *Metroxylon paulcoxi*.

Morphological variation in the species of *Metroxylon* sect. *Coelococcus* has been previously considered (McClatchey, 1996), with recognition of wide variation in many vegetative and fruit characters. Much less infrataxon variation has been observed in floral and inflorescence characters. Characters observed in the field varied much more widely than those observed on herbarium specimens; therefore this research has relied more heavily upon field observations of living trees than only upon preserved materials. Previous analysis of morphological variation among populations of species of section *Coelococcus* (McClatchey, 1996) has supported the phentic distinction of each species. These phentic species were then used in a morphological cladistic analysis that provided a hypothesis that *M. paulcoxi* is more closely related to *M. warburgii* than to the other species of section *Coelococcus* (*M. amicarum* (H. Wendland) Beccari, *M. salomonense*, and *M. vitiense*). Only characters that consistently differentiate *M. paulcoxi* and *M. warburgii* (Table 1) have been selected for this discussion, although many more have been used in historical descriptions of the species of *Metroxylon* (Beccari, 1918). A brief synopsis of the historical record of taxonomic studies of *Metroxylon* in Samoa is provided below.

*Metroxylon upoluense* BECCARI, NOMEN DUBIUM

In 1905, the German botanist Rechinger sent specimens of apparently immature *Metroxylon* fruits from the island of 'Upolu, in Samoa, to Beccari in Italy, which were subsequently named *M. upoluense* Beccari. The author located these fruits in FI still in the original envelope that was used to mail them from Samoa. These fruits are pyriform in shape, as are fruits of *M. warburgii* and *M. paulcoxi*, as well as some fruits of *M. amicarum*. Beccari's (1918) description of *M. upoluense* is simply a description of immature pyriform *Metroxylon* fruits, which are unassignable to species. These may represent either *M. warburgii*, which had previously been described, or *M. paulcoxi*, which is herein described. It is also possible that the immature fruits represent *M. amicarum*, but this is improbable because this species is found in Micronesia, far to the northwest of Samoa. Thus the name *M. upoluense* Beccari, which has a type and description that cannot with confidence be determined [WESTERN SAMOA. 'Upolu Island: 1905, Rechinger s.n. (FI), Asiatic Palms-Lepidocaryae Ann. Roy. Bot. Gard. (Calcutta) 12(2): 156–195. 1918] is considered to be a nomen ambiguum.
HISTORY OF OTHER COLLECTIONS

In the early 1970s Harold E. Moore, Jr., collected two groups of specimens from Samoa that he had identified as *Metroxylon warburgii* and *M. upoluense* Beccari. We collected *Metroxylon* at his collection localities, as well as many additional locations of lowland rainforest-swamp edges, garden hedgerows, and village sites where these trees grow. It is possibly significant that trees of both Samoan ethnovarieties were always found in areas of human activities, although human occupation sites were most common in the near swamp and wet lowland areas preferred by *Metroxylon* (Paijmans, 1980). It is likely that at least one anthropogenic introduction of *Metroxylon* into Samoa has occurred (McClatchey & Cox, 1992), but possibly more than one, either anthropogenic or natural, introductions have occurred.

SPECIES CONCEPTS

It is clear that Moore recognized two separate species of *Metroxylon*, calling them *M. warburgii* and *M. upoluense*. Moore typically used a phenetic species concept (Moore, 1973), depending upon character gaps to separate species. I also recognized two species but have not applied the ambiguous name *M. upoluense*. Instead, the unnamed entity is herein described and named in honor of a long-term student of Samoan botany, culture, and ecology, Paul Alan Cox.

*Metroxylon paulcoxii* is considered to be a cladospecies and is differentiated from its sister species, *M. warburgii*, on the basis of three autapomorphies to form a monophyletic group as determined by phylogenetic analysis (McClatchey, 1996) employing Hennig 86 (Farris, 1989): (1) Terminal (distal) rachillae more than twice as long as lateral (proximal) rachillae; (2) Longest lateral rachillae usually less than 16 cm long; and (3) Rachillae erect, horizontal, and pendulous on each branch with the two species sharing a single synapomorphy (absence of pubescence on rachillae bases/axils). *Metroxylon paulcoxii* is also phenetically distinct (Sneath & Sokal, 1973) from all other members of section *Coelococcus* and fits the diagnosable (or phylogenetic) species concept of Cra- craft (1983) and Davis and Nixon (1992).

When considering the appropriate species concept to use for studies of *Metroxylon paulcoxii*, the
work of Rauwerdink (1986) on M. sugu was considered. Rauwerdink worked with a species complex that he divided into the diagnosable units of forma. This was necessary because he was working with Metroxylon sect. Metroxylon, in which asexual reproduction has apparently led to an array of rarely fertile lineages suitably considered as forma of one species. The species of Metroxylon sect. Coelococcus have never been noted as reproducing asexually, and therefore are more easily considered as sexually reproductive, biological species (Mayr, 1942; Mayr & Ashlock, 1991).

Metroxylon paulcoxii McClatchey, sp. nov.
TYPE: Western Samoa. 'Upolu island: road-side between Falevao and La Mafa pass, 10 m alt., Moore & Fasavalu 9985 (holotype, BH). Figure 1A–H.
Table 1. Morphological distinctions between *M. warburgii* and *M. paulcoxii.*

<table>
<thead>
<tr>
<th>Character</th>
<th><em>M. warburgii</em></th>
<th><em>M. paulcoxii</em></th>
</tr>
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<tbody>
<tr>
<td>Mid-rachis leaflet length</td>
<td>&gt;95 cm</td>
<td>&lt;95 cm</td>
</tr>
<tr>
<td>Rachillae attitude</td>
<td>erect</td>
<td>variable</td>
</tr>
<tr>
<td></td>
<td>(none pendulous)</td>
<td>(some to many pendulous)</td>
</tr>
<tr>
<td>Terminal: lateral rachillae length</td>
<td>~1:1 (&lt;2:1)</td>
<td>&gt;2:1</td>
</tr>
<tr>
<td>Inflorescence branching pattern</td>
<td>3rd order</td>
<td>2-3rd order</td>
</tr>
<tr>
<td>Leaflet thickness</td>
<td>0.2–0.3 mm</td>
<td>0.15–0.2 mm</td>
</tr>
<tr>
<td></td>
<td>(uniformly thick)</td>
<td>(variably thick)</td>
</tr>
<tr>
<td>Position of dense leaflet fibers</td>
<td>abaxial surface</td>
<td>adaxial surface</td>
</tr>
</tbody>
</table>

1Leaflet thickness is very thin except where larger veins and bundles occur, where the leaflet may be as thick as 0.3 mm.

A speciebus *Metroxylon warburgii* (Heim) Beccari, aliiis rachillis distinguenda, rachillia distali elongata et rachillis lateralis longitundine deminuentibus aut nullis, rachillis erectissulis, horizontalibus, vel pendulis, rachillia distali saepiuscule pendula.

Small to moderate-sized, 5–10 m tall, solitary, hapaxanthic, polygamous trees (Fig. 1A). Stem erect, 25–45 cm diam., non-branched, the stem frequently surrounded by deteriorating, partially attached leaf sheaths. Leaves moderately large, pinnate, frequently armed with green to yellow-brown spines on the sheath, petiole, and leaflet margins and midribs; petiole 1–3 m long, unarmred or armed; rachis 1.5–2.9 m long; leaflets 120–150, 5–8 cm wide, 70–95 cm long, regularly arranged to grouped, unarmred or armed with short spines 2–5 mm long, along the margins and main vein. Inflorescences branching to second order, aggregated into a suprafamilial compound inflorescence 1–2 m tall, with 8–15 erect branches equivalent to axillary inflorescences (Fig. 1A); peduncle 0.4–1.3 m long, 5–8 cm wide; peduncular bracts 1–5; rachis longer than peduncle, 0.6–1.7 cm long, first-order branches erect with 1–8 rachillae per branch; rachillae erect, pendulous, or horizontal (Fig. 1B), lateral rachillae (if present) 7–12 mm wide, 3–11 cm long, erect, horizontal, or pendulous; terminal rachilla 11–13 mm wide, 14–26 cm long, pendulous and often sigmoid-shaped, ca. 450 flowers/terminal rachilla, each rachilla with a few to many empty proximal bracts (Fig. 1C) and no to many empty distal bracts; floral prophylls spirally arranged in 4 rows. Staminate flowers 3 mm wide; calyx 5 mm long; corolla 8–11 mm long, with 3 (occasionally 4), woolly, valvate (occasionally imbricate) petals (Fig. 1D); corolla more than twice as long as the calyx (Fig. 1E, F); stamens 6 mm long, medifixed and joined at the base into an androecial tube (Fig. 1G, H). Hermaphroditic flowers 3 mm wide; calyx 5 mm long, sepals as in staminate flower; corolla 8–9 mm long, petals as in staminate flower; corolla as in staminate flower; stamens 5 mm long; gynococ- cium 2.5 mm long (Fig. 1E). Fruit pyriform, 5.4–6 cm diam. (Fig. 1f), 6.5–7 cm long, with emergent apical stigmatic remains; epicarp covered in 24–26 rows of green to golden yellow-brown to gray margined, reflexed scales, with the mid-fruit scales 13 mm long; mesocarp 2 mm or more thick, fibrous, corky or spongy, becoming much thicker toward the fruit base; endocarp thin. Seed globose, 3.7 cm wide, basally attached, invaginated up to 20 mm deep with a thin sarcotesta; endosperm homogenous (ivory white); embryo basal. Germination adjacent-ligular; eophyll pinnate. Cytology unknown.

**DISCUSSION**

Although *Metroxylon warburgii* and *M. paulcoxii* are found growing in the same ecosystems on the same islands (sometimes side by side), they are readily distinguishable, even from a distance. Their distributions, however, are at least in part due to human plantation activities; therefore the sympatric distribution may simply be an artifact of human actions rather than ecological similarities.

*Metroxylon paulcoxii* (Fig. 2) is distinguished from *M. warburgii* (Fig. 3) by the following characters: (1) Mid-rachis leaflets shorter than 95 cm long vs. mid-rachis leaflets longer than 95 cm long in *M. warburgii.* (2) Rachillae pendulous, horizontal, or only some erect vs. rachillae mostly erect with some horizontal. (3) Terminal (distal) rachilla: lateral (proximal) rachilla length ratio greater than 2:1 and some (commonly terminal) rachillae pendulous vs. terminal rachilla: lateral (proximal) rachilla length ratio less than 2:1 (Table 1).

Inflorescences of *Metroxylon warburgii* are always branched to the third order, whereas those of *M. paulcoxii* are typically only branched to the second order (Fig. 4). This appears to be part of a reduction trend in *M. paulcoxii,* where the lateral rachillae have been reduced in size and number or
are entirely absent as compared to specimens of *M. warburgii*. At the same time, there appears to be an increase or dominance in the distal rachilla, which is lengthened through extended growth and maturation of bracts and flowers at its base. One specimen of *M. paulcoxii*, McClatchey, Zona & Poai 1192, has inflorescence branches that have a few secondary branches that resemble *M. warburgii*, while the remaining branches resemble *M. paulcoxii*. This may represent a hybrid or may merely represent part of the morphological variability of *M. paulcoxii*.

Preliminary anatomical studies indicate that *Metroxylon warburgii* and *M. paulcoxii* also differ in their leaf anatomy. Leaflets of *M. warburgii* are thicker (0.2–0.3 mm vs. 0.15–0.2 mm), less variable in thickness (*M. paulcoxii* is highly variable, thicker where bundles are located, sometimes locally up to 0.3 mm thick, and thinner between bundles), and contain larger bundles of non-lignified fibers. Furthermore the fibers of *M. paulcoxii* are distributed with greater numbers occurring under the hypodermis of the abaxial side of the leaflet, whereas greater numbers of fibers are located under the adaxial surface of leaflets of *M. warburgii*.

**Paratypes.** Although H. E. Moore, Jr., typically collected duplicates of specimens, no isotypes of *Moore* have been located. WESTERN SAMOA. Savaii: tapu elieli, McClatchey, Zona, Poai, Schuster & Tipamau 1192 (BH, BISH, BRY, FTG, K), McClatchey, Zona & Schuster 1193 (BH, BISH, BRY, FTG, K). *Upolu Island*: Mafa pass, Lotofaga Uta, McClatchey & Zona 1186 (BH, BISH, BRY, FTG, K); Tuamasaga, Le au va’a uta, McClatchey, Zona, Tipamau & Poai 1198 (BH, BISH, BRY, FTG, K).

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**Literature Cited**


