Two Different Descriptions of Mangifera caloneura Kurz

Yumi UEDA and Hirokazu HIGUCHI*

Graduate School of Agriculture, Kyoto University, Kitashirakawa, Sakyo-ku, Kyoto 606-8502, Japan

Abstract Mangos are the fruits of Mangifera species, most of which are distributed in Southeast Asia. M. caloneura Kurz is a common wild mango in mainland Southeast Asia where it is utilized locally for its edible fruit. This species has been a subject of recent attention in explorations of mango folk taxonomy. However, species assignment to M. caloneura is difficult because there are two different descriptions: one indicates the presence of only 1 fertile stamen per flower and the second indicates 5 fertile stamens. The type diagnosis by Kurz describes 1 fertile stamen per flower; nevertheless, Kurz has been retained as the binomial authority in all subsequent literature, even in works describing the presence of 5 fertile stamens. Here, we track taxonomic developments over 138 years to demonstrate how inconsistencies have arisen.

Key words: Mangifera pentandra Hook. f., Plant taxonomy, Southeast Asia, Wild mangoes

Introduction

Mangos are fruits produced by members of the genus Mangifera (Anacardiaceae). Most species of Mangifera occur wild in Asia; an exception is the common mango (M. indica L.), which is of Asian origin but has been introduced to all subtropical/tropical regions of the planet for commercial fruit production. Fruits of other Mangifera species are sometimes used locally as a source of food.

Wild mangos have been subjected to recent research focused on local utilization and folk taxonomy (e.g., Kostermans and Bompard, 1993; Chayamarit, 2010; Ueda et al., 2011). Kostermans and Bompard (1993) conducted field surveys mainly in Kalimantan and on the Malay Peninsula, recording local names, uses, and the ecological and agronomic features of each species. They prepared a taxonomic revision of the whole genus. Chayamarit (2010) revised congeners occurring in Thailand on the basis of collected specimens. She provided information on distribution, ecology and local names. Ueda et al. (2011) studied wild mangos in mainland Southeast Asia, recording various local names and uses to better understand folk taxonomy.

The dominant wild mango in northeast Thailand occurs in mixed deciduous forests and especially in crop fields (Plate 1). The local term for this plant is *muang paa*. It has thick, stiff leaves, 5 fertile stamens per flower, and small globose fruits weighing ≈40 g each. In formal taxonomic treatments, the species has been assigned to either M. pentandra Hook. f. or M. caloneura Kurz. The confusion can be traced back to two different descriptions of M. caloneura. These two descriptions differ in the number of fertile stamens occurring in each flower of M. caloneura: Kostermans and Bompard (1993) described 5 fertile stamens, but Chayamarit (2010) reported only 1. Here, we review the relevant literature to determine the origins of this inconsistency.

Descriptions of Mangifera caloneura Kurz

Conflicting reports on the number of fertile stamens

Descriptions of M. caloneura Kurz from the original to the latest literature are presented in chronological order in Table 1. Hereafter, we focus only on the number of fertile stamens, because this is the key trait for diagnosing species.

The first description: M. caloneura has 1 fertile stamen

The original description was published by Kurz (1873) (#1 in Table 1) in a work entitled “New Burmese plants part II” (in the Journal of the Asiatic Society). Kurz (1873) named the entity Mangifera caloneura nov. sp., clearly indicating that it was a previously unrecognized species. The Latin diagnosis contains the following unequivocal information: “stamen 1” (Fig. 1).

Descriptions after Kurz (1873)

Descriptions through the next decade refer to 1 or 2 stamens in the species (e.g., Hooker, 1876; Kurz, 1877; Engler, 1883) (Fig. 2).

Hooker (1876) (#2 in Table 1) described M. caloneura flowers with “stamens 1 or 2 fertile” in The Flora of British India, Vol. 2 (Fig. 3). This monograph also contains the original description of M. pentandra Hook. f. This is the first work to list both M. caloneura and M. caloneura.
Plate 1. A typical wild mango tree found in cassava field in northeast Thailand: (A) tree shape, (B) fruit on branches, (C) leaves, (D) flower, and (E) fruit. This species has thick, stiff leaves, 5 fertile stamens, and small globose fruits (≈40 g each).

Table 1. Taxonomic literature on **Mangifera caloneura** presented in chronological order together with details on the number of fertile stamens described; titles of the works are also presented.

<table>
<thead>
<tr>
<th>Literature</th>
<th>Year</th>
<th>Author</th>
<th>Description on the Number of Stamens</th>
<th>Titles of the Works*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1873</td>
<td>Kurz, S.</td>
<td>Stamen 1</td>
<td>New Burmese plants part II</td>
</tr>
<tr>
<td>2</td>
<td>1876</td>
<td>Hooker, J. D.</td>
<td>Stamens 1 or 2 fertile</td>
<td>The Flora of British India, Vol. 2</td>
</tr>
<tr>
<td>3</td>
<td>1877</td>
<td>Kurz, S.</td>
<td>Stamen 1, fertile</td>
<td>Forest Flora of British Burma, Vol. 1</td>
</tr>
<tr>
<td>4</td>
<td>1883</td>
<td>Engler, A.</td>
<td>Staminibus fertilibus 1–2</td>
<td>Monographiae Phanerogamarum, Vol. 4</td>
</tr>
<tr>
<td>5</td>
<td>1897</td>
<td>Pierre, L.</td>
<td>Etamines fertiles au nombre de 5</td>
<td>Flore Forestière de la Cochinchine</td>
</tr>
<tr>
<td>6</td>
<td>1906</td>
<td>Brandis, D.D.</td>
<td>One stamen only perfect, as the description of genus <strong>Mangifera</strong></td>
<td>Indian Trees</td>
</tr>
<tr>
<td>7</td>
<td>1948</td>
<td>Fairchild, D.</td>
<td>Stamens 5, as translation of Pierre (1897)</td>
<td>The mango relatives of Cochin China; those with five stamen flowers</td>
</tr>
<tr>
<td>8</td>
<td>1949</td>
<td>Mukherji, S.</td>
<td>Stamens 5, 1 rarely 2–3 perfect</td>
<td>A monograph on the genus <strong>Mangifera</strong> L.</td>
</tr>
<tr>
<td>9</td>
<td>1968</td>
<td>Singh, L. B.</td>
<td>The stamens are five in number, only one, rarely two to three, being perfect</td>
<td>The Mango: Botany, Cultivation, and Utilization</td>
</tr>
<tr>
<td>10</td>
<td>1993</td>
<td>Kostermans, A. J. G. H. and J. M. Bomard</td>
<td>Stamens 10–12 of which usually 5–6 fertile</td>
<td>The Mangoes: Their Botany, Nomenclature, Horticulture and Utilization</td>
</tr>
<tr>
<td>11</td>
<td>1997</td>
<td>Bomard, J. M. and R. J. Schnell</td>
<td>The flowers are characterized by the presence of five fertile stamens, as the description of section Euntherae Pierre</td>
<td>The Mango: Botany, Production and Uses</td>
</tr>
<tr>
<td>12</td>
<td>2010</td>
<td>Chayamarit, K.</td>
<td>Stamen 1 fertile</td>
<td>Flora of Thailand, Vol. 10</td>
</tr>
</tbody>
</table>

*Titles written in italics indicate titles of books.

**pentandra.** Flowers of *M. pentandra* were described as having “5 perfect” stamens (Fig. 3). These early descriptions indicate no overlap in the number of fertile stamens between the species. **Kurz** (1877) (#3 in Table 1) described *M. caloneura* again (in English) in the *Forest Flora of British Burma, Vol. 1* in which the number of stamens was identical to his previous diagnosis (Kurz, 1873).
131. Mangifera caloneura, nov. sp.

Arbor medio-ensis, glabra; folia oblonga ad oblongo-lanceolata, 8-5 poll., petiolato basi valde inciso-sato 1-4 poll., suffulta, obtuso acuminata, coriacea, glabra, utrinque elegantissime minuta et prominenter reticulata, costa crassa lata, presertim supra prominenti et subplanitectura, nervis laterrubibus viridia virvus 18-23, tenuibus; flores parvi, sessiles vel subsessiles parvulorum terminalis tumescens amplam formantem; calyx pubescens; petala lanceolata, acuta, reflexa, lineam cinctae longa. ellipsoidea, alba, medio linea citrina percursa; stamen 1, anthera atropurpurea; discus 5-latus, lavia; drupa ovata gallinacea magnitudine subreniformi-ovoidae, laves, obtusa, aurantiaca v. lutae, acido-dulces, suberetic.—Peyr., Martaban. M. indicus affinis, reticulatio elegansimae statim recognoscenda.


Fig. 1. The original description of Mangifera caloneura prepared by Kurz (1873). Underlining is that of the authors.

![Figure 1](image1)

Fig. 2. Chronological chart of literature describing Mangifera caloneura dichotomized by the number of fertile stamens.

Engler (1883) (#4 in Table 1) also described M. caloneura in the Monographiae Phanerogamarum, Vol. 4 (Monographs of Flowering Plants) as having “staminibus fere libis 1-2” (fertile stamens 1-2) and M. pentandra as having “staminibus 5” (stamens 5).

Another description: M. caloneura with 5 fertile stamens

There exists a different description of M. caloneura published by Pierre (1897) (#5 in Table 1) in Flore Forestière de la Cochinchine (Fig. 2). He (loc. cit.) divided the genus Mangifera into five sections (discussed below in detail). M. caloneura Kurz and M. pentandra Hook. f. were included in a new section with “etamines 5 à 12 dont 5 à 6 fertiles” (stamens 5–12, of which 5–6 are fertile) (Fig. 4-1). In the individual species descriptions, members of this section are diagnosed as having 5–6 fertile stamens. M. pentandra was described thus: “Etamines 5” (Stamens 5); M. caloneura was described thus: “Etamines fertiles ou nombre de 5” (The number of fertile stamens 5) (Fig. 4-1). The flowers are illustrated by Pierre (1897) in the Flore Forestière de la Cochinchine (Fig. 4-2).

Five decades later, the descriptions by Pierre (1897) became a focus of attention and were published again in English by Fairchild (1948) (#7 in Table 1) in a work entitled “The mango relatives of Cochinch China; those with 5 stamen flowers.”

Descriptions following Pierre (1897)

The descriptions of Pierre (1897) were not accepted by most subsequent taxonomic works (e.g., Brandis, 1906; Mukherji, 1949; Singh, 1968; Chayamarit, 2010) (Fig. 2). Brandis (1906) (#6 in Table 1) listed three Mangifera species, including M. caloneura, and described them as having “1 stamen only perfect”. Mukherji (1949) (#8 in Table 1) described 41 Mangifera species in his work entitled “A monograph on the genus Mangifera L.” M. caloneura Kurz was described as having “stamens 5, 1 rarely 2–3 perfect”, and M. pentandra Hook. f. as having “stamens 5, all perfect.” He also indicated that M. pentandra is closely related to M. caloneura although the two differ in the numbers of perfect stamens. Mukherji’s (1949) descriptions of 15 species, including M. caloneura and M. pentandra, were incorporated into
Singh's (1968) *The Mango: Botany, Cultivation, and Utilization* (#9 in Table 1).

**Resurrection of Pierre's (1897) mango taxonomy**

Kostermans and Bomlard (1993) (#10 in Table 1) accepted Pierre's (1897) descriptions (the first acceptance since 1897) in their monograph *The Mangoes: Their Botany, Nomenclature, Horticulture and Utilization*. They (Kostermans and Bomlard, 1993) described *M. caloneura* as having "stamens 10–12 of which usually 5–6 fertile," and *M. pentandra* as having "stamens (3–)5." Importantly, Kostermans and Bomlard (1993) indicated that "The type specimen of *M. caloneura* has abnormal flowers, where stamens have become narrowly petaloid." This note indicates that Kurz (1873) likely missed 5 fertile stamens in his type material. An isotype specimen of *M. caloneura* prepared by Kurz is available for online viewing (Fig. 5). Bomlard and Schnell (1997) accepted the taxonomic views of Kostermans and Bomlard (1993) in their work *The Mango: Botany, Production and Uses* (#11 in Table 1).

**The latest description**

Chayamarit (1994) published a "Preliminary checklist of the family Anacardiaceae in Thailand" in the *Thai Forest Bulletin*. She included *M. caloneura* in the flora of Thailand. Subsequently, she (Chayamarit, 2010; #12 in Table 1) revised the descriptions of all species in the Anacardiaceae occurring in Thailand. In this monograph, *M. caloneura* is described as having "stamen 1 fertile," and *M. pentandra* as having "stamens 5, all fertile." This is the latest description of *M. caloneura*.
have changed over time. Here, we address these taxonomic shifts, with particular focus on *M. caloneura*.

Hooker (1876) was the first to assign *M. caloneura* to a generic section. He (loc. cit.) subdivided the genus *Mangifera* into two sections based on the size of the flower disc. Engler (1883) accepted Hooker’s sections, and divided one of them into two groups based on differences in the number of petals. Pierre (1897) subdivided the genus *Mangifera* by disc development into no less than five sections; *M. caloneura* was assigned to a new section (section 1 *Euantherae* Pierre), which contained species with 5 or 6 fertile stamens. Mukherji (1949) rejected Pierre’s (1897) subgeneric taxonomy, part of which was also criticized by Kostermans and Bomard (1993). Mukherji (1949) and Singh (1968) ignored Pierre’s (1897) subdivisions, and reverted to those of Hooker (1876). However, Kostermans and Bomard (1993) re-instated the *Euantherae*, and assigned *M. caloneura* to this section. This section was diagnosed by “staminibus fertilibus 5–6” (fertile stamens 5–6).

Both Pierre (1897) and Kostermans and Bomard (1993) referred to the number of stamens in their descriptions of the section. The two publications list *M. caloneura* with 5 fertile stamens; accordingly, the species was assigned to a generic section with 5–6 fertile stamens. However, had these authors described *M. caloneura* with a single fertile stamen, the entity would necessarily have been assigned to a different section. Thus, the number of fertile stamens is crucial for the section assignment of *M. caloneura*.

**Recent trends in the literature adopting the classification of Kostermans and Bomard (1993)**

Most scholarly works describe *M. caloneura* as having only 1 or 2 fertile stamens. Only Pierre (1897) and Kostermans and Bomard (1993) describe 5 or 6 fertile stamens. Nevertheless, there has been wide acceptance of their conclusions in popular literature and online (e.g., Gardner *et al.*, 2000; TISTR, 2009). A contributory factor in this wide acceptance may stem from the fact that the work by Kostermans and Bomard (1993) has been widely read. It was published as a report for a project funded by several influential international organizations,
including the WWF (World Wide Fund for Nature), and was written for an expected audience of horticulturists and mango growers rather than professional taxonomists. Most readers are unlikely to have delved into taxonomic detail presented in rather difficult literature.

Recent studies dealing with *M. caloneura*

Specimens with 5 stamens assigned to *M. caloneura*

*M. caloneura* has recently been subjected to professional taxonomic analysis as follows: Eiadthong *et al.* (1999b) examined 13 *Mangifera* species in Thailand and reported on their morphological and ecological characteristics. They and co-workers analyzed phylogenetic relationships among the *Mangifera* species using a variety of molecular markers, such as RFLPs (restriction fragment length polymorphisms) of chloroplast DNA (Eiadthong *et al.*, 1999a), AFLP (amplified fragment length polymorphism) (Eiadthong *et al.*, 2000a), and the sequence in the ITS (internal transcribed spacer) region of nuclear ribosomal DNA (Yonemori *et al.*, 2002). Specimens of *M. caloneura* sampled in these works appeared to have 5 fertile stamens (Eiadthong *et al.*, 2000b).

In an ethnobotanical work on wild mangoes, Ueda *et al.* (2011) also identified a 5-stamen mango as *M. caloneura* (personal communication).

Specimens assigned to *M. caloneura* without reference to previous descriptions

Sawangchote *et al.* (2009) used leaves of extant *M. caloneura* for comparison with fossil leaves of *Mangifera*. Ecological studies in Thailand on forest species composition have also assigned specimens to *M. caloneura* (Marod *et al.*, 1999, 2002; Yahya *et al.*, 2008). However, in all of these studies there is no presentation of the evidence used for species assignment.

Inconsistency between the type specimen and subsequent descriptions

Pierre’s (1897) description of the number of fertile stamens was radically different from that of Kurz (1873). The difference is so large that the authors were likely not referring to the same species. Nevertheless, Kurz has always been used as the binomial authority. Kostermans and Bompard (1993) supported Pierre’s (1897) description and assumed that the type specimen prepared by Kurz (1873) is abnormal in its petal-like stamen structure. Pierre (1897) did not address this issue.

What is *muang paa*?

Finally, we discuss the species assignment of *muang paa* (Plate 1), which is distributed in Thailand. Our identification is based on the two recent publications: Chayamarit (2010), in which *M. caloneura* is described as having 1 fertile stamen, and Kostermans and Bompard (1993), in which the species is described as having 5 fertile stamens.

On the basis of collections in Thailand, Chayamarit (2010) concluded the existence of four *Mangifera* species with 5 fertile stamens. According to her (loc. cit.) classification, *muang paa* is assigned to *M. pentandra* since it has three ridges on petals and no staminodes.

However, according to the classification of Kostermans and Bompard (1993), which reported the existence of three species with 5 fertile stamens in the genus, the leaf shape of *muang paa* indicates possible affinities with *M. caloneura* and *M. pentandra* (among three candidate species). *M. caloneura* was described as follows: “Petals 1.5–2 mm long. Ridges not free from the petals. Flowers white in almost sessile glomerules. Stamens 10–12 of which usually 5–8 fertile,” and *M. pentandra* as follows: “Petals 3–4.5 mm long. The three inner ridges apically (at the reflexion) slightly free from the petal surface. Flowers yellowish. Fertile stamens (3–5).” Thus, the lengths of the petals and ridges, and the numbers of stamens, including those that are not fertile, distinguish the two species.

In *muang paa*, the ridges are free at the tip of the petal, and no staminode is present in the flower (Plate 1). Petal length is ≈4 mm. Thus, we identify *muang paa* as *M. pentandra* by the criteria published by Kostermans and Bompard (1993).

Why is *muang paa* sometimes identified as *M. caloneura*? We speculate that information on the distribution and ecology of *M. caloneura* and *M. pentandra* may lead to misidentification. Kostermans and Bompard (1993) described the distribution and ecology of *M. pentandra* as follows: “Malay Peninsula, more rare in North Borneo, perhaps also in Thailand. Wet, evergreen tropical forest, lowland,” and those of *M. caloneura* as follows: “From Southern Burma through Thailand to Indochina”; the habitats of the species were described as follows: “Both in ever wet tropical lowland rain forest and in monsoon (deciduous) forest.” The ecology in northeast Thailand is monsoon deciduous forest. *Muang paa* collected in such habitat is likely to be identified as *M. caloneura* by lay botanists.

Conclusion

We describe in this review the inconsistencies within the taxonomic literature on *M. caloneura*. The original de-
cription was published by Kurz (1873) and accepted by most subsequent taxonomic works other than those of Pierre (1897) and Kostermans and Bompard (1993), who listed different numbers of fertile stamens from those described by Kurz (1873). Thus, a dichotomy exists in the literature, with descriptions based on Kurz (1873) reporting 1 fertile stamen per flower and those based on Pierre (1897) reporting 5 fertile stamens per flower.

When an original description is modified, the new version must be identified by changing either the binomial authority or the specific epithet. Kostermans and Bompard (1993) observed the type specimen and concluded that it was abnormal; they then prepared a description that was different from the original. Despite the valuable conclusions of these authors, they (loc. cit.) changed neither the authority nor the specific epithet. This incomplete procedure has caused confusion among subsequent studies. Until taxonomic decisions have been finalized, working botanists should reduce potential confusion by either following the original description or by providing alternate descriptions that are comprehensively linked to the existing literature.

Finally we note that muang pao in northeast Thailand can be assigned to M. pentandra using either of the extant descriptions.

Footnote


References


