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Three new genera of arecoid palm (Arecaceae) from eastern Malesia

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Summary. Recent botanical exploration in eastern Malesia has resulted in the discovery of three spectacular palm taxa that have proved difficult to assign to genus. New evidence from molecular phylogenetic research indicates that these taxa should now be recognised as three monotypic genera. Here, we describe these genera as new to science, all of which are members of subtribe Ptychospermatinae (Areceae: Arecoideae). *Jailoloa* Heatubun & W. J. Baker is restricted to ultramafic vegetation in a single site in Halmahera and is Critically Endangered due to nickel mining. *Manjekia* W. J. Baker & Heatubun is scattered throughout the limestone vegetation of Biak Island, east of the Bird's Head Peninsula of New Guinea, and is Endangered, although parts of its distribution fall within a protected area. *Wallaceodoxa* Heatubun & W. J. Baker, named to mark the centenary of Alfred Russel Wallace's death, is found on Gag and Waigeo, two of the Raja Ampat Islands west of the Bird's Head Peninsula, where it is Critically Endangered due to its small and rapidly reducing population. Full morphological descriptions are provided with detailed comparisons with related genera, alongside a revised key to the genera of Ptychospermatinae. These new genera are unexpected additions to the palm flora of Malesia, and demand urgent conservation attention.

Key Words. Biodiversity, Eastern Indonesia, Maluku, Moluccas, New Guinea, Palmae.

Introduction

With over 1000 species, the palm flora of Malesia is richer than that of any other major tropical region (Dransfield *et al.* 2008; Baker & Couvreur 2012). However, while our understanding of species diversity in Malesia is evolving rather dynamically (e.g. Heatubun *et al.* 2012; Saw 2012; Baker & Dransfield 2014; Fernando 2014), the classification of Malesian genera has remained surprisingly stable (Uhl & Dransfield 1987; Dransfield *et al.* 2008). In the past two decades, there have been only modest changes to a handful of the 53 currently accepted genera occurring in Malesia (Dransfield & Beentje 1995; Baker & Loo 2004; Baker & Dransfield 2008; Bacon & Baker 2011; Zona *et al.* 2011) and just two new genera have been described (Baker *et al.* 2006; Henderson & Bacon 2011). Even these new genera, *Dransfieldia* W. J. Baker & Zona and *Lanonia* A. J. Hend. & C. D. Bacon had already been "discovered", in that some of the constituent species were described over 100 years ago, albeit in existing genera, and were realigned in new genera based on molecular evidence.

In light of this systematic stability, the discovery of three new genera in eastern Malesia, none of which was collected in the wild prior to the turn of the 21st century, is surprising. The new genera belong to subtribe Ptychospermatinae of tribe Areceae, which is the largest of all palm tribes with 59 genera and approaching 700 species distributed throughout the Indo-Pacific region (Dransfield *et al.* 2008). Subtribe Ptychospermatinae ranges from the Moluccas to Australia, Fiji, Samoa and the Caroline Islands, with a disjunct genus, *Adonidia* Becc., in Palawan and northern Borneo and is well-supported as a monophyletic group, characterised by morphological features such as praemorse leaflet tips and multistaminate male flowers that are bullet-shaped in bud (Asmussen *et al.* 2006; Norup *et al.* 2006; Dransfield *et al.* 2008; Baker *et al.* 2009; Baker *et al.* 2011). However, while the subtribe is well-defined, its 12 genera are more ambiguously circumscribed (Zona 1999). A series of morphological and molecular systematic studies (Zona 1999; Zona *et al.* 2011; Alapetite *et al.* 2014) have largely supported the current classification of the subtribe's genera (Dransfield *et al.* 2008) with some refinements, although their morphological characterisation remains challenging in parts.

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It is as a result of the most recent phylogenetic study (Alapetite *et al.* 2014) that the three new genera can be described (Fig. 1). During fieldwork led by two of us (CH and WJB) in the course of our research on the palms of New Guinea and adjacent islands (Baker 2002), three undescribed Ptychospermatinae were discovered (Map 1). At the point of discovery, none of these taxa could be confidently assigned to genus, based on our current knowledge of the subtribe's morphology. Recently, two were described in existing genera, *Ptychosperma halmaherense* Heatubun and *Adonidia maturbongsii* W. J. Baker & Heatubun (Heatubun 2011; Baker & Heatubun 2012). The former was assigned to *Ptychosperma* Labill. based on gross morphology (Essig 1978; Dransfield *et al.* 2008), despite some discordances, while the placement of the latter in *Adonidia* was informed by initial molecular phylogenetic evidence (Zona *et al.* 2011), but was only weakly supported morphologically. The third taxon, first discovered on Gag Island (Heatubun *et al.* 2014), could not be described because its morphology was too ambiguous and DNA sequence data had not yet been obtained.

The most recent molecular phylogenetic analysis of the Ptychospermatinae (Alapetite *et al.* 2014) is a major advance in the systematics of the subtribe because of its dense taxon and data sampling, including DNA sequence data from eight nuclear and plastid regions for 47 out of the c. 60 accepted species. In contrast to previous studies, all three new taxa were also included. Analysis of the total evidence dataset places the three taxa with *Adonidia merrillii* (Becc.) Becc. in a paraphyletic group at the base of a weakly supported clade that also contains the Pacific genera *Balaka* Becc., *Veitchia* H. Wendl. and *Solfia* Rech. (Fig. 1). Within this group, *A. merrillii* is placed as sister to the Gag Island taxon , while *A. maturbongsii* is resolved as sister to *P. halmaherense* (all other *Ptychosperma* species resolving as a monophyletic group in an entirely different major clade). The discovery of so many closely associated new lineages in the phylogeny of Ptychospermatinae is a significant event

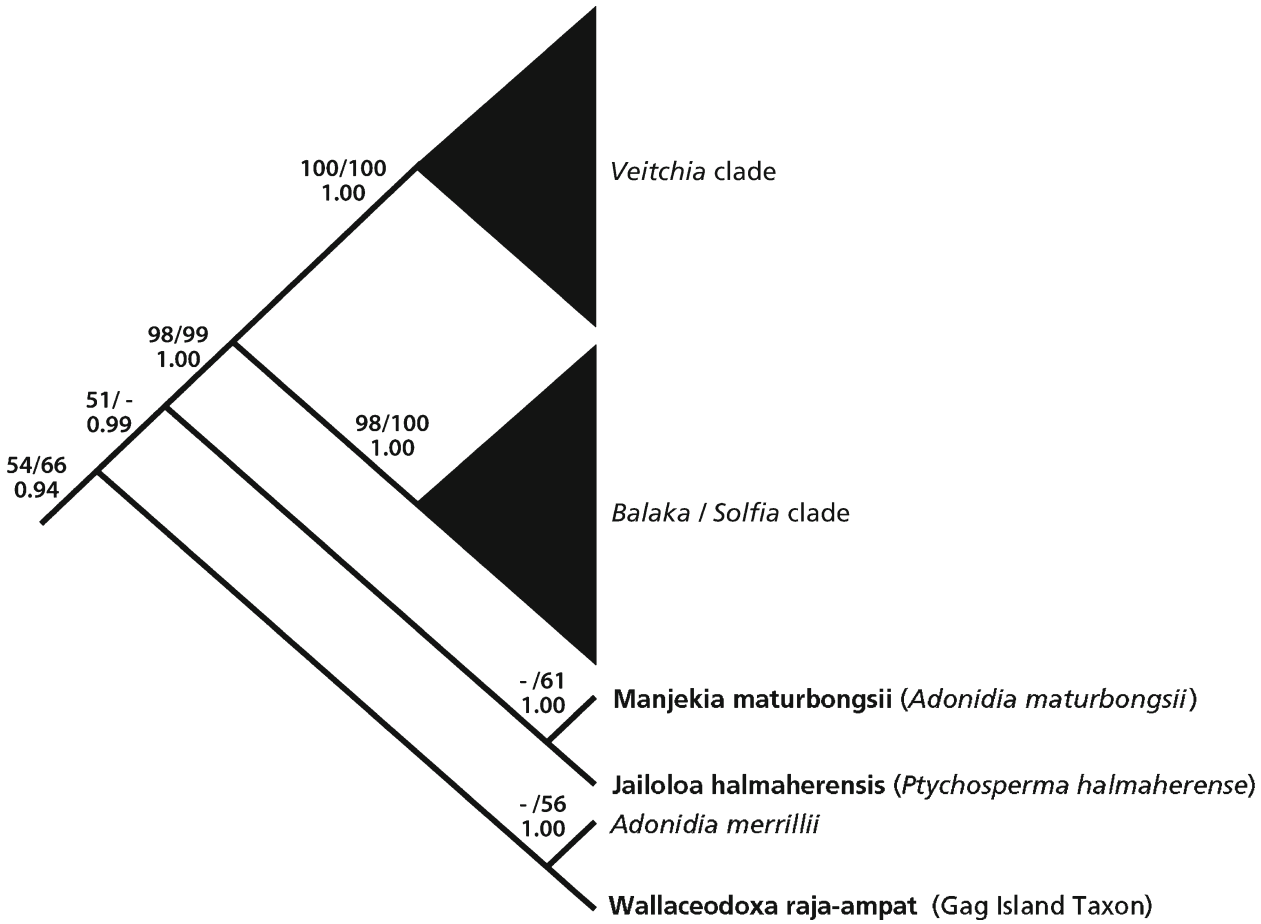
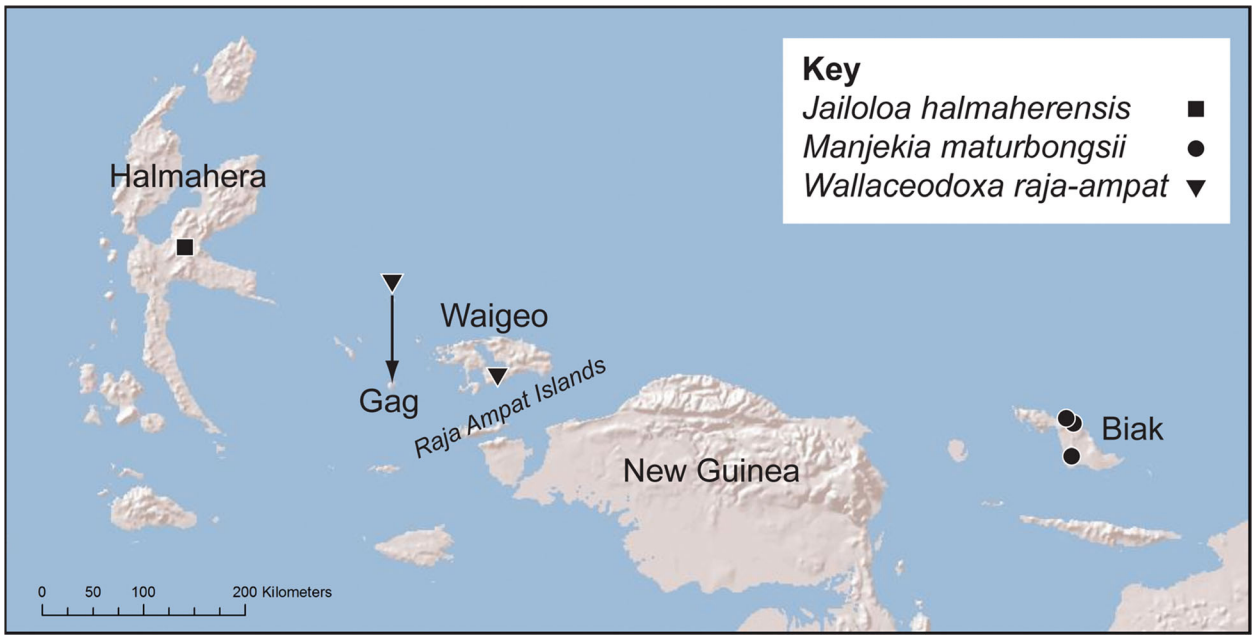


Fig. 1. Schematic diagram of phylogenetic relationships of *Jailoloa*, *Manjekia* and *Wallaceodoxa* to their immediate relatives in subtribe Ptychospermatinae as recovered by Alapetite *et al.* (2014) based on data from five nuclear and three plastid DNA regions. Figures at nodes indicate support values (parsimony bootstrap support/likelihood bootstrap support with Bayesian posterior probabilities below).



Map 1. Distribution map of *Jailoloa*, *Manjekia* and *Wallaceodoxa*

that impinges upon previous interpretations of the spatio-temporal evolution of the group (Zona *et al.* 2011; Baker & Couvreur 2013).

Three broad taxonomic solutions could be applied to the phylogenetic findings of Alapetite *et al.* (2014) that would result in a classification composed of monophyletic genera (Fig. 1). First, the three new taxa, *Adonidia merrillii*, *Balaka*, *Veitchia* and *Solfia* could be reduced to a single genus. This genus would be morphologically heterogeneous and difficult to define, and its monophyly is not highly supported. It would also be a disruptive solution, in view of the horticultural importance of some of the species. Secondly, two genera could be recognised within the paraphyletic group, one new genus comprising *A. maturbongsii* and *P. halmaherense*, and *Adonidia* comprising *A. merrillii* and the Gag Island taxon. Again, these genera would be morphologically heterogeneous and their monophyly is not strongly supported. Moreover, separate analyses of some data partitions yield sometimes strongly supported placements of some of the taxa that are incongruent with the total evidence analysis, especially for *P. halmaherense*. All four taxa within the paraphyletic group sit on relatively long branches, indicative of a high degree of molecular divergence among taxa and, potentially, incongruence between datasets.

In light of the weaknesses of the first two taxonomic solutions proposed above, we apply the third alternative solution here, which is to recognise all four taxa within the paraphyletic group as monotypic genera. This solution minimises taxonomic instability as it does not disrupt the delimitation of well-known genera (apart from rendering *Adonidia* monotypic once again). It is also likely to be robust to future topological changes as monotypic groups cannot become non-monophyletic, and we do not anticipate that these taxa will ever resolve within existing genera, based on available evidence (Zona *et al.* 2011; Alapetite *et al.* 2014). Finally, and perhaps most importantly, it reflects the subtle, yet clear cut morphological differences among the taxa (see below and Table 1), and the lack of characters in support of alternative groupings.

It might be argued that this taxonomic solution is premature and that more data should be sought before describing new genera. However, substantial DNA data underpin the phylogeny of Alapetite *et al.* (2014), and there is no evidence that additional data will lead to any greater support for relationships. Moreover, amid calls to expedite alpha taxonomy in the face of a biodiversity crisis (e.g. Riedel *et al.* 2013), it is essential that taxonomists adopt practical solutions, rather than procrastinate in a quest for "more data", thereby hindering communication, scientific research and, as is the case for the three new palm genera, conservation action.

Thus, *Adonidia* is once again accepted as a monotypic genus, consisting of *A. merrillii* alone, and three new genera, *Jailoloa*, *Manjekia* and *Wallaceodoxa* are

described here. Full taxonomic accounts of the new genera with comparison with related genera (Table 1) are provided below, alongside a revised key to all genera of subtribe Ptychospermatinae.

Key to the genera of subtribe Ptychospermatinae

Note. This key is a heavily revised version of the key published in *Genera Palmarum* (Dransfield *et al.* 2008) and corrects certain inconsistencies that were accidentally included there.

1. Leaf plumose; leaflets of mature leaves divided longitudinally into 7 – 17 linear, secondary segments, held in many different planes 2
1. Leaf not plumose; leaflets of mature leaves linear to wedge-shaped, not subdivided, held in one plane . . . 3
2. Stem slightly ventricose; primary leaflets regularly arranged, divided into 11 – 17 secondary segments, lacking white woolly scales abaxially; outer endocarp with large, conspicuously branched, tough black fibres; endosperm homogeneous. (Queensland, Australia) . . . . . **Wodyetia**
2. Stem moderate to slender, not bottled, primary leaflets grouped, divided into 7 – 9 secondary segments, bearing white woolly scales abaxially; outer endocarp with sparsely branched, thin, terete, straw-coloured fibres; endosperm ruminate. (Queensland, Australia) . . . . . .**Normanbya**
3. Endocarp rounded, often with adhering fibres; seed terete in cross section 4
3. Endocarp rounded, angled, grooved or winged; seed angled or grooved (sometimes only shallowly grooved) in cross section 12
4. Endocarp straw-coloured with a single flattened ridge. (Fiji, Samoa, Solomon Islands, Tonga, Vanuatu)**Veitchia**
4. Endocarp straw-coloured or black, lacking single flattened ridge 5
5. Fruit with a single series of black, anastomosing, flat fibrous bundles closely adherent to the endocarp. (Northern Territory, Australia) . . . . . **Carpentaria**
5. Fruit lacking black fibres, endocarp straw-coloured 6
6. Inflorescence peduncle equal or longer than rachis (excluding terminal rachilla) 7
6. Inflorescence peduncle shorter than rachis (excluding terminal rachilla). 8
7. Moderately robust, mid-storey palm; stilt roots absent; prophyll caducous; endocarp covered with a mix of thin and thick fibres. (Samoa) . . . . . **Solfia**
7. Slender, understorey palms; stilt roots present; prophyll persistent and marcescent; fibres around the endocarp uniformly thin and hair-like. (Maluku to western New Guinea) . . . . . **Drymophloeus**
8. Endosperm homogeneous. (Palau) . . . . . **Ponapea** (in part — *P. palauensis*)
8. Endosperm ruminate 9
9. Leaflets linear-lanceolate, tips bifid, not praemorse or inconspicuously so. (Palawan and offshore islands of North Borneo) . . . . . .**Adonidia**
9. Leaflet linear to broadly lanceolate, tips not bifid, conspicuously praemorse 10
10. Slender, understorey to midstorey palm; leaf recurved with ascending leaflets; inflorescence axes and flowers purple at anthesis; fruit orange-yellow with purple perianth cupule when ripe. (Halmahera) . . . . . .**Jailoloa**
10. Moderately robust sub-emergent to emergent tree palms; leaf arching with pendulous leaflets; inflorescence axes and flowers white, fruit red with white perianth cupule when ripe 11
11. Leaflets broadly lanceolate, up to 30 each side of rachis, leaf sheath, with sparse, grey, indumentum, pistillode long, lageniform. (Biak) . . . . . .**Manjekia**
11. Leaflets linear-lanceolate, more than 50 each side of rachis, leaf sheath, petiole and rachis with thick, white, lanate indumentum interspersed with abundant, large, brown-black, twisted hairs, pistillode short, truncate. (Raja Ampat Islands) . . . . . .**Wallaceodoxa**
12. Inflorescence peduncle elongate, typically equal or longer than rachis (excluding terminal rachilla) 13
12. Inflorescence peduncle short, typically shorter than rachis (excluding terminal rachilla) 14
13. Leaflets truncate; endocarp thin; seed polygonal in cross section. (Fiji Islands, Samoa) . . . . . **Balaka**
13. Leaflets 3-pronged at the apex, the centre prong the longest; endocarp thickened, bony, strong ridged and grooved; seed symmetrical with 5 acute ridges (Papua New Guinea) . . . . . .**Brassiophoenix**
14. Moderately robust tree palm; fruit 3.9 – 6 cm long, endocarp very thick, hardened, black, with numerous irregular groves and flanges; seed pointed apically, with irregular ridges; staminate flowers with pistillode always lageniform. (New Guinea, Bismarck Archipelago, Solomon Islands) . . . . . **Ptychococcus**
14. Slender to moderate tree palms; fruit 1 – 4.5 cm long, endocarp thin, fibrous or if somewhat bony thickened then only five-ridged; seed rounded apically and 5-angled; staminate flowers with short, conic-ovoid or lageniform pistillode 15
15. Inflorescence axes variously coloured (green, yellow, pink, purple), but not white; pistillode lageniform; fruit

1 – 2 cm long. (Moluccas, New Guinea, northeastern Australia, D'Entrecasteaux and Louisiade Archipelagos, Solomon Islands) . . . . . **Ptychosperma**

15. Inflorescence axes white or green; pistillode conic-ovoid, rarely lageniform; fruit 1.5 – 4.5 cm long. (Micronesia, New Britain) . . . . . **Ponapea** (in part — *P. hentyi*, *P. hosinoi*, *P. ledermanniana*)

Taxonomic treatment

Jailoloa *Heatubun & W. J. Baker* **gen. nov.** Type: *Jailoloa halmaherensis* (Heatubun) Heatubun & W. J. Baker (*Ptychosperma halmaherense* Heatubun).

http://www.ipni.org/urn:lsid:ipni.org:names:77141208-1

Small to moderate, solitary, unarmed, pleonanthic, monoecious palm. *Stem* erect, slender, smooth, light brown to whitish, often grey, obscurely or conspicuously ringed with leaf node scars. *Leaves* pinnate, strongly arching, rather few in the crown; sheath tubular, forming well-defined crownshaft, glabrous adaxially, abaxially with sparsely to dense indumentum of brown to black irregular scales of various sizes and brown to white matted fibrous scales; petiole elongate, slender, channelled adaxially, rounded abaxially, covered with dark brown to black, thick indumentum or stellate hairs; rachis slender, arching, somewhat flat adaxially, slightly rounded abaxially, with indumentum as on petiole; leaflets regularly arranged, subopposite to alternate, near petiole long and gradually becoming shorter towards the apex, ascending, borne on adaxial surface of rachis, forming an acute angle, single-fold with inconspicuous main vein, stiff, leathery, slightly discolorous when dried, light brown adaxially, paler abaxially, conspicuous large brown ramenta on abaxial veins, basal leaflets lanceolate, acuminate tip with pendulous remains of the rein, middle leaflets elongate, lanceolate, tip truncate, praemorse, apical leaflets somewhat elongate, paired or solitary, tip truncate, praemorse. *Inflorescence* infrafoliar, protandrous, branching to 3 orders, divaricate, somewhat deflexed at anthesis; peduncle slender, elongate, elliptical in cross section, shorter than rachis, dark purple to light orange with numerous minute purple-brown indument; prophyll caducous, lanceolate, 2-keeled, leathery, cream to light brown, entirely enclosing the inflorescence, then splitting longitudinally when inflorescence expanding and still enclosed with peduncular bract, and falling before anthesis; first peduncular bract, elongate, 2-keeled, leathery, cream to light brown, with abundant, minute, purple, dot-like scales scattered on surface; remaining peduncular bracts and rachis bracts reduced, inconspicuous stubs or sometimes triangular, very low; rachis purple to light orange; the basalmost primary branch relatively long, branched to few second orders branches and then narrowly to widely spaced rachillae; rachillae numerous, sinuous, glabrous, elongate, floral triads sparsely arranged. *Staminate flowers* very small, elongate, bullet-shaped, somewhat asymmetric, purple; sepals 3, imbricate, keeled, rounded; petals 3, valvate, elliptic, tip slightly rounded, thick and fleshy, somewhat striate, purple with cream tinge at the tip; stamens numerous, up to 16, variable in length, filaments dark brown, inflexed; anthers somewhat sagittate, cream-coloured, longer than the filaments; pistillode almost equal in height to the stamens, lageniform with an elongate, filamentous stylar section, sometimes inconspicuous, lobed at apex, cream. *Pistillate flowers* slightly larger than the staminate, ellipsoid, purple, with conspicuous white stigma at anthesis; sepals 3, strongly imbricate, keeled, rounded, somewhat asymmetrical, thicker at the base, purple with white line along the margin; petals 3, strongly imbricate, elliptic, purple with a thin line along the margin, somewhat striate; gynoecium ellipsoidal, purple, stigma trifid, white at anthesis; staminodes inconspicuous; ovule basal. *Fruit* ellipsoidal, somewhat beaked, stigmatic remains apical, persistent, black, perianth persistent; epicarp smooth, shiny, very thin, purple and becoming bright yellow or light orange when mature; mesocarp fibrous, fleshy, mucilaginous and tanniferous; endocarp thin, cartilaginous, fragile, terete, lacking any grooves or angles, straw-coloured with broad, flat adherent fibres, anastomosing towards the apex; seed somewhat ellipsoidal, without any grooves or angles, rounded in cross-section; hilum elliptical, elongate, stretching from base to apex; raphe branches anastomosing; endosperm deeply ruminate; embryo basal.

Jailoloa halmaherensis (*Heatubun*) *Heatubun & W. J. Baker*, **comb. nov.** Type: Indonesia, North Moluccas Province, Halmahera Timur Regency, Maba Town, PT. Buena Persada (Solway International) Nickel Mining Concession Area, Gunung Batu, 25 Feb. 2011, *Heatubun* 1125 (holotype MAN!; isotypes BO!, K!).

http://www.ipni.org/urn:lsid:ipni.org:names:77141212-1

Ptychosperma halmaherense Heatubun, *Palms* 55: 186 (2011), **synon. nov.**

Solitary palm. *Stem* up to 12 m tall, 5 – 7 cm diam.; internodes 5 – 7 cm long, nodal scars conspicuous, dark brown. *Leaves* c. 9 in crown, 190 – 200 cm long

Table 1. Summary of morphological differences between *Jailoloa*, *Manjekia* and *Wallaceodoxa*, and their potential relatives

	Jailoloa	*Manjekia*	*Wallaceodoxa*	*Adonidia*	*Normanbya*	*Ponapea*	*Ptychosperma*
Leaflets	linear lanceolate, praemorse tips, ascending	broadly lanceolate, praemorse tips, pendulous	linear lanceolate, praemorse tips, pendulous	linear lanceolate, acute bifid tips ascending	linear lanceolate, praemorse tips, plumose	broadly lanceolate in a single plane or cuneate and slightly ascending, praemorse	linear to cuneate, praemorse, variously arranged, but never ascending
Inflorescence colour	purple	white	white	white	green	white or green	green, yellow, pink or purple
Stamen number	c. 16	30 – 32	58 – 64	45 – 50	24 – 40	25 – 120	9 – 63
Pistillode	lageniform	lageniform	short, ellipsoid	lageniform	lageniform	short, conical	lageniform
Fruit colour	orange-yellow	red	red	red	red	red	black, purple, red or orange
Endocarp	terete, thin, with fine and broad, straw-coloured longitudinal fibres	terete, thin, with very fine and broad, straw-coloured longitudinal fibres	terete, thin, with fine and broad, straw-coloured longitudinal fibres	terete, thin, with fine and broad, straw-coloured longitudinal fibres	terete, thin with fine, hair-like straw-coloured longitudinal fibres	angled or terete, thick, ridged, straw-coloured or black, fibrous	angled, thin, with fine, straw-coloured longitudinal fibres.
Seed	terete	terete	terete	terete	terete	terete or angled	angled
Endosperm	ruminate	ruminate	ruminate	ruminate	ruminate	homogeneous or ruminate	homogeneous or ruminate

including petiole; sheath tubular, 40 – 50 cm long and about 15 cm wide, tapering to 8 cm wide, greenish-brown; crownshaft up to 75 cm long; petiole 22 – 23 cm long, about 2 cm wide and 1.1 cm thick at the base; rachis arching; leaflets 25 – 26 on each side of the rachis; basal leaflets 55 – 75 cm long, 2.5 cm wide, pendulous rein up to 27 cm long, middle leaflets 44 – 48 cm long, 3.5 – 4 cm wide, apical leaflets 12.5 – 15 cm long, 0.3 – 1.2 cm wide; ramenta up to 3.5 cm long, 0.5 cm wide. *Inflorescence* up to 65 cm long at anthesis, with 18 – 20 primary branches including terminal rachilla; peduncle 10 – 15 cm long; prophyll c. 20 × 4 cm; complete peduncular bract c. 30 × 3 cm; the first order branches 35 – 45 cm long, about 10 – 13 branches (including terminal rachilla), 1 – 7 cm between branches; rachillae numerous, 7 – 12 cm long, each bearing 8 – 15 floral triads. *Staminate flowers* 5.5 × 2 mm in bud near anthesis, purple; sepals 3, free, c. 2.2 × 2 mm; petals 3, c. 4.5 × 2 mm; stamens c. 16, 2.5 – 4 mm long; filaments 1.75 – 2 mm long, dark brown; anthers 2.5 – 3 mm long; pistillode c. 2.5 × 0.1 mm. *Pistillate flowers* 6.5 × 6 mm at anthesis, purple; sepals 3.5 × 3.5 mm; petals 5 × 4 mm, purple with a thin line along the margin; staminodes inconspicuous; gynoecium 4.5 × 2.5 mm including stigma; ovule basal. *Fruit* 13 – 15 × 10 × 10 mm, epicarp purple when juvenile, becoming bright yellow or light orange when mature; pericarp c. 0.5 mm thick. *Seed* 10 × 8.5 × 7 mm; hilum up to 3 mm wide, embryo 2.5 × 1 mm (Figs 2, 3).

RECOGNITION. Distinguished from other genera of subtribe Ptychospermatinae (tribe Areceae) by its slender, solitary habit, recurved leaves with ascending, narrow, leathery leaflets, inflorescence axes and flowers purple at anthesis, stamens c. 16, fruit orange-yellow when ripe with purple perianth cupule, thin, terete, straw-coloured endocarp with fine, longitudinal fibres, and the terete seed.

DISTRIBUTION. Known only from the type locality in East Halmahera, North Moluccas, Indonesia (Map 1).

SPECIMENS EXAMINED. INDONESIA. North Moluccas Province, Halmahera Timur Regency: Maba Town, PT. Buena Persada (Solway International) Nickel Mining Concession Area, Gunung Batu, path way back from camp D to the main camp, 00°42'50.6"N 128°06'02.6"E, 25 Feb. 2011, *Heatubun* 1125 (holotype MAN!; isotype BO!, K!).

HABITAT. Very steep terrain (more than 45°) on rocky outcrops or very poor soils in ultramafic heath forest at an elevation of 530 – 550 m above sea level. As noted by Heatubun (2011), this taxon appears to be adapted to the extreme conditions of ultramafic geology and soils that are thin or even absent. The ultramafic rocks have produced extremely weathered oxisol soils that are reddish yellow due to the high

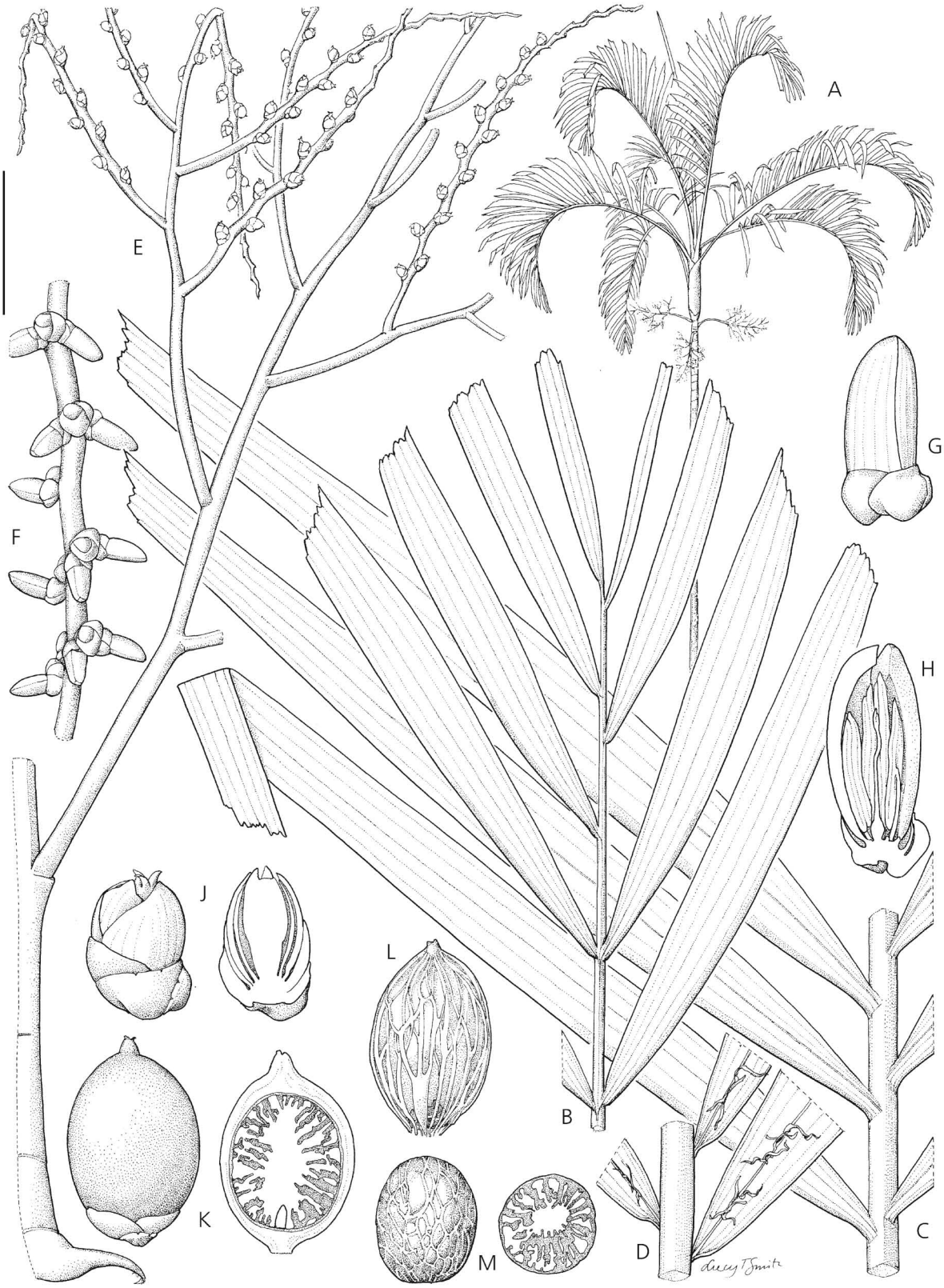


Fig. 2. *Jailoloa halmaherensis.* **A** habit; **B** leaf apex; **C** mid-leaf portion; **D** detail of ramenta on abaxial surface of leaflets; **E** inflorescence; **F** portion of rachilla with triads; **G** staminate flower bud; **H** staminate flower bud in section; **J** pistillate flower whole and in section; **K** fruit whole and in section; **L** endocarp showing longitudinal fibres; **M** seed whole and in cross section. Scale bar: **A** = 1 m; **B** – **D** = 6 cm; **E** = 4 cm; **F** = 1.5 cm; **G** = 4 mm; **H** = 3.3 mm; **J** = 5 mm, **K** – **M** = 1 cm. All from *Heatubun et al.* 1125. DRAWN BY LUCY T. SMITH.

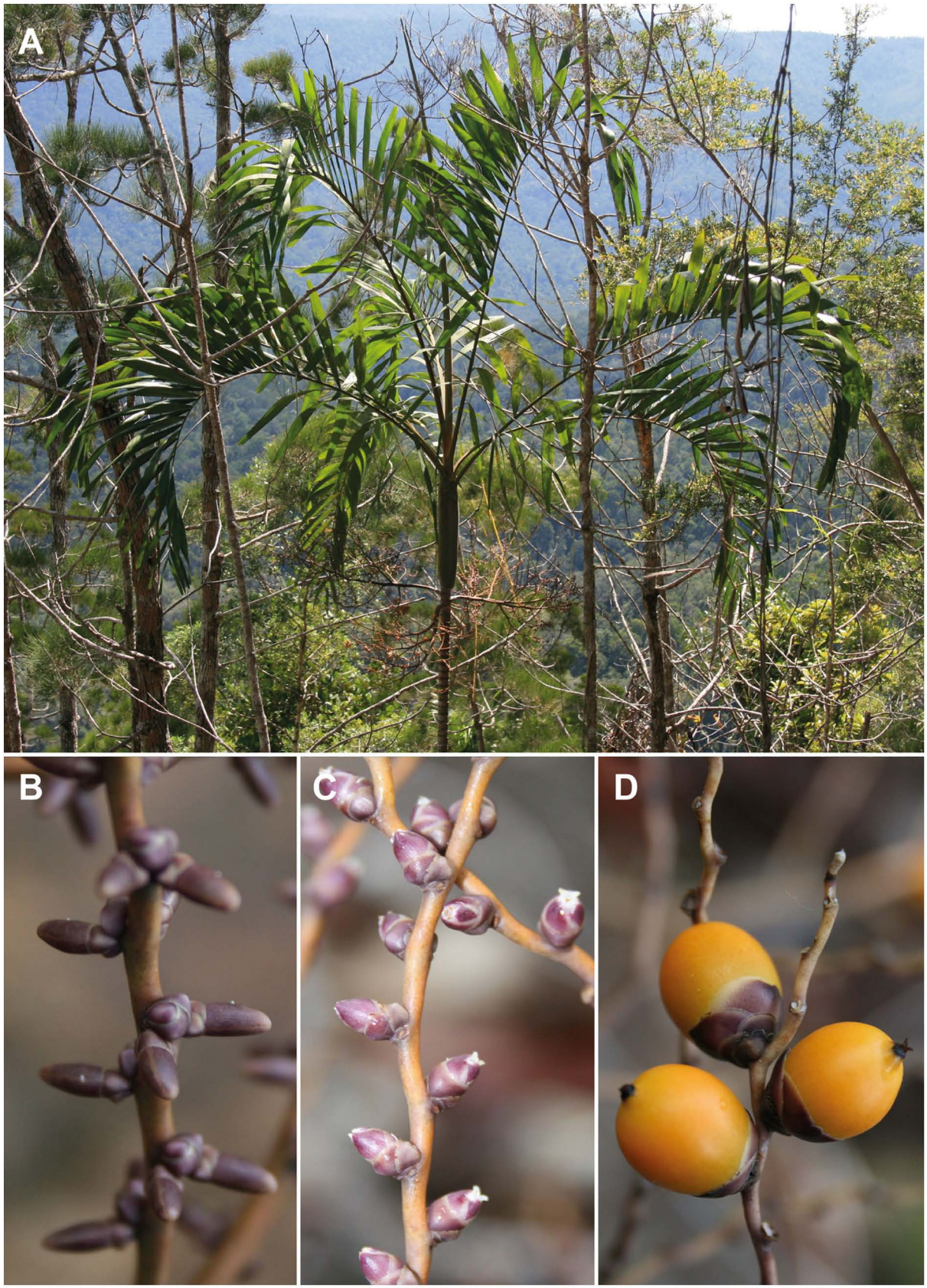


Fig. 3. *Jailoloa halmaherensis*. **A** crown with inflorescences; **B** floral triads showing staminate flower buds close to anthesis; **C** pistillate flowers at anthesis; **D** ripe fruit. PHOTOGRAPHS BY CHARLIE D. HEATUBUN.

concentration of iron, magnesium and other metals, including nickel.

CONSERVATION STATUS. Critically Endangered (see Heatubun 2011).

ETYMOLOGY. The new generic name refers to *Jailolo* (sometimes spelled *Gilolo*), the native name of Halmahera Island, that was formerly widely used (e.g. Wallace 1869).

VERNACULAR NAME. None recorded.

USES. None recorded

NOTES. *Jailoloa halmaherensis* is a slim, solitary palm bearing strongly arching leaves with narrow, leathery, ascending leaflets. It was discovered in Halmahera in 2011 by the first author, who described it in *Ptychosperma* (Heatubun 2011), assigning it to subgenus *Ptychosperma* (*sensu* Essig 1978). However, the molecular phylogenetic evidence of Alapetite *et al.* (2014) leaves little doubt that its placement in *Ptychosperma* is incorrect. Although *Jailoloa* and *Ptychosperma* are superficially similar as slender palms with colourful inflorescences, important morphological differences can be observed. As already noted by Heatubun (2011), *Jailoloa* differs from *Ptychosperma* in the endocarp and seed being rounded and terete in cross section, whereas all species of *Ptychosperma* bear endocarps and seeds that are lobed or angled, even if obscurely so (Essig 1978; Zona 1999). The combination of purple inflorescence axes and yellow-orange fruit colour is also not found in *Ptychosperma*, in which orange fruit are found only in species with green or yellow inflorescences axes (Essig 1978). *Ptychosperma* also never has ascending leaflets.

The total evidence phylogenetic analysis of Alapetite *et al.* (2014) resolved *Jailoloa* as sister to *Manjekia* (syn. *Adonidia maturbongsii*), but some data partitions (*PRK*, *ndhA*) provided evidence for a sister relationship to *Normanbya* F. Muell. ex Becc. when analysed separately. *Jailoloa* differs from *Manjekia* in its slender habit (moderately robust in *Manjekia*), ascending, leathery leaflets (pendulous, non-leathery, broadly lanceolate leaflets in *Manjekia*), inflorescence and fruit colour (white with red fruit in *Manjekia*), and number of stamens (30 – 32 in *Manjekia*). It differs from *Normanbya* in size (moderately robust in *Normanbya*), leaflets (subdivided and plumosely arranged in *Normanbya*) and inflorescence colour (green in *Normanbya*).

Jailoloa halmaherensis is a very rare palm, with a small population known only from ultramafic heath forest at a single site that falls within a nickel mining concession (Heatubun 2011). The conservation status of this taxon, which has been assessed as Critically Endangered, is further accentuated by its new status as a monotypic genus. The future survival of this palm is a serious cause for concern. For further discussion see Heatubun (2011).

2. Manjekia *W. J. Baker & Heatubun* **gen. nov.** Type: *Manjekia maturbongsii* (W. J. Baker & Heatubun) W. J. Baker & Heatubun (*Adonidia maturbongsii* W. J. Baker & Heatubun)

http://www.ipni.org/urn:lsid:ipni.org:names:77141213-1

Moderately robust, solitary, unarmed, pleonanthic, monoecious, mid-storey to emergent tree palm. *Stem* erect, moderate, leaf node scars prominent, surface grey to brown. *Leaves* pinnate, arching, crown spherical in outline; sheath tubular, forming well-defined crownshaft, pale, dull green, with thin grey scurfy indumentum with scattered purple-brown scales, somewhat eroded or fibrous at mouth; petiole present, channelled adaxially, rounded abaxially, with indumentum as on the sheath; rachis arching, rounded abaxially, channelled or ridged adaxially, with indumentum as on the sheath; leaflets single-fold with inconspicuous main vein, regularly arranged (or somewhat subregularly), in one plane, drooping or pendulous in emergent individuals, slightly discolorous, with minute brown punctate scales and scattered medifixed ramenta abaxially, basal leaflets lanceolate, apex obliquely praemorse, with persistent reins attached to apex, middle leaflets oblanceolate, cucullate, apex obliquely praemorse, concave, transverse veinlets inconspicuous, apical leaflets linear or narrowly elliptic, apex truncate, praemorse. *Inflorescence* infrafoliar, protandrous, branching to 4 orders, divaricate, patent, deflexed in fruit, axes white, rubbery, with caducous floccose orange-brown indumentum when young; peduncle moderately elongated, flattened, elliptic in section, shorter than rachis, sometimes with matted, scurfy indumentum of black-brown scales basally; prophyll greenish white, glabrous, 2-keeled, splitting apically, caducous later; first peduncular bract, glabrous, exserted from prophyll apex and enclosing inflorescence prior to anthesis, caducous later; remaining inflorescence bracts inconspicuous; basalmost primary inflorescence branch longer than other primary branches, with numerous secondary branches and rachillae; rachillae somewhat sinuous, glabrous, floral triads moderately closely spaced, spirally arranged. *Staminate flower* bullet-shaped in bud, symmetrical, greenish white, sepals 3, distinct, strongly imbricate, rounded, thickened; petals 3, valvate, briefly united at base, narrowly elliptic, bony; stamens numerous, c. 30, rather similar in length, filaments briefly connate at base, awl-shaped; anthers oblong, dorsifixed near the base, latrorse, connective dark; pistillode almost equal in height to the stamens, lageniform with an elongate stylar section. *Pistillate flower* ovoid, smaller than the staminate flowers, pale green to greenish white, borne in proximal half to two-thirds of the rachilla; sepals 3, strongly imbricate, thickened, rounded, somewhat

asymmetrical; petals 3, strongly imbricate, similar to sepals; staminodes few, minute, tooth-like; gynoecium pyriform, stigmas at anthesis not seen, ovule basal. *Fruit* ellipsoid, stigmatic remains apical, persistent, brown-black; epicarp smooth, somewhat shiny, thin, ripening through orange to red, with sparse, minute black dots, perianth cupule clasping; mesocarp fibrous, fleshy; endocarp thin, straw-coloured, with few, thick, longitudinal fibres interspersed and numerous, very fine fibres closely adhering to endocarp. *Seed* ellipsoid, without grooves or angles, rounded in cross-section; hilum elliptical, elongate, running from base to apex; raphe branches anastomosing; endosperm ruminate; embryo basal, white.

Manjekia maturbongsii *(W. J. Baker & Heatubun) W. J. Baker & Heatubun* **comb. nov.** Type: Indonesia, Papua Province, Biak Numfor Regency, Biak Island, forest on the road side, main road from North Biak Nature Reserve to Biak town, July 2009, *Heatubun et al.* 971 (holotype K!; isotypes BO!, FTG!, MAN!, NY!).

http://www.ipni.org/urn:lsid:ipni.org:names:77141215-1

Adonidia maturbongsii W. J. Baker & Heatubun, *Palms* 56: 134 (2012), **synon. nov.**

Solitary palm. *Stem* 10 – 15 m tall, 10 – 20 cm in diam., tapering towards apex, surface brown with white blotches, internodes 2 – 4 cm apart. *Leaves* c. 10 in crown; sheath 60 – 70 cm long, crownshaft 80 – 90 × 10 – 12 cm; petiole 26 – 45 cm long, rachis 2.5 – 3 m long; leaflets 25 – 30 each side of the rachis, basal leaflets 32 – 50 cm long, 1 – 4.5 cm wide, sometimes with rein up to 1 m attached, middle leaflets 40 – 49 cm long, 9 – 12 cm wide, apical leaflets 6.5 – 42 cm long, 2 – 4.5 cm wide. *Inflorescence* 60 – 70 cm long; prophyll 24 – 26 cm long, 6 – 8 cm wide, greenish white, splitting apically, caducous later; first peduncular bract 31 – 35 × 5 – 7 cm, attached 15 – 20 mm above prophyll insertion; peduncle 8 – 14 cm long, 2 – 2.5 cm wide; primary branches 25 – 28, longest primary branch (basalmost) 40 – 65 cm; rachillae 8 – 19 cm long, 1.5 – 3.5 mm in diam., floral triads 3 – 9 mm apart. *Staminate flower* 6.5 – 8 mm long, 2.5 – 3.2 mm in diam. in bud; sepals 2 – 2.4 mm long, c. 3 mm wide; petals 7 – 7.5 mm long, c. 3 mm wide; stamens 30 – 32, 4.5 – 6 mm long; filaments 1.5 – 4 mm long; anthers 3 – 3.8 mm long, 0.5 – 0.8 mm wide; pistillode c. 5 mm long, 1.2 – 1.4 mm in diam. *Pistillate flower* 4.5 – 5 mm long, c. 4.5 mm in diam.; sepals 3 – 4 mm long, 4 – 4.5 mm wide; petals 4 – 4.5 mm long, 3 – 3.5 mm wide; staminodes 2 – 3; gynoecium c. 4 mm long, c. 3 mm in diam. *Fruit* 24 – 31 mm long, 14 – 16 mm in diam.; pericarp 1.5 – 3 mm thick, endocarp 23 – 30 mm long, 12 – 12.5 mm in diam. *Seed* 14 – 20 mm long, 9.5 – 12 mm in diam, ellipsoid (Figs 4, 5).

RECOGNITION. Distinguished from other genera of subtribe Ptychospermatinae (tribe Areceae) by its moderately robust, solitary habit, arching leaves, broadly lanceolate pendulous leaflets with wide, concave, praemorse apices, white inflorescence axes and terete, straw-coloured endocarp with broad, adherent, longitudinal fibres interspersed with very fine fibres.

DISTRIBUTION. Biak Island (Map 1).

SPECIMENS EXAMINED. INDONESIA. Papua Province, Biak Numfor Regency, Biak Island: forest on the road side, main road from North Biak Nature Reserve to Biak town, 0°44'20"S 135°52'57"E , 25 July 2009, *Heatubun et al.* 971 (holotype K!; isotypes BO!, FTG!, MAN!, NY!); North Biak Nature Reserve, Sansundi village, 0°42'S 135°50'E, 8 Sept. 1998, *Maturbongs et al.* 559 (BO!, K!, MAN!), *Maturbongs et al.* 560 (BO!, K!, MAN!); Samber forest, 1°8'33"S 135°53'43"E, 22 July 2009, *Baker et al.* 1336 (BO!, K!, FTG!, MAN!), 1°8'45"S 135°53'37"E, 22 July 2009, *Baker et al.* 1338 (BO!, K!, FTG!, MAN!); locality uncertain (given incorrectly on the label as Merauke district, but number sequence indicates the collector was active in Biak), 15 June 2001, *Maturbongs et al.* 686 (AAU!, BO!, FTG!, K!, MAN!).

HABITAT. Lowland forest on limestone with thin soils and many sink holes, 80 – 170 m elevation.

CONSERVATION STATUS. Endangered (Baker & Heatubun 2012).

ETYMOLOGY. The new generic name is based on *Manjek*, the local name in Biak dialect for this palm. The species epithet, coined previously (Baker & Heatubun 2012), honours Rudi Maturbongs, palm expert at Universitas Negeri Papua and first collector of herbarium specimens of the species.

VERNACULAR NAME. *Manjek* (Biak dialect)

USES. The stems are used for flooring and pillars in traditional houses.

NOTES. This palm is immediately recognised by its tall, elegant habit combined with its arching leaves with broad, pendulous, conspicuously praemorse leaflets and profusely branched greenish white inflorescences. Reports of a distinctive, undescribed species of Ptychospermatinae from Biak began to circulate during the 1990s (Zona 2000; Baker & Heatubun 2012). The first herbarium specimens were made by Rudi Maturbongs in 1998, although the material was at first overlooked at Kew as a robust form of *Drymophloeus litigiosus* (Becc.) H. E. Moore. Having observed it during a short visit to Biak in 2000, WB arranged an expedition to Biak in 2009 with CH to secure adequate material for morphological and molecular study.

Manjekia maturbongsii was originally described in *Adonidia* (Baker & Heatubun 2012) based on molec-

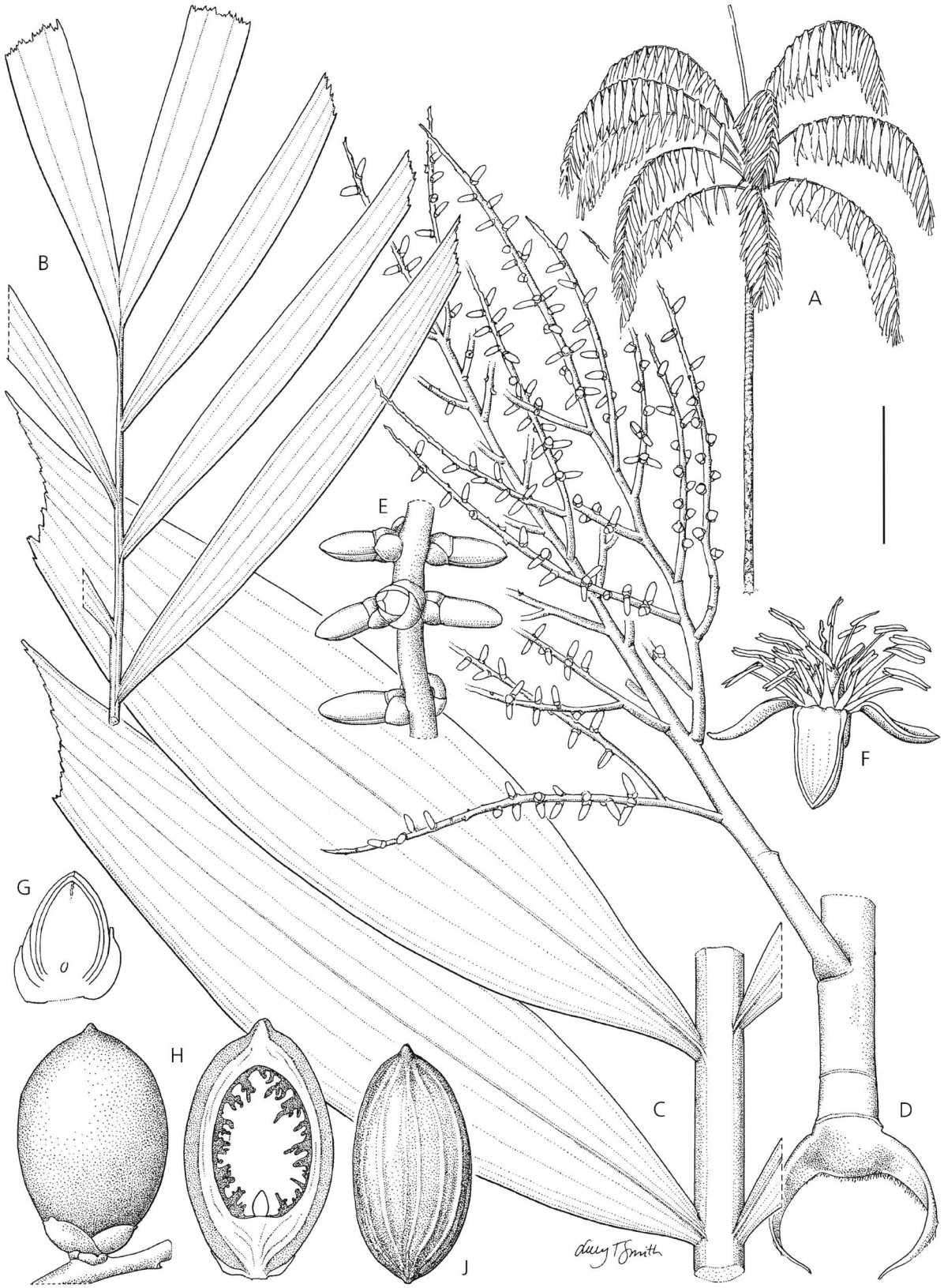


Fig. 4. *Manjekia maturbongsii*. **A** habit; **B** leaf apex; **C** mid-leaf portion; **D** inflorescence; **E** portion of rachilla with triad; **F** staminate flower; **G** pistillate flower in section; **H** fruit whole and in section; **J** endocarp showing longitudinal fibres. Scale bar: **A** = 2 m; **B** – **D** = 6 cm; **E** = 1.5 cm; **F, G** = 7 mm; **H, J** = 7 mm. From *Heatubun et al.* 971, except **A** from photograph and **F** from *Baker et al.* 1338. DRAWN BY LUCY T. SMITH.

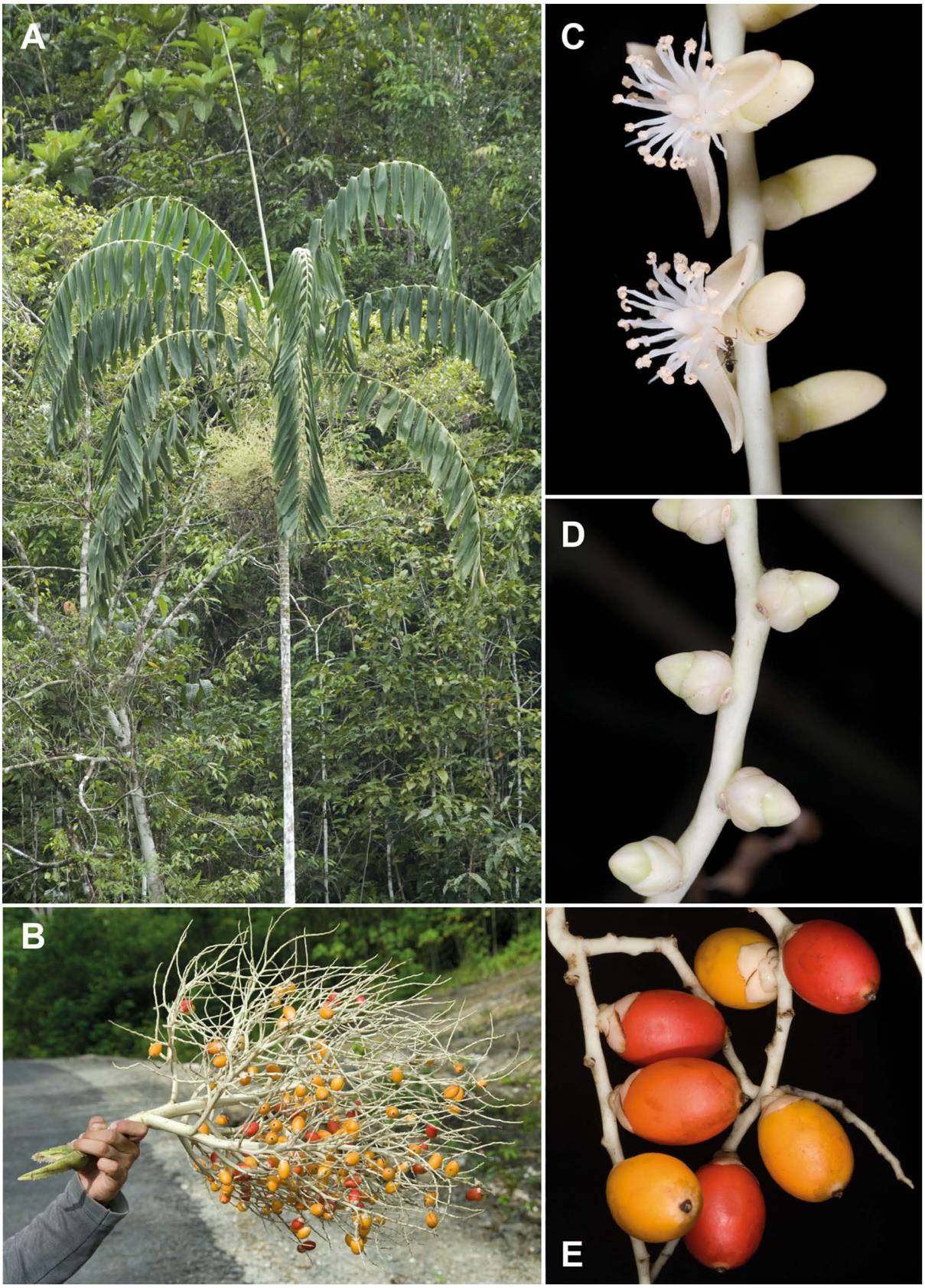


Fig. 5. *Manjekia maturbongsii*. **A** habit; **B** inflorescence with fruit; **C** staminate flowers at anthesis; **D** pistillate flower buds; **E** ripe fruit. PHOTOGRAPHS BY WILLIAM J. BAKER.

ular phylogenetic evidence from two low-copy nuclear genes (Zona *et al.* 2011). Morphological similarities to the existing species of *Adonidia*, *A. merrillii*, were identified, such as the limestone habitat of both species, their white inflorescences branched up to four orders, the fruits with red epicarp, the endocarps with adhering pale, flattened, longitudinal fibres interspersed with finer fibres, and seeds with ruminate endosperm. However, differences between the two taxa were also highlighted by the authors (Baker & Heatubun 2012). *Manjekia* bears leaves with broad, pendulous leaflets in a single plane with wide, concave, praemorse tips, whereas leaflets of *Adonidia* are ascending, narrower and in slightly different planes with inconspicuously praemorse or bifid tips. In addition, the staminate flowers of *Manjekia* contain fewer stamens (30 – 32) than those of *Adonidia* (45 – 50).

The latest molecular phylogenetic evidence (Alapetite *et al.* 2014) contradicts the earlier study (Zona *et al.* 2011) and most strongly indicates a sister relationship with *Jailoloa*, though one low-copy nuclear data partition (*AG1*) indicates an alternative, poorly supported placement as sister to *Ponapea* Becc. Compared to *Jailoloa*, *Manjekia* is more robust with very different leaflets (ascending, narrow, leathery leaflets in *Jailoloa*), more stamens per staminate (c. 16 in *Jailoloa*) and contrasting inflorescence morphology and fruit colour (purple inflorescences branched to three orders with orange-yellow fruit in *Jailoloa*). *Manjekia* differs from *Ponapea* in its elongate, lageniform pistillode (short and conical in *Ponapea*) and the terete seed with ruminate endosperm (seed ridged in *Ponapea*, or if terete then homogeneous endosperm).

For further discussion of *Manjekia* in the context of the Biak palm flora see Baker & Heatubun (2012).

3. Wallaceodoxa *Heatubun & W. J. Baker* **gen. nov.** Type: *Wallaceodoxa raja-ampat* Heatubun & W. J. Baker

http://www.ipni.org/urn:lsid:ipni.org:names:77141221-1

Moderately robust, solitary, unarmed, pleonanthic, monoecious emergent tree palm. *Stem* erect, moderate, roughly fissured, whitish brown, nodes inconspicuous. *Leaves* pinnate, pendulous, crown hemispherical in outline; sheath tubular, forming well-defined crownshaft, glabrous adaxially except for scattered patches of white floccose indumetum, abaxially with thick, white, caducous, lanate indumentum composed of very fine translucent fibres mixed with a lesser proportion of similar brown fibres, interspersed with numerous, large, brown-black twisted hairs that are more abundant near the sheath mouth and junction with petiole; petiole elongate, slender, channelled adaxially, rounded abaxially, with dense indumentum as on the sheath; rachis somewhat slender, arching, forming a ridge adaxially, rounded abaxially, with indumentum as on the sheath, but with the large, brown-black twisted hairs more numerous; leaflets regularly arranged, subopposite to alternate, pendulous, borne on adaxial surface of rachis on the slope of the ridge, forming a sharp-angle, single-fold with inconspicuous main vein, green, slightly discolorous when dried, paler adaxially, darker and glaucous abaxially, papery, basal leaflets linear to lanceolate or slightly sigmoid, tips inconspicuously praemorse, sometimes with persistent, pendulous remains of the rein, middle leaflets elongate, somewhat lanceolate, tips obliquely and inconspicuously praemorse, apical leaflets paired or solitary, tips truncate and unevenly praemorse or toothed. *Inflorescence* infrafoliar, protandrous, branching to 3 orders (rarely to 4 orders?), divaricate; peduncle elongate, rather flat, slightly elliptical in cross section, shorter than rachis, light green to cream with abundant light brown to dark brown indumentum; prophyll caducous, lanceolate, 2-keeled, papery, cream to light green, entirely enclosing the inflorescence, then splitting longitudinally when inflorescence expanding and falling before staminate anthesis; first peduncular bract caducous, elongate, papery, cream to light green, with abundant lanate indumentum scattered on surface; remaining inflorescence bracts reduced to inconspicuous, horizontal, scar-like grooves; rachis light green to cream; the basalmost primary branch relatively long, branched to few second orders branches and then rachillae, primary branches widely spaced; rachillae numerous, fleshy, slightly sinuous near the tip, glabrous, floral triads densely arranged. *Staminate flowers* small to moderate, elongate, bullet-shaped in bud, symmetrical, whitish cream to greenish white; sepals 3, distinct, strongly imbricate, rounded; petals 3, valvate, united at the base, elliptic, tip slightly rounded, thick and fleshy, somewhat striate, light green to cream; stamens numerous, 58 – 64, variable in length, filaments awl-shaped, much longer than anther, white to cream; anthers sagittate, latrorse, cream-coloured; pistillode shorter than the stamens, irregularly ellipsoidal, lobed, cream to dark brown. *Pistillate flowers* slightly smaller than the staminate, ellipsoid, light green to cream, with conspicuous stigma at anthesis; sepals 3, strongly imbricate, keeled, rounded, somewhat asymmetrical, thicker at the base; petals 3, strongly imbricate, elliptic, somewhat striate; staminodes few, inconspicuous, membranous, triangular, cream to light brown; gynoecium ellipsoidal, light green to cream, stigma trifid, white at anthesis; ovule basal. *Fruit* ellipsoidal, stigmatic remains apical, persistent, black, perianth persistent; epicarp smooth, shiny, thin, light green when immature, turning yellow, orange to red when mature; mesocarp fibrous, fleshy, mucilaginous, tanniniferous, with slender to

large fibres and sclerified ground tissue surrounding the endocarp; endocarp very thin, cartilaginous, fragile, terete, lacking any grooves or angles, straw-coloured, with numerous flat adherent fibres; seed broadly ellipsoid, without any grooves or angles, round in cross-section; hilum elliptical, elongate, stretching from base to apex; raphe branches anastomosing; endosperm deeply ruminate; embryo basal, white.

Wallaceodoxa raja-ampat *Heatubun & W. J. Baker* **sp. nov.** Type: Indonesia, Raja Ampat Islands Regency, Waigeo Island, Waisai, Kelurahan Warmasen, behind Kantor Bupati, forest on right side of road to Pari Convention Centre Building (tanjakan gedung Pari), 15 April 2011, *Heatubun et al.* 1126 (holotype MAN!; isotypes BO!, K!).

http://www.ipni.org/urn:lsid:ipni.org:names:77141222-1

Solitary palm. *Stem* up to 30 m tall, 9 – 30 cm diam.; internodes with nodal scars inconspicuous, whitish brown. *Leaves* 11 – 19 in crown, 275 – 410 cm long including petiole; sheath tubular, 76 – 115 cm long and 16 – 30 cm wide, tapering to 10 cm wide; crownshaft 100 – 150 cm long; petiole 28 – 50 cm long, 2.5 – 3.5 cm wide and 1 – 1.5 cm thick at the base; leaflets 50 – 85 on each side of the rachis; basal leaflets 41 – 60 cm long, 0.5 – 2.5 cm wide, middle leaflets 70 – 114 cm long, 1 – 4.5 cm wide, apical leaflets 32 – 40 cm long, 0.5 – 1.5 cm wide. *Inflorescence* 50 – 100 cm long and 75 – 80 cm wide at anthesis; peduncle 15 – 20 cm long, 4 – 6 cm wide; prophyll 50 – 60 × 7 – 12 cm; peduncular bract similar to prophyll; primary branches up to 27 (including terminal rachilla), 33 – 50 cm long, 0.5 – 2.5 cm between branches; rachillae numerous, 11 – 18 cm long, 12 – 15 floral triads per 5 cm length of rachilla. *Staminate flowers* 7 – 7.5 × 2.5 – 4 mm in bud near anthesis, whitish cream to greenish white; sepals 3, free, 3.2 – 3.5 × 2.5 – 3 mm; petals 3, united at the base, 6 – 6.3 × 3 – 3.5 mm; stamens 58 – 64, 3.5 – 5 mm long; filaments 2.5 – 3 × 0.3 – 0.4 mm, white; anthers 2 – 2.5 × 0.5 – 0.75 mm; pistillode 1 – 2 × 0.9 – 1.2 mm, 2 – 3 lobes, c. 0.5 mm deep, c. 0.3 wide, cream to brown. *Pistillate flowers* 5 – 6 × 3.5 – 4 mm near anthesis, cream to light green; sepals 3.3 – 5 × 3.5 – 7 mm; petals 5 × 6 mm, light green; staminodes 5 – 7, 0.4 – 1 × 0.2 – 0.3 mm; gynoecium 4 – 4.5 × 1.5 mm including stigma; ovule c. 1.5 × 0.8 mm. *Fruit* 17.5 – 20 × 10 – 12 mm, light green and turning yellow, orange and red when mature; pericarp c. 1 mm thick. *Seed* 10 – 12 × 9 – 9.5 mm; embryo 1.5 – 2.75 × 1 – 1.75 mm. (Figs 6, 7, 8).

RECOGNITION. Distinguished from other genera of subtribe Ptychospermatinae (tribe Areceae) by its moderately robust, solitary habit, arching leaves, thick, white, lanate indumentum interspersed with large, brown-black twisted hairs on sheath, petiole and rachis, narrowly linear lanceolate pendulous leaflets with obliquely praemorse apices, white inflorescence axes, thick rachillae with rather crowded triads, short, irregularly ellipsoidal pistillode and rounded, straw-coloured endocarp with adherent, longitudinal fibres.

DISTRIBUTION. Only known from two of the Raja Ampat islands, Gag Island and Waigeo Island, off the western end of mainland New Guinea (Map 1).

SPECIMENS EXAMINED. INDONESIA. West Papua Province, Raja Ampat Islands Regency: Gag Island, limestone forest near airstrip, 00°24'00.0"S 129°53'15.0"E, 26 July 2006, *Heatubun et al.* 741 (BO!, K!, MAN!, NY!, FTG!, BPK Manokwari!), *Heatubun et al.* 742 (BO!, K!, MAN!, FTG!, BPK Manokwari!); Gag Island, Kali Kablebet, 00°24'44.3"S 129°53'48.2"E, 28 July 2006, *Heatubun et al.* 746 (BO!, K!, MAN!); Waigeo Island, Waisai, Kelurahan Warmasen, behind Kantor Bupati, forest on right side of road to Pari Convention Centre Building (tanjakan gedung Pari), 15 April 2011, *Heatubun et al.* 1126 (holotype MAN!; isotypes BO!, K!).

HABITAT. This palm has been recorded in lowland forest on limestone up to 50 m elevation. It has primarily been found in secondary and heavily disturbed forest, and old gardens, where it appears to grow as a relict from times when the forest was not disturbed. It is often found association with *Areca macrocalyx* Zipp. ex Blume, *Calamus* species, *Heterospathe elata* Scheff. and *Licuala* species.

CONSERVATION STATUS. Critically Endangered (CR B1ab(iii,v) + 2ab(iii,v); C1 + 2a(i); D). *Wallaceodoxa raja-ampat* is known from only two subpopulations, one in Gag Island and the other in Waigeo Island. In a census of the Gag subpopulation in 2006, 45 adults, 32 juveniles and 129 seedlings were recorded. In 2011, however, the same subpopulation consisted of only 28 adults and no juveniles or seedlings, due to land clearance by local people for slash-and-burn agriculture and the expansion of coconut plantation, representing a 38% decline in adults. The Waigeo subpopulation was discovered in 2011. A rapid survey within a 2 × 2 km area in the middle of the developing town of Waisai, the new capital of Raja Ampat Regency, located 5 adults, 63 juveniles and 378 seedlings. Although we have not been able to explore for further subpopulations elsewhere on Waigeo, we estimate that there are very few additional individuals to find because this taxon is restricted to the limestone forest in Waisai in the south of Waigeo.

Thus, *Wallaceodoxa raja-ampat* meets the threshold for the extinction risk category Critically Endangered (IUCN 2012) on multiple criteria, primarily because of its small size of the total adult population, area of occupancy of 8 km^2 (<10 km^2), extent of occurrence of 66 km^2 (<100 km^2), observed and inferred population decline and the severe fragmentation of the two subpopulations, which are located on separate islands. The decline in habitat

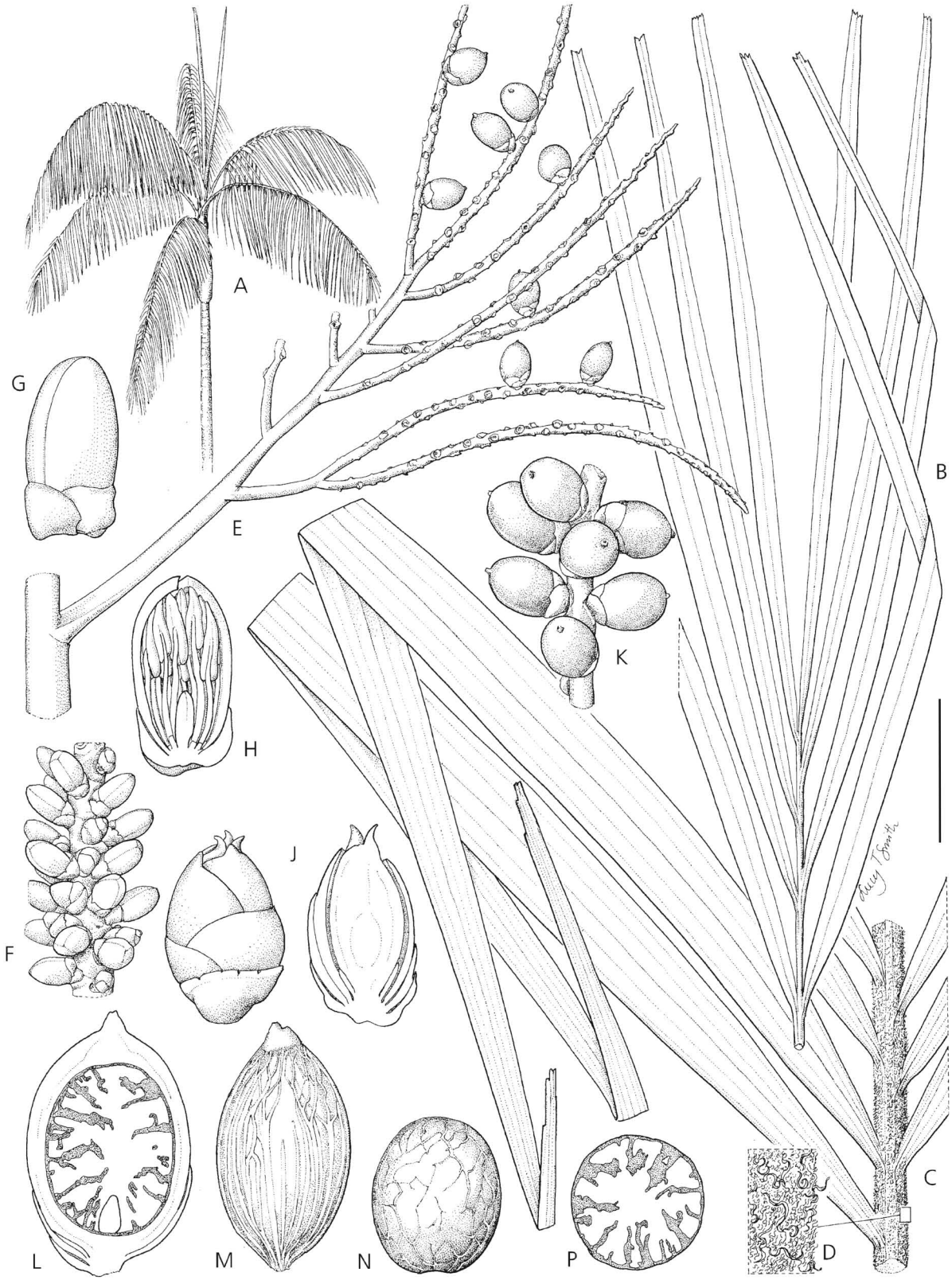


Fig. 6. *Wallaceodoxa raja-ampat*. **A** habit; **B** leaf apex; **C** mid-leaf portion; **D** detail of indumentum on rachis; **E** inflorescence primary branch; **F** portion of rachilla with triads; **G** staminate flower bud; **H** staminate flower bud in section; **J** pistillate flower whole and in section; **K** portion of rachilla with fruit; **L** fruit in section; **M** endocarp showing longitudinal fibres; **N** seed; **P** seed in cross section. Scale bar: **A** = 2 m; **B, C** = 8 cm; **D, J** = 7 mm; **E** = 6 cm; **F** = 1.5 cm; **G, H** = 5 mm; **K** = 2.5 mm, **L – P** = 1 cm. All from *Heatubun et al.* 746, except **B – D** from *Heatubun et al.* 1126 and **E** from *Heatubun et al.* 741. DRAWN BY LUCY T. SMITH.

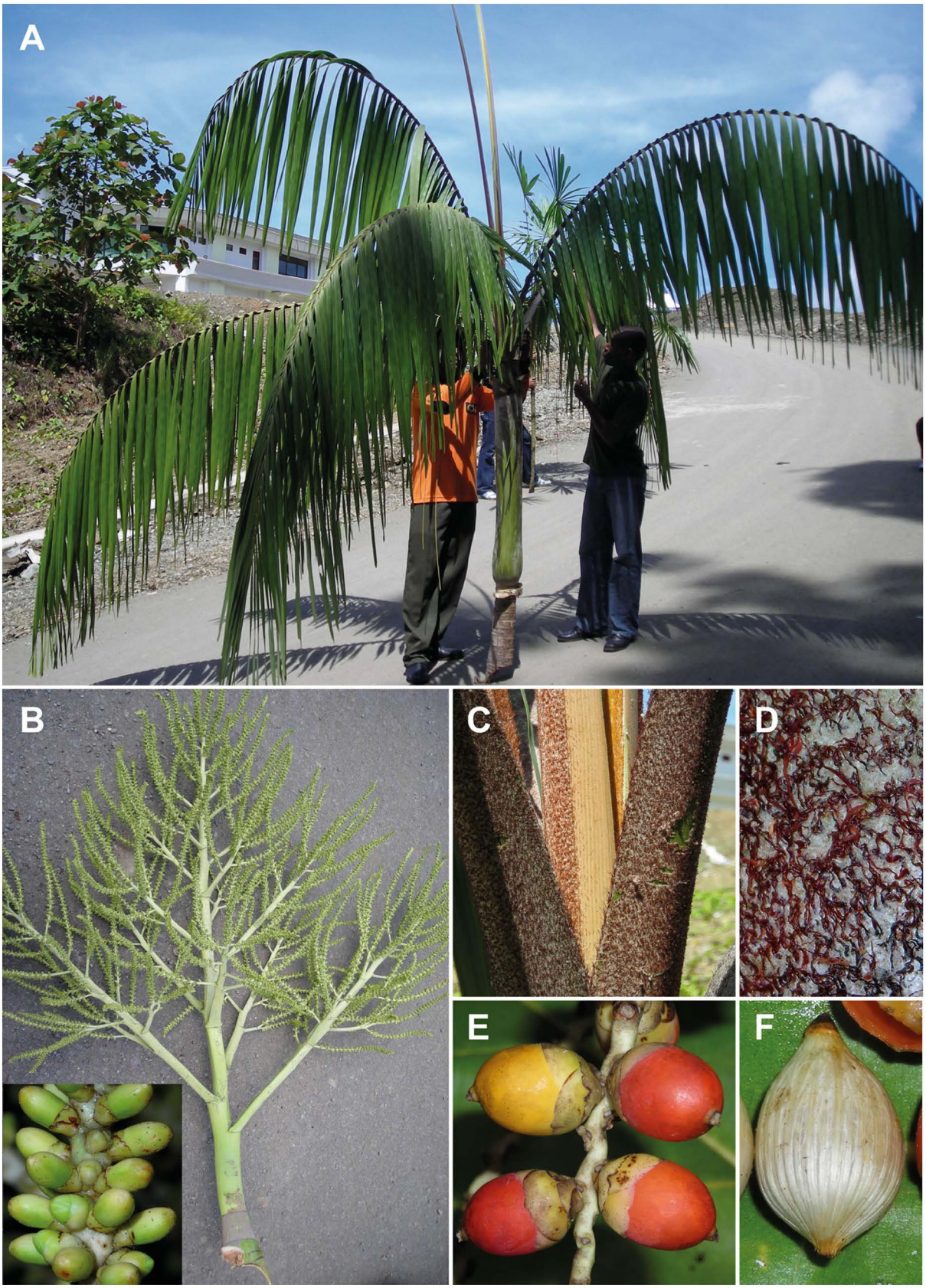


Fig. 7. *Wallaceodoxa raja-ampat*. **A** crown; **B** inflorescence, inset showing congested floral triads; **C** indumentum on petiole base; **D** close-up of indumentum; **E** fruit; **F** endocarp. PHOTOGRAPHS BY CHARLIE D. HEATUBUN.

Fig. 8. *Wallaceodoxa raja-ampat* on Gag Island. PHOTOGRAPH BY CHARLIE D. HEATUBUN.

quality and its fragmentation are issues of grave concern for both subpopulations. In Gag Island, 75% of the island has been included in a nickel mining concession and the remainder of the island on limestone-rich soils has been largely converted to coconut plantation and traditional mixed-crop gardens. Only patchy rain forest remnants persist in the limestone part of the island. The Waigeo subpopulation is highly threatened by the development of Waisai. In fact, the entire area of occupancy for the Waigeo subpopulation lies within the town and will be Waisai's town centre in future. For example, the herbarium specimen from this site was collected at the local government office complex and town hall next to the Pari Convention Centre building.

ETYMOLOGY. The generic name commemorates Alfred Russel Wallace, the great English naturalist and co-discoverer of the theory of evolution by natural selection, who visited Waigeo in the Raja Ampat Islands in 1860 during his celebrated Malay Archipelago travels (Wallace 1869; van Wyhe 2013). This eponymy marks the centenary of his death on 7 November 1913. The generic name is derived by suffixing Wallace's surname with the Greek word (*-doxa*) to mean "to the glory of Wallace".

VERNACULAR NAME. *Gulbotom* (Wayaf or Gebe dialect)

USES. The stem of this palm is used for flooring and the fruit is chewed as a substitute for betel nut (*Areca catechu* L.)

NOTES. *Wallaceodoxa raja-ampat* is an impressive, solitary canopy palm that is recognised by its arching leaves with narrow, linear leaflets, the thick indumentum throughout the sheath, petiole and leaf rachis, and the white inflorescence, branched to three orders, with thick rachillae crowded with floral triads. It was discovered by the first author on Gag Island in 2006 (Heatubun *et al.* 2014) and is of grave conservation concern, both on Gag and Waigeo.

Wallaceodoxa has been resolved as sister to *Adonidia* (Alapetite *et al.* 2014), but differs markedly from this species in the indumentum (thin grey indumentum in *Adonidia*), drooping leaflets in one plane with praemorse apices (ascending leaflets with acute bifid apices in *Adonidia*), the thick, congested rachillae (more slender with more widely spaced triads in *Adonidia*), the staminate flowers with 58 – 64 stamens (45 – 50 in *A. merrillii*) and the ellipsoid pistillode (lageniform in *Adonidia*). As sister taxa, *Wallaceodoxa* and *Adonidia* represent a notable disjunction across Wallace's Line, the most important biogeographic boundary in the Malesian region (Baker & Couvreur 2012).

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