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THE PANDAN FLORA OF FOJA-MAMBERAMO GAME RESERVE AND BALEIEM VALLEY, PAPUA-INDONESIA

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ABSTRACT
KEIM, A. P. 2012. The Pandan flora of Foja-Mamberamo Game Reserve and Baliem Valley, Papua–Indonesia. Reinwardtia 13 (3): 271–297. — Seven species of Pandanus and seven species of Freycinetia are observed in Kwerba and adjacent areas within the Foja-Mamberamo Game Reserve, Papua-Indonesia. Two species are proposed as new: Freycinetia kwerbaensis A.P. Keim and Pandanus korwae A.P. Keim. This recent study also acknowledges a new record for F. mariannensis and a possibly new record for F. vidalii. The rest are extension of distribution areas in mainland New Guinea. The discovery of a long searched almost mythical wild type of widely cultivated P. conoideus is also accomplished. A new species from Baliem Valley nearby Wamena in the Jayawijaya Mountains, Papua-Indonesia namely F. wamenaensis A.P. Keim is described

Keywords: Foja, Freycinetia, Jayawijaya, Mamberamo, New Guinea, Pandanaceae, Pandanus, Papua, Wamena.

INTRODUCTION

Amberamo Basin
The Mamberamo river basin (i.e. Mamberamo Basin) is a large area nurtured by the mighty river Mamberamo located in the northern-central Indonesian province of Papua. The area covers both Foja (then Gauttier, Anonymous, 1938) and van Rees Mountains, in which Foja being the largest part of the basin.

The Foja Mountains is located north of the Mamberamo river basin and covers an area of 9,712 km², in which more than 3,000 km² are composed of lavish tropical rainforests. The highest point is Mount Foja (hence the name of the mountains) with altitude of approximately 2,193 meters and located at latitude of 3°5’49‖S and longitude of 138°44’16‖ E.

The combination of difficult accessibility and low density of human population make the forests in the Foja Mountains are relatively untouched, and thus make them as the largest undisturbed tropical rainforest in the Asia Pacific region. Based on this exceptional nature circumstance on October 21st 1982 (Anonymous, 2004) the Indonesian government established the mountains and the neighbouring Mamberamo Basin as a protected area in the form of Game Reserve formally the Foja-Mamberamo Game Reserve.

Prior to this current study, the only information on the pandan flora of the Mamberamo Basin was by Brass based on collections made through the 3rd Archbold Expedition to New Guinea (Merrill & Perry, 1939; 1940). However, this expedition did not penetrate further north into the Foja-Mamberamo area.

This current study was carried out in the Kwerba vicinity, which is within the Foja-Mamberamo area. The main location was Bringnyawa (ca. 1200 m altitude) and surrounding areas from that altitude down to approximately 800 m. Bringnyawa was a village for the Kwerba people prior to the
Indonesia Administration (UNTEA Administration, ca. 1969). Since then the Wamenas had moved down to the present location, Kwerba (2°38′32.2″S, 138°24′38.2″E) at much lower altitude (90 to 100 m) and Brinnyawa was deserted, but it is still regarded a sacred place though.

The result of this current study indicates that seven species of Pandanus and eight species of Freycinetia are observed in Wamena and adjacent areas within the Foja-Mamberamo Game Reserve. Three species are proposed as new: *Freycinetia kwerbaensis* A.P. Keim, *F. wamenaensis*, and *Pandanus korvae* A.P. Keim. This recent study also acknowledges a new record for *F. mariannensis* and a possibly new record for *F. vidalii*. The rest are extension of distribution areas in mainland New Guinea. The discovery of a long searched almost mythical wild type of widely cultivated *P. conoideus* is also attained.

**Baliem Valley**

South of the Mamberamo river basin stand the mighty Jayawijaya Mountains with the great Baliem Valley rest within. Wamena, located at 1600 to 1700 meter altitude, is the most important city in the valley and being the centre of administration, Wamena is the capital of the mountainous District of Jayawijaya, and cultural activities it is undoubtedly the most populated area in the valley.

Prior to this current study the pandan flora of the Baliem Valley was studied by Brass (Merrill & Perry 1940), but the area understudy was restricted to around Lake Habema. Keim (Keim et al. 2006) incorporated wider areas covering Wamena up to Trans Kurulu-Pass Valley, excluding Lake Habema. Interestingly there has been no report of any species of Freycinetia in the two publications. The result of this current study reveals both the first record of Freycinetia in the valley and the existence of a species new to science from the Wamena Biological Garden namely *F. wamenaensis*.

Wamena Biological Garden is a 150 hectares garden located in the Gunung Susu area about 8 km Northwest of Wamena. The garden was established by the Indonesian Institute of Sciences (LIPI) on 12 June 1995. It aim is to serve as an ex-situ conservation area for the indigenous biota of the central highlands of Papua and adjacent areas including the Lorentz National Park.

There are two creeks of importance flow in the garden, the Gur and Dupuk. These creeks serve as the source of running water and are of biologically most diverse areas in the garden. Freycinetia wamenaensis was firstly found along the banks of Dupuk Creek in 2009. It has never been so far spotted in Gur.

**DESCRIPTIONS OF SPECIES**

1. *Freycinetia kwerbaensis* A.P. Keim, *sp. nov.* — Figs. 1 & 2.

    Gracilis fruticosa, non scandens; infructescetiae ternate vel quaternate; cephalium ellipsoides; stigmata 2 vel 3, plerumque 3. — Type: A.P. Keim 1165 (BO!), Indonesia, Papua, Mamberamo Raya, Kwerba, Tace-waram, Kuikarawar, 21 Nov. 2008.

    Slender non climbing pandan, up to 1 m high. *Stem* 0.5–0.6 cm diameter; internodes 0.8 cm. *Leaf* oblong (spathoides), 20–28 cm long, 3.5–5 cm wide, acuminate apex, spines on terminal and basal parts only; adaxial surface green, glabrous; abaxial surface light green, glabrous; auricle tapered, glabrous, brown. *Infructescence* terminal, consists of 3 or 4 cephala (ternate or quaternate – in quaternate infructescence one cephala undeveloped), each 4–6 cm long; peduncle 1–1.5 cm long; pedicel 1.5–1.8 cm long, bright yellowish green, glabrous. *Cephalium* ellipsoides, 2.5–3.5 cm long, 1.5–1.5 cm circumference, green when young turns to orange when mature. *Berry* 0.2 cm long, 0.1 cm wide; number of stigmatic remains 2–3, mostly 3, deep brown.

    **Etymology.** After the village Kwerba, where the type was collected.

    **Distribution.** Known only from type locality.

    **Habitat.** Lowland, hill slope, commonly found close to a path at about 75 m altitude.

    **Vernacular name.** Not recorded.

    **Uses.** Cephalium said to be consumed by birds.

    **Notes.** Despite sharing the possession of oblong (spathoides) leaves, *F. kwerbaensis* differs from *F. oblongoleata* in 3 morphological characters (Table 1). Although the minute advantages (i.e. climbing) roots are observed in *F. kwerbaensis*, this species has never been observed to undertake the climbing habit. Prior to this current study *F. arborea* is the only species in the genus known to posses a non climbing (i.e. arborescent) habit. The number of stigmatic remains in *F. kwerbaensis* is almost always 3. Berries with the number of stigmatic remains 2 are rarely seen and they are only observed in the undeveloped cephala in the quaternate infructescence.

    **Specimen collected.** Only known from the type.
Table 1. Morphological comparison on habit, number of stigmatic remains, and the length of berries between *Freycinetia kwerbaensis* and *F. oblanceolata*.

<table>
<thead>
<tr>
<th>Species</th>
<th>Habit</th>
<th>Number of stigmatic remains</th>
<th>Length of a berry</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Freycinetia kwerbaensis</em></td>
<td>Non climber, small fairly erect bush but never climber</td>
<td>2 to 3, mostly 3 and never less than 2</td>
<td>2 mm</td>
</tr>
<tr>
<td><em>F. oblanceolata</em></td>
<td>Climber</td>
<td>1 to 2, never more than 2</td>
<td>7 mm (according to Beccari, 1910)</td>
</tr>
</tbody>
</table>

Fig. 1. *Freycinetia kwerbaensis* A.P. Keim (from the type, *A.P. Keim* 1165) showing the slender habit, the oblanceolate (spathoideous) leaves that exceedingly similar to *F. oblanceolata* and the infructescence consist of 4 unequal cephalia (quaternate). Photo: A.P. Keim.

Distribution. Mainland New Guinea
Habitat. Lowland tropical rainforest at about 100 m altitude. In Kwerba it is found at about 85 m altitude. Although abundantly found, mostly were not in flowering or fruiting.

Vernacular name. Not recorded.
Uses. Not recorded.
Notes. Prior to this study F. laeta was only known from Papua New Guinea, thus the result of this study extends the species distribution into the Mamberamo Basin. Freycinetia laeta can be easily recognised in the field by its robust habit, the obvious reddish orange colouration on bracts and basal part of leaf, the tapered auricle, the non needle-like berries with 3 to 4 stigmas. In the field F. laeta looks exceedingly similar to F. marginata; however, the two species differ mainly in three morphological characters (Table 2). Even if the individuals are sterile, F. laeta can still be distinguished from F. marginata through the colour of the terminal leaves. The terminal leaves in F. laeta are green with bright orange tints. In F. marginata the terminal leaves are green with reddish orange to red tints on terminal parts.

Specimen collected. Indonesia, Papua, Mamberamo Raya, Mamberamo Tengah, Kwerba, Tacewaram, Kwerep, 02 Nov. 2008, A.P. Keim 1078 (BO!).

3. FREYCINETIA MARGINATA Blume. — Type: Zippelius 219-a (L), Indonesia, Papua, Triton Bay, Kaimana, Dobo, June-July 1828. — Fig. 3.

Table 2. Morphological comparison on the colours of bracts and anthers, and the shapes of berries between Freycinetia laeta and F. marginata.

<table>
<thead>
<tr>
<th>Species</th>
<th>Colour of bracts</th>
<th>Colour of anthers</th>
<th>Shape of berries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freycinetia laeta</td>
<td>Orange</td>
<td>Orange to deep red</td>
<td>Prismatic</td>
</tr>
<tr>
<td>F. marginata</td>
<td>White or white with reddish orange to bright red tints on apical parts</td>
<td>Pink to deep pink</td>
<td>Needle-like (filiform)</td>
</tr>
</tbody>
</table>

from Papua New Guinea, thus the result of this study extends the species distribution into the Mamberamo Basin. Freycinetia laeta can be easily recognised in the field by its robust habit, the obvious reddish orange colouration on bracts and basal part of leaf, the tapered auricle, the non needle-like berries with 3 to 4 stigmas. In the field F. laeta looks exceedingly similar to F. marginata; however, the two species differ mainly in three morphological characters (Table 2). Even if the individuals are sterile, F. laeta can still be distinguished from F. marginata through the colour of the terminal leaves. The terminal leaves in F. laeta are green with bright orange tints. In F. marginata the terminal leaves are green with reddish orange to red tints on terminal parts.

Specimen collected. Indonesia, Papua, Mamberamo Raya, Mamberamo Tengah, Kwerba, Tacewaram, Kwerep, 02 Nov. 2008, A.P. Keim 1078 (BO!).

3. FREYCINETIA MARGINATA Blume. — Type: Zippelius 219-a (L), Indonesia, Papua, Triton Bay, Kaimana, Dobo, June-July 1828. — Fig. 3.

Freycinetia reineckei Warb. (1898) 578. — Syntypes: Reinecke 255 (B†), Reinecke 255a (B†), Reinecke 255b (B†), Reinecke 353a (B†), Reinecke 362 (B†; isosyntype Costenoble s.n. (US), USA, Marianas Islands, Guam Island, 1914, syn. nov.

Freycinetia ponapensis Martelli in Kaneh. (1934) 129. — Type: Lederman 13245 (B†), Micronesia, Pohnape, Patapat, November 1913, syn. nov.

Freycinetia carolinensis Kanehira (1935) 185, f. 17. — Type: R. Kanehira 2359 (TI), Micronesia, Palau, Aimirrik, 01 Aug. 1933, syn. nov.

Freycinetia mariannensis var. microsyncarpa Hosok. (1937) 191. — Type: Koidzumi s.n. (TI), Micronesia, Pohnape, July 1915, syn. nov.


Freycinetia carolana F. v. Muell. (1887) 126, nom. nud.

Freycinetia insignis Bailey non Blume (1902) 1691, nom. nud.

Distribution. Borneo (Sarawak), Sulawesi (including Wawoni Island), the Philippines (Luzon Island), the Moluccas (Morotai Island), Micronesia (the islands of Palau and Pohnape), the Marianas (the islands of Guam, Rota, and Saipan), New Guinea (including the islands of Batanta, Waigeo, and Yapen), Solomon Islands, the island of Savaii in Samoa, and northern part of mainland Australia.
Fig. 2. *Freyceitia kwerbaensis* A.P. Keim (from the type, *A.P. Keim* 1165) showing the infructescence consists of 3 ellipsoidal cephalia (ternate) and glabrous pedicel. Photo: A.P. Keim.
Habitat. Lowland tropical rainforest. In Kwerba it is found from 75 to 125 m altitude, but it is abundantly seen occupying hill slope at about 85 m altitude.

Vernacular name. Érorit (Kwerba).

Uses. Local people mentioned that cephalium is eaten by birds.

Notes. Freycinetia marginata can be easily recognised in the field by the possession of robust habit, conspicuous white inner bracts, white with reddish orange to red tints on apical parts on the much larger and more persistent outer bracts, pink to deep pink numerous anthers (thus giving the colour to the whole male inflorescence), ternoate to quadrate infructescence, elongate-ellipsoidal cephalium, and the distinctive needle-like (filiform) berries. Even when sterile, the habit and colouration of bracts and terminal leaves are sufficient for identification.

Blume (1835) did not mention the exact location of the type; however, Zippelius was known to visit and collect botanical specimens at Dobo in Triton Bay, Kaimana on June to July 1828 (van Steenis, 1950). Thus it is assumed here that the type was collected in that area and around that time. The presence of *F. marginata* in Mamberamo Basin extends the species distribution in mainland New Guinea.

The result of this current study regards the species listed above as synonyms of *F. marginata*. Apart from the slight differences in the surface of pedicels and sizes of cephalia (Table 3), there is no distinctive morphological character that can be used to distinguish any of those species from *F. marginata*. In fact all the species share one obvious morphological character that is considered unique in the genus, the needle-like (*i.e.* filiform) berries. Stone (1968) based on the common possession of this character grouped twelve species into a section of their own, *Filiformicarpae*, but with a note that the section is noticeably homogenous and the species included were rather poorly defined.

Among the species listed above possess glabrous pedicels except three species, *F. parviaculeata*, *F. ponapensis*, and *F. tesselata* (Table 3). This raises a question concerning the inclusion of the three species into the synonyms of *F. marginata*. Yet, despite having scabrous pedicels in this present study the three species are treated as a synonym of *F. marginata* based on the fact that scabrous and glabrous pedicels can be found in the same individual as can be seen in the then *F. minahassae*, where the fairly scabrous and glabrous pedicels can be found in different infructescences but of the same individual (Keim & Wahjuningsih, *in prep.*). Thus, the result of this current study indicates that at least in the section *Filiformicarpae* the scabrous or glabrous pedicels are considered less important in defining a species. Consequently, *F. parviaculeata*, *F. ponapensis*, and *F. tesselata* perish into synonymy.

This result is not in accordance with Stone (1967a) that regarded the pedicel covering (scabrous versus glabrous) as an important character and was employed as the most distinctive character to differ *F. mariannensis* from *F. ponapensis* despite thought that *F. ponapensis* was morphologically very similar to *F. mariannensis*. As in this study the pedicel surface has been regarded as less important in determining a species the boundary between *F. mariannensis* and *F. ponapensis* subsequently disappears. The two species thus are placed here as synonyms of *F. marginata*.

Indeed, apart from the differences in the surface of the pedicels, there is no distinctive morphological character that can be used to set any of the two species apart from *F. marginata*. Apparently Stone failed to spot the presence of both scabrous and glabrous pedicels in the same species as in the case of *F. minahassae*. Nevertheless, it is assumed here that by the time Stone studied the section *Filiformicarpae* there was not enough material of *F. minahassae* in his disposal. Indeed then *F. minahassae* was known only from the type kept at BO; thus there was insufficient variations within the species could be observed. The situation was worsened by the fact that Stone was never known to conduct any collecting activities in Sulawesi. It is not surprise to know that *F. minahassae* was neither mention nor included in the first publication of the section *Filiformicarpae* (Stone, 1968).

Nonetheless the result of this current study is in accordance with Stone (1967a) that placed *F. mariannensis* var. *microsyncarpia* as the synonym of *F. ponapensis* based on the possession of scabrous pedicels. However, as the pedicel coverings has been regarded as less important character for species determination, both *F. ponapensis* and *F. mariannensis* var. *microsyncarpia* have been reduced here into synonymies.

Merrill & Perry (1939) mentioned that *F. tesselata* was very closely related to *F. ponapensis*; thus suggesting morphological similarities. *Freycinetia tesselata* was separated from *F. ponapensis* based on the broader and somewhat abruptly acuminate leaf-tips and scabrous
Table 3. Morphological comparison between *F. carolinensis*, *F. marginata*, *F. marianensis*, *F. mariannensis* var. *microsyncarpia*, *F. minahassae*, *F. ponapensis*, *F. reineckei*, and *F. tesselata*.

<table>
<thead>
<tr>
<th>Species name</th>
<th>Colour of outer bracts</th>
<th>Colour of inner bracts</th>
<th>Surface of pedicel</th>
<th>Size of cephalium</th>
<th>Colour of cephalium</th>
<th>Length of a berry</th>
<th>Number of stigmatic remains</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. carolinensis</em></td>
<td>No data</td>
<td>White</td>
<td>Glabrous</td>
<td>9.5 by 5 cm</td>
<td>Orange to red</td>
<td>15 mm</td>
<td>2–3, rarely 3</td>
</tr>
<tr>
<td><em>F. marginata</em></td>
<td>Reddish orange or white with reddish orange tints on apical parts</td>
<td>White</td>
<td>Glabrous</td>
<td>8–13 by 1.5–3 cm (Stone 1982)</td>
<td>Red</td>
<td>5–8 mm</td>
<td>2–3, mostly 2</td>
</tr>
<tr>
<td><em>F. marianensis</em></td>
<td>Salmon to orange</td>
<td>Creamy white (Stone 1967b)</td>
<td>Glabrous</td>
<td>8–9 by 5 cm</td>
<td>Orange to red</td>
<td>10–15 mm</td>
<td>2–3, mostly 2</td>
</tr>
<tr>
<td><em>F. marianensis</em> var. <em>microsyncarpia</em></td>
<td>Yellow with scarlet tints on apical part (Stone 1967a)</td>
<td>Creamy white</td>
<td>Sparsely scabrous</td>
<td>6 by 1 cm (Stone 1967a)</td>
<td>Orange to red</td>
<td>10–15 mm</td>
<td>2–3, mostly 2</td>
</tr>
<tr>
<td><em>F. minahassae</em></td>
<td>Orange or reddish orange</td>
<td>White to milky white (Koorders in the field note attached onto the type)</td>
<td>Glabrous or sparsely scabrous</td>
<td>8–20 by 1.8–5 cm</td>
<td>Orange to red</td>
<td>5–18 mm</td>
<td>2–3, mostly 2</td>
</tr>
<tr>
<td><em>F. parviaculeata</em></td>
<td>No data</td>
<td>No data</td>
<td>Scabrous</td>
<td>7 by 3 cm</td>
<td>Bright red</td>
<td>13–15 mm</td>
<td>2–3, rarely 3</td>
</tr>
<tr>
<td><em>F. ponapensis</em></td>
<td>Orange (yellow with orange tints on apical part; Stone 1967a)</td>
<td>No data</td>
<td>Sparsely scabrous</td>
<td>5–5.5 (6–7; Stone 1967) by 1–1.2 cm</td>
<td>Orange to red</td>
<td>No data</td>
<td>2–3</td>
</tr>
<tr>
<td><em>F. reineckei</em></td>
<td>Yellow with orange tints on apical part to orange</td>
<td>Creamy white (Stone 1967b)</td>
<td>Glabrous</td>
<td>6–7 by 2.5–3 cm (7–9 by 2.5–3 cm; Martelli 1934)</td>
<td>Orange to reddish orange</td>
<td>10 mm (13 mm; Martelli 1934)</td>
<td>2–3, mostly 2</td>
</tr>
<tr>
<td><em>F. tesselata</em></td>
<td>Orange</td>
<td>White</td>
<td>Scabrous (at least on apical part; Merrill &amp; Perry 1939)</td>
<td>10 by 3–3.5 cm</td>
<td>Red</td>
<td>7–8 mm</td>
<td>2–4, mostly 2</td>
</tr>
</tbody>
</table>
Fig. 3. Freycinetia marginata Blume. a. Conspicuous white outer bracts enclosing young male inflorescence; b. Young terminal staminate inflorescence consists of 3 flowering parts (ternate) enclosed by layers of bright white thick-fleshy inner bracts, in which each flowering part consists of numerous pink to deep pink anthers. Photos: A.P. Keim.

pedicels (peduncles of syncarps, according to Merrill & Perry, 1939). In this current study the differences are regarded less significant. In Freycinetia the leaves can be greatly varies including shapes and the forms of apical parts as can be seen in F. marginata (particularly the then F. minahassae) or F. scandens. The same is also for the pedicel covering as can be seen in F. minahassae. Therefore, F. tesselata follows F. ponapensis into the world of synonymies.

Despite mentioned F. carolinensis that was published previously by Kanehira (1935), Merrill & Perry (1939) regarded F. carolinensis as a synonym of F. ponapensis; thus disregarding Kanehira that mentioned F. carolinensis as morphologically near to F. mariannensis and distinguished by the possession of prominently tessellate leaves (Kanehira, 1935; Merrill & Perry cited the publication year of Kanehira’s protologue of F. carolinensis as 1937). In this current study it is assumed that Merrill & Perry (1939) failed to spot the tessellate leaves and glabrous pedicels possessed by F. carolinensis. As the consequence they placed the glabrous pedicels possessing F. carolinensis as the synonym of the scabrous F. ponapensis. Furthermore, the tessellate leaves, which is the prominent distinctive character of F. carolinensis (Kanehira, 1935) was used as the important character to distinct their proposed new species F. tesselata from F. ponapensis (Merrill & Perry, 1939). The reason for this sloppy work was unknown.

Although there is a difference in the sizes of berries (Table 3), it is continuous; thus cannot be used as a strong distinctive character to define F. minahassae. In other word, in this current study F. minahassae is regarded as the synonym of F. marginata. The placement of the eastern Malesian widespread species of F. minahassae and F. parviaculeata, the only member of the section Filiformicarpae occurs in western Malesia have a consequence that F. marginata is now recognised as the most widely distributed species in the genus, extending from Borneo in the west to Samoa in the east (encompassing both western and eastern Malesia and beyond), and surpassing the previously known F. scandens.

Freycinetia reineckei has smaller cephalia but fairly larger berries than F. marginata (Table 3). However, these differences are regarded in this current study as less important compared to more obvious similarities between the two species, such as the colour of both bracts and the shape of berries. Thus, F. reineckei is lowered to the rank of synonym.

Indeed, so far F. reineckei is the only member of the section Filiformicarpae known to possess the tendency of bisexuality or towards monoecy (Cox, 1981, 1982, 1990; Cox et al., 1984; Poppendieck, 1987); however, this tendency is also possessed by other species from various morphologically different sections such as F. cumingiana (§ Polystachyae), F. funicularis (§ Blumeella), F. imbricata (§ Sarawakenses), F. negrosensis (§ Pristophyllae), and F. scandens (§ Oligostigma; see Poppendieck, 1987; Cox, 1990). In other word, the tendency is wide spread within the genus. On the contrary, the needle-like (filiform) berries are exclusively possessed by the members of the section Filiformicarpae, in which F. reineckei and F. marginata are grouped (Stone, 1968). Therefore, if we put too much emphasis on the tendency of bisexuality we might disregard a more important morphological character for phylogeny of the section understudy, the possession of filiform
berries.


4. FREYCINETIA OBLANCEOLATA Martelli. — Syntypes: *Beccari 545* (FI), Indonesia, Papua Barat, Manokwari, Andai, 19 July 1872; *Beccari s.n.* (FI); *De Albertis s.n.* (FI); Dorei, *J.E. Teijsmann 6762* (BO!).

**Distribution.** Sulawesi (Keim & Rustiami, 2007) and mainland New Guinea (including the Raja Ampat Islands, Keim et al., 2007).

**Habitat.** Lowland tropical rainforest. In Kwerba it is commonly found from 85 to 250 m altitude. Although it was found abundant during exploration most were found without flowers or fruits. Apparently both the flowering and fruiting times were over by the time the research proceeded.

**Vernacular names.** Daidoté (Papasena), kakacir (Kwerba).

**Uses.** Not recorded.

**Notes.** The presence of *F. ob lanceolata* in the Mamberamo Basin extends the species distribution area in the mainland New Guinea. In the field *F. ob lanceolata* looks exceedingly similar with *F. k werbaensis*; however the two species differ in three morphological characters described in Table 1 (see above).

**Specimens collected.** Indonesia, Papua, Mamberamo Raya, Kwerba, Tacewaram, 02 Nov. 2008, *A.P. Keim 1084* (BO!); Hehetem, Pumpunom Hill, close to Lake Hehetem, 12 Nov. 2008, *A.P. Ke im 1127* (BO!).

### Table 4. Morphological comparison on leaf and cephalium dimensions, shape of auricle, number of cephalia per infructescence, and number of stigma between *Freycinetia angustissima*, *F. forbesii*, *F. ob lanceolata*, *F. scandens*, *F. s umbawaensis*, and *F. w amenaensis*.

<table>
<thead>
<tr>
<th>Species</th>
<th>Leaf dimension</th>
<th>Shape of auricle</th>
<th>Number of cephalia per infructescence</th>
<th>Cephalium dimension</th>
<th>Number of stigma</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Freycinetia angustissima</em></td>
<td>5–6 by 0.6 cm</td>
<td>Tapered</td>
<td>1 to 2</td>
<td>1.26–1.3 by 1.26–1.3 cm</td>
<td>2 or 3 (current study), but 1 or 2 (Stone, 1967)</td>
</tr>
<tr>
<td><em>F. forbesii</em></td>
<td>10–15 by 1.9–2 cm</td>
<td>Tapered</td>
<td>3 to 4</td>
<td>1.9–2 by 1.9–2 cm</td>
<td>1 or 2, rarely 2</td>
</tr>
<tr>
<td><em>F. ob lanceolata</em></td>
<td>15–21 by 3–4 cm</td>
<td>Tapered</td>
<td>3 to 4</td>
<td>2.5 by 2 cm</td>
<td>1 or 2</td>
</tr>
<tr>
<td><em>F. scandens</em></td>
<td>8–10 by 1–2.7 cm</td>
<td>Tapered</td>
<td>3 to 4</td>
<td>3–6 by 2.5–3 cm</td>
<td>2 to 4, usually 2 &amp; rarely 4S</td>
</tr>
<tr>
<td><em>F. sumbawaensis</em></td>
<td>10 by 1.5 cm</td>
<td>Tapered</td>
<td>2 to 3</td>
<td>2.5 by 1.5 cm</td>
<td>1</td>
</tr>
<tr>
<td><em>F. w amenaensis</em></td>
<td>11–12 by 2.5–3.5 cm</td>
<td>Lobed</td>
<td>3, rarely 4</td>
<td>4.5–5 by 2–2.5 cm</td>
<td>1, rarely 2</td>
</tr>
</tbody>
</table>
Fig. 4. Habit of *Freycinetia wamenaensis* A.P. Keim with mature infructescence as can be seen in the bank of Dupuk Creek in Wamena Biological Garden. In appearance *F. wamenaensis* is exceedingly similar to *F. scandens*. Photo: A.P. Keim.
Fig. 5. Freycinetia wamenaensis A.P. Keim (× 2.5) showing the evidence of the distinctive lobed auricle (arrow). Photo: A.P. Keim.
Fig. 6. The ternate infructescence of *Freycinetia wamenaensis* A.P. Keim showing the elongate-ellipsoidal cephalia (× 1.5) with number of stigma almost always one, very rarely two. Photo: A.P. Keim.
Fig. 7. a. Lanceolate-elongate immature cephalium of *F. wamenaensis* A.P. Keim (× 2) clearly showing the number of stigma almost always one. b. The number persists through maturity (× 1.5). Photo: A.P. Keim.
5. FREYCINETIA SCANDENS Gaudich. — Type: *Gaudichaud* s.n. “crescit in Insula Timor” (P), Indonesia, Nusa Tenggara Timur (Eastern Lesser Sunda Islands), Timor (presumably from West Timor).

   - Freycinetia gaudichaudii R. Br. & Benn. in Horsfield (1838) 31, t. 9. — Type: *Horsfield* s.n. (BM), Indonesia, Java, West Java.
   - Freycinetia muelleri Martelli (1910) 311, 313. — Type: *Mueller* s.n. (possibly at BM or K), Australia, Queensland.
   - Freycinetia propinqua Domin (1915) 150. — Type: *Domin* s.n. (possibly at PR).
   - Freycinetia gonoacarpa Moore in Gibbs (1917) 309 — Type: *Gibbs* 6348 (BM), Australia, Queensland.

**Distribution.** Sumatra, Java, Borneo, Sulawesi (including the Sangir and Talaud Islands), Timor, New Guinea (including the islands of Waigeo and Yapen), and northern part of mainland Australia (Queensland).

**Habitat.** Lowland tropical rainforest to lower montane forests from coastal to about 1000 m altitude. In Kwerba it is found growing close to a creek from 75 to 250 m altitude.

**Vernacular names.** Not recorded.

**Uses.** Not recorded.

**Notes.** *Freycinetia scandens* has previously never been reported from Mamberamo Basin, thus the species distribution extends further into the interior of New Guinea. Following the placement of several species into the synonyms of *F. marginata* (see above) that increases the distribution area of *F. marginata*, in this current study *F. scandens* is regarded as the second most widely distributed species in the genus. As in *F. marginata*, such a wide distribution reflects also in the vast morphological variations. Several other species found in New Guinea, such as *F. beccarii* Solms, *F. ellipsoidalis* Merr. & L.M. Perry, *F. elliptica* Merr. & L.M. Perry, *F. globiceps* Warb., *F. nervosa* Merr. & L.M. Perry, and *F. streptopifolia* Warb. are suggested in this study would eventually fall into synonymies. Further study is being proceeded.

**Specimen collected.** Indonesia, Papua,
6. Freycinetia wamenaensis A.P. Keim, sp. nov. — Figs. 4–8.


Medium size climbing pandan, climbing up to 15 m high. Stem green, glabrous, 0.5–0.7 cm diameter, internodes 1–1.5 cm. Leaf elongate-oblong to spathoideus, 11–12 cm long, 2.5–3.5 cm wide, acute to acuminate apex, minute spines on apical part, rest of leaf margin glabrous; adaxial surface green, glabrous; abaxial surface light green, slightly glaucous; auricle lobed, persistent already dried, ca. 5 cm long; pedicel ca. 2 cm long, scabrous, flowering part 2 cm long. Male inflorescence ternate, persistent, already dried, ca. 5 cm long; pedicel ca. 2 cm long, scabrous, flowering part 2 cm long. Female inflorescence not observed but it seems in a different branch with male inflorescence. Infructescence terminal, ternate or rarely quaternate, 6.5–8 cm long; peduncle short, 1–1.5 cm long; pedicel 1–1.5 cm long, light green, fairly scabrous; bracts persistent, ca. 9 cm long, ca. 15 cm wide, already disintegrated. Cephalium elongate-ellipsoid, 4.5–5 cm long, ca. 2–3 cm wide, green when young turns to reddish orange to deep red when mature; number of stigmatic remains almost always one, very rarely two, deep blackish brown.

Etymology. After Wamena, the city where the type was collected.

Distribution. Known only from type locality.

Habitat. Montane forest at about 1700 to 1750 m altitude. Freycinetia wamenaensis is also reported to inhabit the banks of the neighbouring Holima Creek about 1 km west of the Dupuk. However, there is no collection has been made so far to confirm this report.

Vernacular name. Wuluhélé (Wamena).

Uses. Local people mentioned that cephalium is consumed by Cuscus (Spilocuscus maculatus). Stem is used for strings.

Notes. The result of this present study indicates that now there are five species of the genus Freycinetia known to possess a berry with single stigmatic remain: F. angustissima, F. forbesii, F. ob lanceolata, F. sumbawaensis, and F. wamenaensis (Table 4). Nevertheless, F. wamenaensis can be easily distinguished by its distinctive lobed auricle. In fact F. wamenaensis is the only species bearing lobed auricles and berries with single stigmatic remain, thus it is proposed here as a new species. Prior to this present study Ridley (1886) suggested F. forbesii and F. scandens as closely ally. Keim & Rahayu (2010) expanded the alliance with the inclusion of F. sumbawaensis. The result of this current study increases the number of species in the alliance with the addition of F. wamenaensis.

Specimens collected. Indonesia, Papua, Jayawijaya, Wamena, Gunung Susu, Wamena Biological Garden, 8 km NW of Wamena, 03 Aug. 2010.


Habitat. Lowland tropical rainforests.

Vernacular name. Not recorded.

Uses. Not recorded.

Notes. The specimen A.P. Keim 1149 is sterile, thus identification is based on the vegetative character, especially lanceolate-elongate leaf (9 × 1.2 cm). Thus, this taxon is regarded here a possibly belonging to F. angustissima.

Specimen collected. Indonesia, Papua, Mamberamo Raya, Mamberamo Tengah, Kwerba, 17 Nov. 2008, A.P. Keim 1149 (BO!).

8. FREYCINETIA AFF. VIDALII Hemsl. Distribution. Prior to this publication F. vidali i was known only from the Philippines. It is strongly suggested here that the distribution area may expands to New Guinea.

Habitat. Lowland tropical rainforest.
Vernacular names. Araripaja (Papasena), kamahakura (Kwerba).

Uses. Not recorded.

Notes. This taxon is also identified based on sterile collection. Nevertheless the possession of lobed auricle indicates that this taxon belongs to the section *Auriculifoliae* (Stone, 1968). Except *F. vidalii* (a species previously known as endemic to the Philippines), all members of this section are robust climbers; thus the result of this current study suggests that this taxon (*A.P. Keim 1128*) possibly belonging to *F. vidalii*. The strong floristic link between the Philippines and Eastern Malesia is not something new as it has been suggested previously by Lam (1945a; 1945b). It seems that the result of this study supports the existence of such link.

Specimen collected. Indonesia, Papua, Mamberamo Raya, Mamberamo Tengah, Kwerba, Hehetem, 12 Nov. 2008, *A.P. Keim 1128* (BO!).

9. PANDANUS ATROPURPUREUS Merr. & L.M. — Type: *Brass* 13648 (A; iso. BO!), Indonesia, Papua, 4 km SW of Bernhard Camp, Idenburg (now Taritatu) River, March 1939.


Habitat. Lowland and swampy forests at 200 to 800 m altitude. In Kwerba it is found in the lowland or hill slope rather open area at altitude 80 to 90 m. Not a common species, very rarely seen.

Vernacular name. Tatacir (Kwerba).

Uses. Local people report that the cephalium and drupes are eaten by birds.

Notes. Prior to this recent study *P. atropurpureus* was known only from the type locality (Merrill & Perry, 1940; Stone, 1982; Jebb, 1992). Thus, the result of this study extends the species distribution further north in the Mamberamo Basin. The result of this study also suggests that *P. columbiformis* fall...
Fig. 9. *Pandanus conoideus* Lam. a. Cephalium from the cultivated form at Kwerba, b. The yellow variety, c. The cephalium being prepared showing the much longer size, d. Cephalium of the wild form showing the shorter and smaller size compare to the cultivated one, e & f. Cephalia collected from wild individuals showing colour variation from orange to red. Photos: Hari Sutrisno & Suparno (MZB, used here with permission).

Fig. 10. *Pandanus conoideus* Lam. Lateral section (l-s) of a cephalium showing the massive insect invasion (arrows) into pedicel through the pericarps, where the vegetable fat is produced and usually extracted. The invasion is mainly at the basal parts. The invasive insect is still not yet identified. The correct identification of this invasive insect is essential to protect the highly valued cultivated forms (cultivars) from possibly imminent danger. Photo: Suparno (MZB, used here with permission).
into synonymy with *P. atropurpureus*. Apart from the small difference in the shape of drupe, there is no significant morphological difference between the two species. *Pandanus columbiformis* is characterised by the shape of its drupes that are like “small pigeons” (hence the name, see Stone, 1974), but some other drupes have approximately the same shape, size and colours than *P. atropurpureus*. Furthermore, some drupes of *P. atropurpureus* collected in this current study also bear small pigeons shape. A molecular phylogeny will hopefully solve this question. Until the data from molecular study became available *P. columbiformis* is considered here as a synonym of *P. atropurpureus*.

**Specimen collected.** INDONESIA, Papua, Mamberamo Raya, Kwerba, Tacewaram, Karenaepu Hill, Itanem, 19 Nov. 2008, A.P. Keim 1158 (BO!).

10. **PANDANUS CONOIDEUS** Lam. — Figs. 9–10.


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**Table 5.** Morphological and ecological comparison on habitat preferences, stem height, dimensions of leaf and drupe between *Pandanus carrii* and *P. korwae*.

<table>
<thead>
<tr>
<th>Species name</th>
<th>Habitat preferences</th>
<th>Stem height</th>
<th>Leaf dimension</th>
<th>Drupe dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pandanus carrii</em></td>
<td>Savanna grassland</td>
<td>5 m</td>
<td>120 by 3 cm</td>
<td>60 by 15 mm</td>
</tr>
<tr>
<td><em>P. korwae</em></td>
<td>Lowland tropical rainforest</td>
<td>1.5 m</td>
<td>300–450 by 10 cm</td>
<td>55–60 by 8 mm</td>
</tr>
</tbody>
</table>

---

**Fig. 11.** *Pandanus korwae* A.P. Keim showing the shape and size of cephalium with long peduncle. Photo: H. Sutrisno (MZB, used here with permission).
Fig. 12. Pandanus korwae A.P. Keim. a. Ellipsoidal drupe, long-elongated conical pileus. b. Blunt-flattened stigmatic remain (arrow) indicates that this species is a member of the subgenus Lophostigma and section Karuka. Photos: A.P. Keim.
Fig. 13. *Pandanus korwae* A.P. Keim. a. The presence of minute adaxial ventral pleats (arrow). b. The absence of recurved spines. Photos: A.P. Keim.
Central, Bella Vista.

**Pandanus comosii** Hemsl. var. *micronesicus*


**Pandanus erythros** St. John (1968) 515. – Type: *Carr* 15922 (BM, L), Papua New Guinea, Central, Isuara.

**Pandanus plicatus** St. John (1968) 517. – Type: *Carr* 12590 (BM), Papua New Guinea, Central, Koitaki.

**Pandanus rubrispicatus** St. John (1968) 519. – Type: Not designated. nom. nud, anglice, “Northeast New Guinea”.

**Pandanus comosii** Hemsl. var. *augustus* B.C. Stone (1972) 109. – Type: *B.C. Stone* 2570 (fem.) (BISH), Solomon Islands, Santa Isabel Isl., Vulavu to Thathaje trail, along south-west coast, 17 October 1957.

**Distribution.** Moluccas, New Guinea and adjacent islands, Bismarck Archipelago, Solomon Islands and the islands of Micronesia (i.e. Caroline Islands).

**Habitat.** Mostly cultivated from sea level up to 2000 m altitude. In Kwerba village three cultivars are observed; the individuals with red, yellow, and brown long-trigonal (triangular) shaped cephalium with the red cultivar being the most widely planted. In Hehetem-Kwerba the wild individuals are mostly found growing close to a creek at about 200 m altitude.

**Vernacular names.** Kutéri péri, péri (Papasena), ehéna (Kwerba, for the yellow cultivar), Piri (Kwerba, for the red and brown cultivars).

**Uses.** Leaves are used for mats and cigarette papers. Vegetable fat extracted from the pericarp is used as sauce, medicine, and tonic. The use of vegetable fat is only recorded from the cultivated individuals.

**Notes.** Both the people of Kwerba and Papasena recognised the wild individuals as belonging to the same taxon with the red cultivar indicated by the use of the same vernacular name, “piri” or “péri”. The addition of the word “kutéri” in the “kutéri péri” is to identify that it is a wild kind (“kutéri” means wild, bush or a kind of forest in Papasena language).

The taxonomical study of this species has been done by Keim (2009; see also 2006a). Prior to this current study, *P. conoideus* was known only as cultivated plants (Stone 1982; French 1986; Jebb 1992; Walter & Sam 2002). Although large efforts had been done to find the wild form of this species—including by the author of this paper in the neighbouring Wamena area (i.e. Baliem valley, see Keim, 2006b), the wild form had never been successfully found. Therefore, the result of this study is significant for the study of this highly praised (both culturally and economically) and widely cultivated species of *Pandanus* in New Guinea.

Cephalium of the wild form is observed greenish orange then turns to orange and finally deep red and it is noticeably smaller than the cultivated ones (Figure 9). The difference in the size as seen in the cultivated forms is apparently related with the domestication effect. The morphological features observed in the wild form of *P. conoideus*, most particularly the size and colour of cephalia, support the placement of several closely related species mentioned above into synonymies proposed by Keim (2009).

Unlike the cultivated form (i.e. cultivar), the cephalia of the wild form of *P. conoideus* are almost always found being invested by insect (Figure 10). This is presumably due to high concentration of vegetable fat as source of nutrition for the insect pupa. Interestingly, the case of insect invasion to the cephalium of the cultivated form (cultivar) has never been reported. Study is being done by entomologists from the Museum Zoologicum Bogoriense (MZB) at Cibinong, West Java.


11. **Pandanus korwae** A.P. Keim, sp. nov. — Figs. 11–13.

Fruticosus, circa 1.5 m altus; pileus elongatus, conicus; stigma obtusus, complanatus. — Typus: *A.P. Keim* 1144 (BO!), Indonesia, New Guinea, Papua, Mamberamo Raya, Mamberamo Tengah, Kwerba, Tacewaram, Mancin, Kuwamuk Creek, 17 Nov. 2008.

Solitary short stemmed or shrubby pandan, 1.5 m tall. *Prop roots* short, 50 cm tall, deep brown with sharp nodules. *Stem* very short, less than 50 cm long with sharp nodules, unbranched. *Leaves* in a
rosette, tristichously arranged; each 300–450 cm long, 10 cm wide, spines throughout length; adaxial surface deep green, glabrous, adaxial ventral pleats present; abaxial surface light green, glabrous, recurved spines absent. **Infructescence** terminal, solitary, pendulous, 90 cm long, massive, heavy; peduncle 51 cm long, light green, glabrous. **Cephalium** globose-slightly elongate, 39 cm long, 62 cm circumference, deep green, consisting of numerous drupes. **Drupe** ellipsoidal, 5.5–6 cm long, 0.8 cm wide; pileus 4.2–4.5 cm long, orange to reddish orange; style elongate, conical, deep purplish green, 1.3–1.5 cm long; stigmatic remains blunt, flattened, deep brown.

**Etymology.** After Michael Korwa, a member of the team involved in this RAP 2 and community developer for the Conservation International stationed at Kwerba.

**Distribution.** Known only from type locality.

**Habitat.** Lowland tropical rainforest growing close to a creek.

**Vernacular name.** Técéni (Kwerba).

**Uses.** Cephalium is said to be consumed by Cassowaries.

**Notes.** The ellipsoidal drupe, long-elongated conical pileus, and blunt-flattened stigma (Figure 12) indicate that this taxon is a member of the subgenus *Lophostigma* and section *Karuka*. The section *Karuka* includes three edible and economically important highland species of New Guinea: *Pandanus brosimos* Merrill & Perry (1940), *P. iwen* B.C. Stone (1984), and *P. jiulianettii* Martelli (1912; 1913). Prior to this current study the members of the section *Karuka* are massive tree pandans with stems height more than 10 m. The only member of this section to have stem height less than 10 m was the imperfectly known *P. carrii* St. John (1968). However, *P. carrii* is known to have a stem of 5 m tall and grows in savanna grassland at much lower altitude that is about 450 m altitude. Furthermore, *P. korwae* differs from *P. carrii* in two other morphological characters: The dimensions of leaves and drupes (Table 5).

**Specimen collected.** Only known from the type.

12. **PANDANUS KRAUELIANUS** K. Schum. — Type: Holrung 164 (B†), Papua New Guinea (then German New Guinea), Morobe (then Kaiserwilhelmsland), Kollua near Finschhafen.

*Pandanus silvestris* Rumph. (1743) 145, t. 77 (―Keker wassi‖), nom. inval. – *Pandanus rumphii* Warb. (1900-b) 84, non Gaudich., 1846. – *Pandanus ceramicus* Kunth (var.) sylvestris Kunth (1841) 98. – Type: Rumph., Herb. Amboin. 4: t. 77. 1743. Warburg (1900-b) erroneously used “montanus” as the name for this plate. Rumphius had two “species”, “silvestris” and “montanus”. The plate is of “silvestris”, Rumphius wrote. – Epitype: Indonesia, Moluccas, Amboina, Lateri, Sept. 9, 1913, Robinson Pl. Rumph. Amboin. 31 (US; iso:

_Pandanus montanus_ Rumph. (1743) 145 ("Keker ewan"), nom. inval. – _Pandanus montanus_ Miq. (1855) 161, non Bory, 1804. – _Pandanus terrestris_ Warb. (1900-b) 84.– Type: Not indicated. – Merrill (1917) erroneously identified the Rumphian plate with this.

_Pandanus amboinensis_ Warb. (1900-b) 83. – Type: _De Vriese_ s.n. (L), Indonesia, Moluccas, Ambon.


_Pandanus tabbersianus_ Rendle ex Gibbs (1917) 198. – Type: _Gibbs_ 6213 (BM), Indonesia, Papua Barat, Manokwari track to Ambani (Amban), Jan. 1914.

_Pandanus kivi_ Martelli (1929) 140. – Type: _Brass_ 1557 (A), Territory of Papua, Eastern Div., Lower Mori River, 28 May 1926.

_Pandanus microdontus_ Merr. & L.M. Perry (1939) 177, t. 1, f. 18. – Type: _Brass_ 7695 (A; iso. L), Papua New Guinea, Western, Lake Daviembu, Middle Fly River, Sept. 1936.


_Pandanus cernuiolius_ Merr. & Perry (1939) 180. t. 1, f. 20. – Type: _Brass_ 3916 (A; iso. BRI, NY), Papua New Guinea, Central, Ononge Road, Dieni, 1 May 1953.


_Pandanus nakanaiensis_ B.C. Stone (1965) 2. – Type: _NGF_ 6440 (Floyd) (LAE), Papua New Guinea, New Britain.


_Pandanus luteus_ St. John (1973) 77, t. 318, 319. – Type: _Brass_ 24732 (K, iso LAE), Papua New Guinea, Goodenough Island, eastern slope, mossy oak forest, 8–15 October 1953.


_Pandanus imbrialis_ St. John ex Huynh (1976) 93, gallice, nom. nud. – Voucher: _Brass_ 5655 (FI), Papua New Guinea.


_Pandanus wauensis_ St. John ex Huynh (1976) 93, gallice, nom. nud. – Voucher: _NGF_ 24963 (Womersley) (L), Papua New Guinea, Morobe.


Distribution. Moluccas, New Guinea and adjacent islands including Yapen Island, Raja Ampat Archipelago, Bismarck Archipelago, D’ Entrecasteaux Islands, Solomon Islands and northern part of Australia (Queensland).

Habitat. Mangrove, lowland swampy up to sub montane forests from 0 up to around 1600 m altitude. In Kwerba it is commonly found in lowland secondary forest at 90 to 95 m altitude.
Vernacular name. Kacir (Kwerba).

Uses. Neither leaf nor cephalium is used by the people of Kwerba and Papasena. This is a rather surprising finding as other people in New Guinea widely use the leaves and cephalia of this species, such as people from Yapen Island (Keim et al., 2006; Keim, 2009), where the cephalium is eaten with the usage and method of preparing the fatty substrate extracted from the pericarp similar to that of *P. conoideus* Lam. Indeed, in the other areas in New Guinea, *P. krauelianus* is used as a substitute to *P. conoideus* (Stone, 1992).

Notes. The taxonomical study has been previously done by Keim (2009). *Pandanus krauelianus* is a widespread species in mainland New Guinea. The presence of this species in Mamberamo Basin is new information on the species distribution.

Specimen collected. Indonesia, Papua, Mamberamo Rayat, Kwerba, Tacewaram, 03 Nov. 2008, A.P. Keim 1092 (BO!).

13. PANDANUS LAUTERBACHII K. Schum. & Warb. – Type: Lauterbach 863 (B†), Papua New Guinea, northern part of mainland Papua New Guinea (then Kaiserwilhelmsland).

Distribution. Moluccas (Keim et al. 2008) and New Guinea including the adjacent islands.

Habitat. Swamp and lowland tropical rainforests, along riverbanks from coastal to 100 m altitude. In Kwerba found in lowland and close to a creek (riverbank) close to plantation at about 75 m altitude. Rare.

Vernacular name. Hamicah (Kwerba).

Uses. Leaves used for mats. Cephalium is said to be consumed by birds.

Notes. *Pandanus lauterbachii* is a widespread species. This species is easily recognised in the field by the presence of panicle infructescence consists of 12 to 18 cephalia and the lack of prop roots.

Specimen collected. Indonesia, Papua, Mamberamo Rayat, Kwerba, Tacewaram, Aruh Creek, 19 Nov. 2008, A.P. Keim 1157 (BO!).

14. PANDANUS PSEUDOSYNCARPUS Kanehira. — Type: Inokumae 636 (FU), Indonesia, Papua, Nabire, 1940. — Fig. 14.

Distribution. New Guinea, including the island of Yapen (Keim 2009).

Habitat. Lowland tropical rainforest. In Kwerba it is found at 75 to 80 m altitude.

Vernacular name. Kawani (Kwerba).

Uses. Leaf used for mats, young leaf for cigarette paper. Cephalium is not consumed.

Notes. The taxonomical study of this species has been published by Keim (2009). Prior to this present study the presence of this species in mainland New Guinea was known only from the type locality, thus its occurrence in Mamberamo Basin extends its distribution area.

Specimen collected. Indonesia, Papua, Mamberamo Rayat, Kwerba, Tacewaram, Kwerep, 01 Nov. 2008, A.P. Keim 1074 (BO!).

15. PANDANUS STENOCARPUS Solms. — Type: Beccari s.n. (FI), Indonesia, Papua Barat, Manokwari, Arfak Mountain, July 1875.


*Pandanus nigridens* B.C. Stone (1966) 1. – Type: *B.C. Stone* 2304 (BISH), Solomon Islands, Malaita Island, Malaita.


*Pandanus assurgens* St. John, nom. nud. – Voucher: *St. John* 26132 (LAE), Indonesia, Papua, Warossor.

*Pandanus batavus* St. John, nom. nud. – Voucher: *Brass* 8873 (LAE), Indonesia, Papua,
Jayapura.

Pandanus eramosus St. John, nom. nud. – Voucher: Brass 23512 (LAE), Papua New Guinea, Mt. Dayman.

Pandanus hentyi St. John, nom. nud. – Voucher: Henty NGF 11581 (LAE), Papua New Guinea, Morobe, Oomsis.

Pandanus hohi St. John, nom. nud. – Voucher: St. John 26134 (LAE), Indonesia, Papua Barat, Manokwari, Andei (Andai).

Pandanus kalip St. John, nom. nud. – Voucher: St. John 26102 (LAE), Indonesia, Papua Barat, Sorong, Sele Strait.

Pandanus major St. John, nom. nud. – Voucher: St. John 26120 (LAE), Indonesia, Papua Barat, Manokwari, Amban.

Pandanus missimaensis St. John, nom. nud. – Voucher: Brass 27401 (LAE), Papua New Guinea, Milne Bay, Louisiade Islands, Missima Island.


Pandanus echinatus St. John, nom. nud.

Pandanus noviberiensis St. John, nom. nud.

Pandanus rererivalis St. John, nom. nud.

Pandanus rudis St. John, nom. nud.

Distribution. Moluccas, New Guinea and adjacent islands including Raja Ampat, Bismarck, and Solomon Islands.

Habitat. This species is reported to be found from coastal up to 1300 m altitude (Stone, 1982; Jebb, 1992). In Kwerba it is found in humid lowland tropical forest below 100 m altitude (about 65 to 90 m).

Vernacular name. Kamani (Kwerba)

Uses. Leaf is used for mats, young leaf for cigarette paper. Cephalium has never been eaten.

Notes. Pandanus stenocarpus is a wide spread species in New Guinea. This current study places P. danckelmannianus K. Schum. (Schumann & Hollnag, 1889) as synonym for P. stenocarpus. Based on the study of the protologues, there has been no significant difference between the two species. Both species lack visible prop roots possess long and similar beaked styles. This current study also places the Moluccan (Halmahera Island precisely) species P. verruculosus C. Backer & B.C. Stone into synonymy. Apart from slight difference in the size of cephalia and dotted surface of the pileus, there has been no decisive character that can be used to distinguish P. verruculosus from P. stenocarpus. On the other hand, there are several important morphological features that support the placement of P. verruculosus into synonymy, such as the lack of visible prop roots, drupe with long and beaked style, and the distinctive colour of the mature drupe, which is bright red. The same argument can also be implemented when placing P. jacobisi B.C. Stone (1983) into synonymy. Further study for a proper paper regarding this matter is still being undertaken.

Specimen collected. Indonesia, Papua, Mamberamo Raya, Kwerba, Tacewaram, Kwerep, 02 Nov. 2008, A.P. Keim 1077 (BO!); A.P. Keim 1089 (BO!); Mancin, 17 Nov. 2008, A.P. Keim 1152 (BO!).

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REINWARDTIA Vol. 13, Part 2, 2010

1. Please change the existing word in p. 213, LINE 7 on ABSTRAK (written in Bahasa Indonesia version) with the following:

Keberadaan dua jenis terakhir melampaui distribusi yang sebelumnya hanya diketahui di barat garis Wallace.

2. Please change the existing epithet name in p. 214, COLUMN 1, LINE 40 on Key to the species of Marantaceae in Sulawesi number 5.a. after Phrynium:

..........................Jongispicum
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W.J.J.O. DE WILDE & BRIGITTA E.E. DUYFJES. Trichosanthes (Cucurbitaceae) in Malesia: additions and corrections, including a new species and a new variety ................................................................. 221

DEDEN GIRMANSYAH. Two new species of Begonia (Begoniaceae) from Bukit Tiga-puluh National Park, Riau, Sumatra ........................................................................................................ 229

PUDJI WIDODO. New nomenclature in Syzygium (Myrtaceae) from Indonesia and its vicinities ......... 235

ALEX SUMADIJAYA & JAN FRITS VELDKAMP. Non-Bambusoid Grasses (Gramineae) from Raja Ampat Archipelago, Papua Barat Province, Indonesia ........................................................................ 241

ARY PRIHARDYANTO KEIM. New variety, records & discoveries of some species of Pandanus (Pandanaceae) in Sumatra and Kalimantan, Indonesia ................................................................. 255

HARRY WIRIADINATA. A new species of Begonia (Begoniaceae) from Sagea Lagoon, Weda Bay, Halmahera Island, North Moluccas, Indonesia ........................................................................... 263

ARY PRIHARDYANTO KEIM. The Pandan flora of Foja-Mamberamo Game Reserve and Baliem Valley, Papua-Indonesia ........................................................................................................ 271

JAN FRITS VELDKAMP. Koordersiochloa Merr. (Gramineae), the correct name for Streblochaete Hochst. ex Pilg. ........................................................................................................................................ 299

SRI ENDARTI RAHAYU, KUSWATA KARTAWINATA, TATIEK CHIKMAWATI & ALEX HARTANA. Leaf anatomy of Pandanus species (Pandanaceae) from Java ........................................................................ 305

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