



PHYTOTAXA

370

A monograph of *Hydriastele* (Areceae, Arecaceae) in New Guinea and Australia

PETER PETOE¹, CHARLIE D. HEATUBUN^{1,2,3} & WILLIAM J. BAKER^{1*}

¹Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom.

²Fakultas Kehutanan, Universitas Papua, Jl. Gunung Salju, Amban, Manokwari 98314, Papua Barat, Indonesia.

³Badan Penelitian dan Pengembangan Daerah Provinsi Papua Barat, Jl. Brig. Jend. Mar. (Purn.) Abraham O. Atururi, Arfai, Manokwari 98315, Papua Barat, Indonesia.

*author for correspondence, w.baker@kew.org



Magnolia Press
Auckland, New Zealand

PETER PETOE, CHARLIE D. HEATUBUN & WILLIAM J. BAKER

A monograph of *Hydriastele* (Areceae, Arecaceae) in New Guinea and Australia

(*Phytotaxa* 370)

92 pp.; 30 cm.

24 September 2018

ISBN 978-1-77670-472-9 (paperback)

ISBN 978-1-77670-473-6 (Online edition)

FIRST PUBLISHED IN 2018 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: magnolia@mapress.com

<http://www.mapress.com/j/pt/>

© 2018 Magnolia Press

All rights reserved.

No part of this publication may be reproduced, stored, transmitted or disseminated, in any form, or by any means, without prior written permission from the publisher, to whom all requests to reproduce copyright material should be directed in writing.

This authorization does not extend to any other kind of copying, by any means, in any form, and for any purpose other than private research use.

ISSN 1179-3155 (print edition)

ISSN 1179-3163 (online edition)

Abstract

A taxonomic revision of the genus *Hydriastele* H.Wendl. & Drude in New Guinea, Australia and immediately adjacent islands is presented. We recognise 25 species from this area including three new species of robust tree palms from New Guinea: *Hydriastele calcicola*, *H. lanata* and *H. wosimiensis*. All species are described in full in the taxonomic treatment, with accompanying botanical illustrations, photographs, distribution maps and preliminary IUCN Red List Assessments. In addition, a key to the species in New Guinea and Australia is provided as well as a systematic conspectus placing all 39 accepted species of *Hydriastele* in an informal infrageneric framework.

Key words: Arecoideae, Indonesia, Papua New Guinea, Palmae, Taxonomy, IUCN

Introduction

The tree palm genus *Hydriastele* Wendl. & Drude (1875: 180, 208) currently contains 39 accepted species (Govaerts *et al.* 2018, Petoe *et al.* 2018, Heatubun *et al.* 2018). Most of this diversity is concentrated in New Guinea, but the genus extends to northern Australia (Northern Territory and Queensland), Wallacea (Sulawesi and the Moluccas), east Melanesia (the Solomon Islands, Vanuatu and Fiji), and Palau (Baker & Loo 2004, Dransfield *et al.* 2008). Members of *Hydriastele* are common and conspicuous components of the floras where they occur, and are known to have many different uses among local people (Essig 1982, Petoe *et al.* 2018, Heatubun *et al.* 2018). Some species are well established in cultivation as attractive ornamentals (Riffle *et al.* 2012).

The species of *Hydriastele* range from small, clustering understorey palms to robust, solitary canopy emergents. They are distinguished by having a well-defined crownshaft, pinnate leaves with leaflets that are often praemorse at their tips (rarely the leaves are entire-bifid) and horsetail-like inflorescences (rarely spicate). Before emergence, the inflorescence is fully contained within two well-developed bracts (a keeled and beaked prophyll and a superficially similar peduncular bract). Similar to other arecoid genera, the unisexual flowers are arranged in units of three. In *Hydriastele* complete triads are distributed throughout the length of the rachillae, with female flowers typically present even in the distalmost triads. The staminate flowers are asymmetrical, larger and more colourful (white, pink, red, violet) than the typically inconspicuous pistillate flowers.

Molecular phylogenetic studies of *Hydriastele* unanimously support the genus as monophyletic within the large Indo-Pacific tribe Areceae, but there is not currently enough evidence to place the genus to subtribe (Loo *et al.* 2006, Norup *et al.* 2006, Dransfield *et al.* 2008, Baker *et al.* 2009, Baker *et al.* 2011, Baker & Dransfield 2016). To date, the relationships among species of *Hydriastele* were explored in greatest detail by Loo *et al.* (2006), who used two low-copy nuclear genes to build a molecular phylogeny, which resulted in significant generic realignments (Baker & Loo 2004; see below).

Here, as part of ongoing research on the palms of New Guinea (Baker 2002), we present a monograph of *Hydriastele* in New Guinea (from the Raja Ampat Islands to the Bismarck Archipelago) and Australia. New Guinea is home to more species of *Hydriastele* than any other island, but some of the New Guinea species also reach northern Australia, hence the geographical delimitation of this account. These species have not been subject to a modern monographic revision despite their ecological and economic importance, and available accounts have become outdated (Essig 1982, Essig & Young 1985, Baker *et al.* 2000). While the species of *Hydriastele* in Wallacea also require a new revision, we do not have enough data available currently to treat this group effectively. The east Melanesian species along with the single species from Palau were covered in Essig's (1982) monograph with one recent addition from Fiji described in Baker & Loo (2004).

In preparation, for this account, we published taxonomic treatments of two subgroups of *Hydriastele* (Petoe *et al.* 2018, Heatubun *et al.* 2018). Prior to this work, 35 species of *Hydriastele* were accepted for our region. In this account, we accept 25 species of *Hydriastele* for our region. Through these publications we have placed 17 species in synonymy (four in this paper) and described seven new species (three in this paper). Here, we bring together taxonomic information for all 25 species in a single monographic account, including nomenclature, typification, descriptions, distribution maps, illustrations and preliminary IUCN Red List assessments.

A note on dichogamy

Dichogamy (protandry vs. protogyny) has been a central character in the systematic history of *Hydriastele*. Protogyny is inferred when a taxon displays low, rounded, pistillate petals that do not cover the stigmas, which are therefore congenitally exposed, whereas protandry is inferred when the pistillate petals bear pronounced, triangular, valvate tips that are closed over the stigmas in bud and are presumed to remain so while staminate anthesis occurs (Uhl & Dransfield 1987, Loo *et al.* 2006). Protandry can be quite confidently inferred, because staminate anthesis tends to complete rapidly after the inflorescence expands before pistillate flowers open. However, protogyny is less straightforward because an exposed stigma is not necessarily a receptive stigma. We note here that protogyny has been confirmed in only one species, *Hydriastele wendlandiana* (F.Muell.) Wendland & Drude (1875: 209) through a field experimental approach (Essig 1973). To account for the uncertainty of inferred protogyny we have described species here that are not immediately related to *H. wendlandiana*, but display the protogynous floral morphology type, as “apparently protogynous”. As inferring protandry is less problematic, these species are therefore simply described as “protandrous”.

Taxonomic history

The species currently referred to *Hydriastele* were initially described in one of the following genera, all now synonymised in *Hydriastele* (Baker & Loo 2004; Dransfield *et al.* 2008; Baker & Dransfield 2016): *Kentia* Blume (1838: 64), *Hydriastele*, *Gronophyllum* Scheffer (1876: 135), *Nengella* Beccari (1877: 32), *Adelonenga* Hook.f in Bentham & Hooker (1883: 885), *Leptophoenix* Beccari (1885: 82), *Gulubia* Beccari (1885: 128, 131, 134), *Gulubiopsis* Beccari (1924: 11), *Siphokentia* Burret (1927: 198), and *Paragulubia* Burret (1936a: 84). A few species were also placed in *Areca* Linnaeus (1753: 1189), *Nenga* Wendland & Drude (1875: 182) or *Ptychosperma* Labillardière (1809: 252) at various times in their taxonomic histories. All of these genera are described in detail in Beccari’s posthumously published account of Old World arecoid palms *Subfamiliae Arecoidearum palmarum gerontogaeae tribuum et generum conspectus* (Beccari & Pichi-Sermolli 1955).

The genera now synonymised in *Hydriastele* listed above were erected between 1838 and 1936 and then gradually combined in a series of taxonomic revisions starting with Burret’s (1936c) synopsis of *Nengella*. Here, Burret reduced the genus *Leptophoenix* into synonymy under *Nengella*, arguing that all that separates the two genera is the difference in endosperm condition (ruminant in *Leptophoenix* and homogeneous in *Nengella*), and that this difference is too trivial to merit a generic distinction. Later, Burret (1937b) synonymised *Adelonenga* under *Hydriastele sensu* Wendland and Drude (1875) applying the same logic that the only difference is in the endosperm condition (ruminant in *Adelonenga* and homogeneous in *Hydriastele*). Heatubun *et al.* (2018) and Petoe *et al.* (2018) give more detailed taxonomic history accounts of the understory to midstorey genera *Nengella* and *Hydriastele sensu* Burret (1936, 1937b).

Most of the big tree palm species of *Hydriastele* were first referred to the genera *Kentia* (Blume 1838, Beccari 1917, Beccari 1923, Burret 1933, Burret 1936d) and *Gulubia* (Beccari 1910, Beccari 1914, Beccari 1923, Burret 1935, Essig 1982) with the species described in *Kentia* having pistillate petals with long and valvate tips and the species referred to *Gulubia* having pistillate petals with low and rounded tips. Both genera were also regarded as having homogeneous endosperm and staminate petals with valvate margins in bud (Beccari & Pichi-Sermolli 1955). The two *Gulubia*-like, monospecific genera *Gulubiopsis* and *Paragulubia* were then erected by Beccari (1924) and Burret (1936a) respectively to account chiefly for the exposed stamens (staminate petals not closed in bud) seen in *Gulubiopsis palauensis* Beccari (1924: 11) and the ruminant endosperm in *Paragulubia macrospadix* Burret (1936a: 84). Moore & Fosberg (1956) and Moore (1966) deemed these features inadequate to justify a generic distinction and as a result synonymised *Gulubiopsis* and *Paragulubia* under *Gulubia*. Moore (1963) also broadened the delimitation of the genus *Gronophyllum*, which at the time contained eight understory to midstorey species of palms with ruminant endosperm (Scheffer 1876, Beccari 1885, Beccari 1909, Burret 1934, Burret 1936b, Burret 1937a, Burret 1939), by combining it with *Kentia*. As early as 1885, Beccari had noted that the only difference between *Kentia* and *Gronophyllum* is the endosperm condition, thus prompting Moore (1963) to make the formal combination, the name *Gronophyllum* being applied due to *Kentia* being an illegitimate name (a later homonym of *Kentia* Adanson (1763: 508), which is now a synonym of *Trigonella* Linnaeus (1753: 776; Fabaceae); Beccari & Pichi-Sermolli 1955, Moore 1963, Lewis *et al.* 2005). *Gronophyllum* was later broadened further with the inclusion of *Nengella* (Essig & Young 1985), which falls within the continuum of morphology accepted for *Gronophyllum sensu* Moore (1963).

In the first modern genus-level monograph of palms (Uhl & Dransfield 1987), only four of the original ten genera were still accepted, *Gronophyllum*, *Gulubia*, *Hydriastele* and *Siphokentia*. However, a molecular phylogenetic analysis (Loo *et al.* 2006) using DNA sequences from two low-copy nuclear genes, indicated significant problems of non-monophyly of these genera. Only *Hydriastele sensu* Burret (1937b) was well supported as monophyletic, but embedded in a broader clade in which the remaining three genera were intercalated with each other. The only solution evident at the time was to expand the generic limits of *Hydriastele* to include *Gronophyllum*, *Gulubia* and *Siphokentia* (Baker & Loo 2004). This broadly defined *Hydriastele* is now widely accepted (Dransfield *et al.* 2008, Baker & Dransfield 2016) and is the generic concept applied in this monograph.

Phylogeny and an informal classification of *Hydriastele*

The phylogenetic analysis performed by Loo *et al.* (2006) resolves *Hydriastele* as consisting of four major clades (Fig. 1). The monophyly of Clade A, Clade B and Clade D is well supported whereas the monophyly of Clade C is not well supported by the bootstrap. Our taxonomic revision reflects the overall topology of Loo *et al.* (2006) as we have found each clade to be delimited by a unique combination of morphological characters. These character suites are shown in Table 1, which places all species currently accepted in *Hydriastele* globally (Govaerts *et al.* 2018, Petoe *et al.* 2018, Heatubun *et al.* 2018) in an informal classification. Building onto the phylogenetic backbone established by Loo *et al.* (2006) we have designated a number of informal groups here, primarily as a guide to the navigation of morphology, but also attempting wherever possible to define monophyletic groups within the limitations of the available phylogenetic evidence. The species in the taxonomic treatment are arranged within these informal groupings, which are briefly described here (see also Table 1):

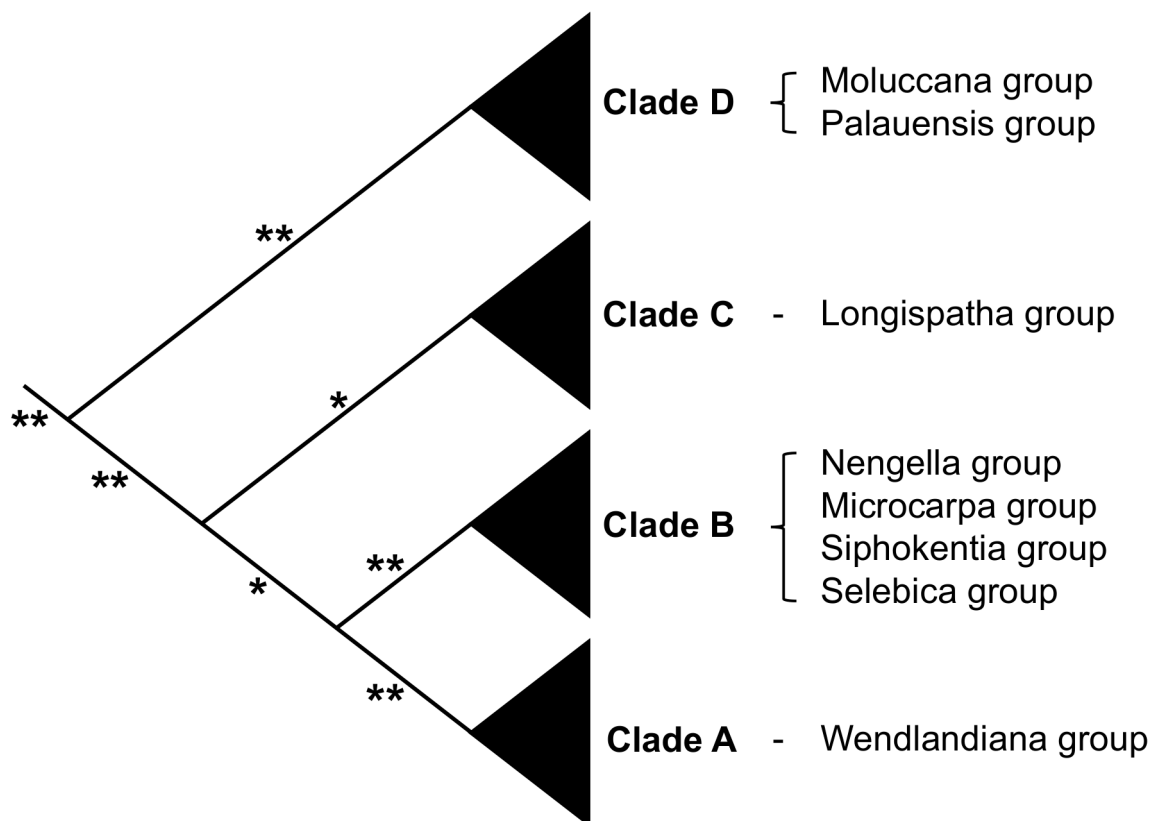


FIGURE 1. Strict consensus cladogram of *Hydriastele* summarising the relationships between four major monophyletic groups with informal subgroups listed (see also Table 1 for a full listing of species). The cladogram results from simultaneous parsimony analysis of DNA sequence data from two low-copy nuclear regions (Loo *et al.* 2006). ** = 80–100% bootstrap support, * = 60–79% bootstrap support. Modified from Baker & Loo (2004).

TABLE 1. Systematic conspectus of all species of *Hydriastele*. Asterisks indicate taxa occurring outside of New Guinea, Australia and immediately adjacent islands. Numbers indicate position in the taxonomic account for the species treated in full in this paper.

Slender, solitary or clustering, understorey to midstorey palms, leaflets ≤ 40 per side	
<p>Protogynous inflorescences, branched to two (rarely one) orders and never spicate, petals of pistillate flowers rounded, fruit with inconspicuous stigmatic remains lacking encircling dark sclerotic zone. (Clade A of Loo <i>et al.</i> 2006)</p> <p>Wendlandiana group (<i>sensu</i> Petoe <i>et al.</i> [2018])</p> <p><i>H. wendlandiana</i> (1) <i>H. kasesa</i> (2) <i>H. variabilis</i> (3) <i>H. apetiolata</i> (4) <i>H. rheophytica</i> (5)</p>	<p>Protandrous inflorescences, branched to one or two orders, occasionally spicate, petals of pistillate flowers with pronounced pointed apex, fruit with a distinct, dark, sclerotic zone encircling apical stigmatic remains. (Clade B of Loo <i>et al.</i> 2006)</p> <p>Nengella group (<i>sensu</i> Heatubun <i>et al.</i> [2018])</p> <p><i>H. pinangoides</i> (6) <i>H. simbiakii</i> (7) <i>H. splendida</i> (8) <i>H. divaricata</i> (9) <i>H. flabellata</i> (10) <i>H. montana</i> (11) <i>H. aprica</i> (12)</p> <p>Microcarpa group</p> <p><i>H. lurida</i> (13) <i>H. microcarpa</i> (*) <i>H. oxypetala</i> (*)</p> <p>Siphokentia group</p> <p><i>H. dransfieldii</i> (14) <i>H. beguinii</i> (*)</p> <p>Selebica group</p> <p><i>H. kjellbergii</i> (*) <i>H. nannostachys</i> (*) <i>H. sarasinorum</i> (*) <i>H. selebica</i> (*)</p>
Robust, solitary, subcanopy to emergent palms, leaflets ≥ 30 per side (≥ 38 per side in New Guinea and Australia)	
<p>Protogynous or protandrous inflorescences in combination with strongly arching leaves and ascending leaflets, multi-fold terminal leaflets with praemorse tips (in New Guinea species), and flowers with 6–24 stamens enclosed by valvate petals in bud <i>or</i> Protandrous inflorescences in combination with straight to slightly drooping leaves and pendulous leaflets with acuminate to briefly bifid tips. (Clade C of Loo <i>et al.</i> 2006)</p> <p>Longispatha group</p> <p><i>H. calcicola</i> sp. nov. (15) <i>H. gibbsiana</i> (16) <i>H. lanata</i> sp. nov. (17) <i>H. ledermanniana</i> (18) <i>H. longispatha</i> (19) <i>H. manusii</i> (20) <i>H. procera</i> (21) <i>H. wosimiensis</i> sp. nov. (22) <i>H. hombronii</i> (*) <i>H. macrospadix</i> (*) <i>H. cylindrocarpa</i> (*) <i>H. boumae</i> (*) <i>H. vitiensis</i> (*)</p>	<p>Protogynous or protandrous inflorescences in combination with strongly arching leaves and ascending leaflets, single-fold terminal leaflets with acuminate to briefly bifid tips, and flowers with 6 congenitally exposed stamens <i>or</i> Protogynous inflorescences in combination with straight to slightly drooping leaves and pendulous leaflets with acuminate to briefly bifid tips. (Clade D of Loo <i>et al.</i> 2006)</p> <p>Moluccana group</p> <p><i>H. costata</i> (23) <i>H. moluccana</i> (*)</p> <p>Palauensis group</p> <p><i>H. biakensis</i> (24) <i>H. palauensis</i> (*) <i>H. ramsayi</i> (25)</p>

The *Wendlandiana* group corresponds with Clade A of Loo *et al.* (2006) who found strong support for its monophyly. The group is distinguished by its small to moderate habit and protogynous inflorescences branched to 1 or 2 orders, with decussately arranged triads. The *Wendlandiana* group was monographed and informally named by Petoe *et al.* (2018). It is distributed in New Guinea and Australia.

The *Nengella* group is a subset of Clade B of Loo *et al.* (2006) who found strong support for its monophyly. This group is distinguished by its small to moderate habit and protandrous inflorescences with 0 (spicate) or 1 order of branching. The triads are spirally arranged, except in the species *H. aprica* (B.E. Young) Baker & Loo (2004: 62) where they are decussately arranged. The *Nengella* group was monographed and informally named by Heatubun *et al.* (2018). It is distributed in New Guinea.

The *Microcarpa* group is a subset of Clade B of Loo *et al.* (2006). Sampling was limited to the single species *Hydriastele lurida* (Becc.) Baker & Loo (2004: 65) (syn. *H. brassii* (Burret) Baker & Loo [2004: 63]). The group is distinguished by its moderately slender habit and protandrous inflorescences branched to 2 orders, with spirally arranged triads. The *Microcarpa* group is known from the Moluccas and New Guinea.

The *Siphokentia* group is a subset of Clade B of Loo *et al.* (2006). This protandrous group is well delimited morphologically by its pistillate sepals and petals, which are fused in a cup, a unique feature in *Hydriastele*, but this group may not be monophyletic. Baker *et al.* (2000) monographed the group as the genus *Siphokentia* (= *Hydriastele*). The *Siphokentia* group is known from the Moluccas and the Biak Islands.

The *Selebica* group was not included in the phylogenetic analysis by Loo *et al.* (2006) but we here provisionally assigned it to Clade B of Loo *et al.* (2006) based on its morphological affinity with the other groups known to belong to this clade. The *Selebica* group is distinguished by its small to moderate habit, protandrous inflorescences branched to 1 or 2 orders with decussately arranged triads, and ruminant endosperm. The exact placement of this group remains elusive until it has been sampled and included in a thorough phylogenetic analysis. This group is known from Sulawesi.

The *Longispatha* group corresponds with Clade C of Loo *et al.* (2006) whose analysis resolved it as monophyletic. The group is distinguished by its robust habit, strongly arching leaves with ascending leaflets (except *Hydriastele procera* (Blume) Baker & Loo (2004: 67) and *H. wosimiensis* Baker & Petoe, which have straight to slightly drooping leaves with pendulous leaflets), and staminate flowers with 6–24 stamens that are enclosed by valvate petals in bud. In New Guinea the group is further distinguished by the multi-fold, terminal leaflet pair with truncately praemorse tips (except *H. procera* and *H. wosimiensis* where the pair is single-fold with acuminate to briefly bifid tips) and protandrous inflorescences (except *H. longispatha*, which is protogynous). The *Longispatha* group was partially treated by Essig (1982) and is known from New Guinea, Manus Island and east Melanesia.

The *Moluccana* group is a subset of Clade D of Loo *et al.* (2006). Sampling was limited to the single species *Hydriastele costata* Bailey (1898: 129), but it is placed with *H. moluccana* (Becc.) Baker & Loo (2004: 66) due to their morphological affinity. The *Moluccana* group is distinguished by its robust habit and more-or-less straight leaves with pendulous leaflets in combination with protogynous inflorescences. The terminal leaflet pair consists of single-fold leaflets that are pointed or briefly notched at their tips. The *Moluccana* group was partially treated by Essig (1982) and is known from the Moluccas, New Guinea, Biak Island, the Bismarck Archipelago and Australia.

The *Palauensis* group is a subset of Clade D of Loo *et al.* (2006) and Baker & Heatubun (2012) whose analysis resolved it as paraphyletic. The group is distinguished by its robust habit, strongly arching leaves with ascending leaflets, and staminate flowers with 6 stamens that are congenitally exposed in bud, i.e. the margins of the staminate petals do not meet. The terminal leaflet pair consists of single-fold leaflets that are pointed or briefly notched at their tips. Both protogynous and protandrous species are found within this group. The *Palauensis* group is known from Palau, the Biak Islands and Australia.

Material and methods

We examined 450 herbarium specimens from key international herbaria (A, AAU, BM, BRI, BO, CANB, FI, K, L, LAE, MEL, NYBG, S; herbarium abbreviations following Thiers [2018]). Gross morphological data obtained from these collections, in combination with field observations made by CDH and WJB, were evaluated applying a morphological species concept (Davis & Heywood 1963, McDade 1995) where species were delimited as morphologically homogeneous groups of specimens exhibiting distinct breaks from one another in taxonomically informative characters (Utteridge 2011), e.g. leaflet orientation (qualitative) and number of leaflets (quantitative). Fruit and flower dissections and measurements were based on spirit material where possible although we relied largely on rehydrated material, the

use of which is indicated in appropriate places in the descriptions, where this was unavailable. An exclamation mark in specimen citations indicates specimens that we have seen, either physically or as digital images online.

All specimens were georeferenced where possible and the resulting occurrence data were used to generate distribution maps (Quantum GIS Development Team 2018) and preliminary global conservation assessments applying the International Union for the Conservation of Nature (IUCN) categories and criteria version 3.1 (IUCN 2001). We improved the resolution of distribution maps and the accuracy of conservation assessments for species occurring in Australia by combining coordinates from Dowe (2010) with our own occurrence dataset. In conservation assessing the Australian species *H. ramsayi* (Becc.) Baker & Loo (2004: 67) we further included the Flora Atlas N.T. Occurrence Dataset (Northern Territory Department of Land Resource Management 2017). Palm terminology used in the taxonomic treatment follow the glossaries provided by Dransfield *et al.* (2008) and Beentje (2016).

Taxonomic treatment

Hydriastele Wendland & Drude (1875: 180, 208). Type: *H. wendlandiana* (F.Muell.) H.Wendl. & Drude (syn. *Kentia wendlandiana* F. Muell.)

Kentia Blume (1838: 64) (non *Kentia* Adans. 1763). Type: *K. procera* Blume (= *Hydriastele procera* (Blume) W.J.Baker & Loo), *nom. illeg.*

Gronophyllum Scheffer (1876: 135). Type: *G. microcarpum* Scheff. (= *H. microcarpa* (Scheff.) W.J.Baker & Loo).

Nengella Beccari (1877: 32). Lectotype (designated by Burret 1936c): *N. montana* Becc. (= *Hydriastele montana* (Becc.) W.J.Baker & Loo).

Adelonenga Hook.f in Bentham & Hooker (1883: 885). Lectotype (designated by Beccari & Pichi-Sermolli 1955): *A. variabilis* (Becc.) Becc. (syn. *Nenga variabilis* Becc.) (= *H. variabilis* (Becc.) Burret).

Leptophoenix Beccari (1885: 82). Lectotype (designated by Beccari & Pichi-Sermolli 1955): *L. pinangoides* (Becc.) Becc. (syn. *Nenga pinangoides* Becc.) (= *Hydriastele pinangoides* (Becc.) W.J.Baker & Loo).

Gulubia Beccari (1885: 128, 131, 134). Lectotype (designated by Beccari & Pichi-Sermolli 1955): *G. moluccana* (Becc.) Becc. (syn. *Kentia moluccana* Becc.) (= *H. moluccana* (Becc.) W.J.Baker & Loo).

Gulubiopsis Beccari (1924: 11). Type: *G. palauensis* Becc. (= *Hydriastele palauensis* (Becc.) W.J.Baker & Loo).

Siphokentia Burret (1927: 198). Type: *S. beguinii* Burret (= *Hydriastele beguinii* (Burret) W.J.Baker & Loo).

Paragulubia Burret (1936a: 84). Type: *P. macrospadix* Burret (= *Hydriastele macrospadix* (Burret) W.J.Baker & Loo).

Small, moderate or tall, solitary or clustering, unarmed, pleoanthic, monoecious palms. **Stem** erect or leaning, slender to robust, bare, conspicuously ringed with leaf scars. **Leaf** entire-bifid or pinnate, neatly abscising; sheath elongate, forming a well-defined crownshaft, usually densely scaly or lanate, often with chaffy scales, a ligule-like ± fibrous prolongation sometimes present opposite or at the base of the petiole; petiole short to long or rarely lacking, adaxially channelled, flattened or keeled, abaxially rounded, usually conspicuously scaly; rachis straight, drooping or strongly arcuate, adaxially channelled or angled near the base, distally angled, abaxially rounded, usually scaly as the petiole; leaflets regularly arranged or grouped, pendulous or horizontal or ascending, straight or curved, single- or multi-fold, the terminal pair often broad and multi-fold, the rest linear or cuneate, apically acute, bifid or obliquely to truncately praemorse, adaxial and abaxial surfaces bearing scattered minute scales, abaxially sometimes with scattered ramenta along the midrib, sometimes also with bands of deciduous chaffy scales along major ribs, transverse veinlets conspicuous or obscure. **Inflorescence** infrafoliar, spicate or branching to 1–4 orders, usually horsetail-like, protandrous or protogynous; peduncle short or elongate, winged at the base, sometimes becoming swollen; prophyll compressed, entirely enclosing the inflorescence in bud, 2-keeled, with a conspicuous apical beak, thin, papery when dry, glabrous or scaly, soon drying on exposure, splitting longitudinally on the abaxial face and abscising together with the peduncular bract; peduncular bract 1 rarely 2 (and then the second bract vestigial), similar to and entirely enclosed by the prophyll, tubular, enclosing the inflorescence in bud; subsequent bracts inconspicuous; rachis short, bearing inconspicuous rachis bracts subtending few to many crowded, ± spirally arranged primary branches, the proximal bearing a few to several branches or all unbranched; rachillae elongate, usually ± straight or curved to sinuous, of ± equal length, tending to curve downwards, bearing throughout their length spirally arranged or opposite and decussate pairs of triads of cream-coloured or violet-, pinkish- or reddish-tinged flowers, sometimes except at the very tip where bearing solitary or paired staminate flowers; rachilla bracts normally very inconspicuous, low, ± rounded. **Staminate**

flower fleshy, asymmetrical; calyx sessile or with a short stalk-like base, sepals 3, short, triangular, \pm distinct or joined into a cup for ca. 1/2 their length; petals 3, fleshy, distinct, except at the very base, valvate or with margins not meeting in bud, 4–5 times as long as the calyx, narrow, triangular, 1 usually larger than the other 2; stamens 6–24, filaments very short, fleshy, variously epipetalous and connate, anthers elongate, erect, basifixed, dehiscence latrorse, connective sometimes prolonged into a short point; pistillode present or lacking. **Pollen** grains ellipsoidal, bi-symmetric; aperture a distal sulcus, \pm same length as long axis or, frequently, extended; ectexine semi-tectate and coarsely (rarely finely) reticulate, muri of reticulum sometimes perforate, aperture margins similar; or pollen ellipsoidal or oblate-triangular, asymmetric; aperture a distal sulcus or trichotomosulcus; ectexine tectate, coarsely perforate, foveolate, coarsely perforate-rugulate or rarely scabrate verrucate, aperture margin similar; longest axis ranging from 33–70 μ m; post-meiotic tetrads tetragonal or tetrahedral. **Pistillate flower** globose or \pm conical in bud, smaller than the staminate; sepals 3, distinct, rounded or triangular, broadly imbricate or connate in a ring with 3 low triangular lobes; petals 3, distinct or connate, not more than ca. twice as long as the sepals, rounded or triangular, basally broadly imbricate or connate in a ring, apically rounded except for very small triangular tips or with conspicuous triangular valvate tips, closely appressed in bud, the tips persisting or eroding into fibres in fruit; staminodes 3(–6), tooth-like, minute; gynoecium \pm globose or ovoid, unilocular, uniovulate, stigmas 3, low, sessile or fleshy, reflexed, ovule laterally attached near apex of locule, hemianatropous (?always). **Fruit** globose through ovoid to ellipsoid or \pm cylindrical, straight or curved, white to yellowish or bright red to purplish-black, sometimes drying ridged or furrowed, sometimes briefly beaked or with discoid region at the apex, stigmatic remains apical, perianth whorls persistent, the petal tips sometimes reflexed or appressed to the fruit; epicarp smooth or slightly pebbled, mesocarp thin, with abundant tannin cells, and longitudinal fibre bundles, endocarp thin, crustose or obsolescent. **Seed** ovoid or globose, laterally or basally attached with elongate or rounded hilum, raphe branches sparse, anastomosing, endosperm homogeneous or shallowly to deeply ruminant; embryo basal. **Germination** adjacent-ligular; eophyll bifid with entire or minutely to strongly praemorse tips. **Cytology**: $2n=32$. (Generic description modified from Dransfield *et al.* [2008]).

Key to *Hydriastele* in New Guinea and Australia

1. Solitary or clustering, slender, understory to midstorey palms; stem diam. <10 cm (rarely up to 15 cm); leaf <2.5 m long, leaflets ≤ 40 each side of rachis 2
 - Solitary, robust, subcanopy to emergent palms; stem diam. >10 cm; leaf >1.5 m long (usually >2.5 m), leaflets ≥ 40 each side of rachis (rarely as few as 38 per side) 18
2. Leaf blade irregularly pinnate 3
 - Leaf blade regularly pinnate or entire-bifid 10
3. Inflorescence protandrous, spicate or branched to 1 or 2 orders; pistillate petals with pronounced pointed apex; fruit with a distinct, dark, sclerotic zone encircling apical stigmatic remains (ca. 1.5–5 mm in diam.) 4
 - Inflorescence protogynous, branched to 1 or 2 orders; pistillate petals rounded; fruit with inconspicuous stigmatic remains lacking encircling dark sclerotic zone 9
4. Leaf typically with 3 broad, multi-fold leaflets each side of rachis interspersed with a few single-fold leaflets; pistillate sepals fused in a cup and petals fused basally (Biak Islands) *H. dransfieldii* (14)
 - Leaf not consisting of broad, multi-fold leaflets interspersed with single-fold leaflets; pistillate sepals and petals only fused briefly at the very base (New Guinea) 5
5. Palm up to 25 m tall; leaflets 27–40 each side of rachis (rarely as few as 21 per side); leaf sheath conspicuously fibrous at apex; inflorescence branched to 2 orders (New Guinea) *H. lurida* (13)
 - Palm up to 10 m tall; leaflets 2–23 each side of rachis; leaf sheath not conspicuously fibrous at apex; inflorescence spicate or branched to 1 order 6
6. Leaflets 15–23 each side of rachis, concavely praemorse at their tips; triads decussately arranged (Sandaun Province, Papua New Guinea) *H. aprica* (12)
 - Leaflets 2–13 each side of rachis, never concavely praemorse at their tips; triads spirally arranged 7
7. Stem 1.5–7.5 cm in diam. (rarely as slender as 0.8 cm in diam.); inflorescence 18–30 cm long (rarely as short as 13 cm), with 2–6 rachillae; endosperm ruminant (New Guinea) *H. pinangoides* (6; in part)
 - Stem 1–2 cm in diam.; inflorescence 8–15 cm long, spicate or with 2 rachillae (rarely with 3 rachillae in cultivation); endosperm ruminant or homogeneous 8
8. Basal and middle leaflets narrowly linear and divaricate, i.e. appearing to be extending nearly perpendicular to the leaf rachis; endosperm ruminant (Papua Province, western New Guinea) *H. divaricata* (9)
 - Leaflets variable in size and shape but never narrowly linear and not divaricate; endosperm homogeneous (New Guinea) *H. flabellata* (10; in part)
9. Slender clustering palm; leaf sheath 15–30 cm long; leaflets 6–13 each side of rachis; endosperm ruminant (Bismarck Archipelago) *H. kasesa* (2)
 - Slender or moderate, solitary or clustering palm; leaf sheath 40–73 cm long; leaflets 12–30 each side of rachis; endosperm homogeneous to ruminant (New Guinea and Australia) *H. wendlandiana* (1; in part)

10. Leaf entire-bifid or with 2–16 leaflets each side of rachis; inflorescence spicate or with up to 6 rachillae, protandrous 11
 - Leaf with 11–30 leaflets each side of rachis (juvenile leaf may be entire-bifid); inflorescence with at least 6 rachillae, protogynous 15
11. Leaf entire-bifid; inflorescence with 3–4 rachillae; endosperm ruminant (Papua Province, western New Guinea) *H. splendida* (8)
 - Leaf entire-bifid, bijugate, or with at least 3 leaflets each side of rachis; inflorescence spicate or with up to 6 rachillae; endosperm homogeneous or ruminant (if leaf entire-bifid then inflorescence spicate or with 2 rachillae, and endosperm homogeneous) 12
12. Inflorescence spicate or with 2 rachillae, axis (or axes) usually green-yellow; endosperm homogeneous 13
 - Inflorescence with 2–6 rachillae, axes usually bright red; endosperm ruminant 14
13. Stem 5–8 mm in diam.; leaf with 9–11 narrowly linear leaflets each side of rachis (West Papua Province, western New Guinea) *H. montana* (11)
 - Stem 1–2 cm in diam.; leaf entire-bifid, bijugate, or with 3–6 cuneate leaflets each side of rachis (New Guinea) *H. flabellata* (10; in part)
14. Clustering palm; stem pliable and leaning when tall; leaflets 14–16 each side of rachis, linear; restricted to river banks (West Papua Province, western New Guinea) *H. simbiakii* (7)
 - Solitary or clustering palm; stem rigid and erect; leaflets 4–13 each side of rachis, narrowly linear or narrowly cuneate; not restricted to riverine habitats (New Guinea) *H. pinangoides* (6; in part)
15. Juvenile leaf entire-bifid; petiole lacking on adult leaves (southern New Guinea) *H. apetiolata* (4)
 - Juvenile leaf dissected; petiole always well-defined 16
16. Stem 2–10 cm in diam.; basal leaflets truncately praemorse at their tips; endosperm homogeneous or ruminant (New Guinea and Australia) *H. wendlandiana* (1; in part)
 - Stem 2–4 cm in diam.; basal leaflets pointed to obliquely praemorse at their tips; endosperm ruminant 17
17. Palm forming large clumps of up to 30 pliable stems on river banks; leaflets 18–32 each side of rachis; terminal leaflets comprising 2 or 3 folds (central New Guinea) *H. rheophytica* (5)
 - Palm forming smaller clumps not restricted to strictly riverine habitats; leaflets 11–23 each side of rachis; terminal leaflets comprising 4–11 folds (West Papua Province, western New Guinea) *H. variabilis* (3)
18. Leaves straight or a little drooping; leaflets pendulous; terminal leaflets single-fold, pointed to briefly bifid at their tips 19
 - Leaves arcuate; leaflets ascending (at least at their bases); terminal leaflets single- or multi-fold, pointed to briefly bifid or praemorse at their tips 21
19. Leaflets 58–75 each side of rachis; inflorescence protogynous; fruit with light, longitudinal stripes (New Guinea, Biak Islands, Bismarck Archipelago, Australia) *H. costata* (23)
 - Leaflets 40–61 each side of rachis; inflorescence protandrous; fruit without stripes 20
20. Rachillae ca. 2–3 mm in diam.; staminate flower with 6 stamens; fruit 10–15 × 6–7 mm when dry (West Papua Province, western New Guinea) *H. procera* (21)
 - Rachillae ca. 3.5 mm in diam.; staminate flower with 12 stamens; fruit 7.5–9.5 × 5–5.5 mm when dry (West Papua Province, western New Guinea) *H. wosimiensis* (22)
21. Terminal leaflets single-fold, pointed to briefly bifid at their tips; prophyll often somewhat sinuously distorted; stamens 6, exposed in bud (i.e. staminate petal margins never valvate even in bud) 22
 - Terminal leaflets multi-fold, truncately praemorse at their tips; prophyll straight; stamens 6–24, enclosed by valvate, staminate petals in bud 23
22. Stem moderately ventricose; leaf 1.5–3 m long; leaflets without ramenta; inflorescence branched to 2 orders (Northern Territory, Australia) *H. ramsayi* (25)
 - Stem not ventricose; leaf 3.3–3.6 m long; leaflets with ramenta on the abaxial side of the midrib; inflorescence branched to 4 orders (Biak Islands) *H. biakensis* (24)
23. Stem ≤15 cm in diam., not ventricose; petiole channelled adaxially, immediately below the lowermost leaflets 24
 - Stem ≥15 cm in diam. (when ventricose at least in swollen portion of stem); petiole ± flattened adaxially 26
24. Leaf ca. 1.5–2 m long including ca. 10 cm petiole; peduncle at least 20 cm long (Manus Island) *H. manusii* (20)
 - Leaf 2.4–2.7 m long including 32–60 cm petiole; peduncle up to 12 cm long 25
25. Lanate indumentum on leaf sheath thick and fluffy; peduncle 11–12 cm long (Western Province, Papua New Guinea) *H. lanata* (17)
 - Lanate indumentum on leaf sheath thin and smooth; peduncle 3–5 cm long (Gulf Province, Papua New Guinea) *H. calcicola* (15)
26. Stem strongly ventricose; inflorescence 55–60 cm long including 4–5 cm peduncle (West Papua Province, western New Guinea) *H. gibbsiana* (16)
 - Stem not ventricose; inflorescence 60–120 cm long (rarely as short as 50 cm) including 6–15 cm peduncle 27
27. Leaflets 57–70 each side of rachis (rarely as few as 48 per side); inflorescence apparently protogynous; fruit subglobose to broadly ellipsoid (New Guinea) *H. longispatha* (19)
 - Leaflets 38–51 each side of rachis; inflorescence protandrous; fruit broadly ellipsoid (New Guinea) *H. ledermanniana* (18)

Species accounts

WENDLANDIANA GROUP

Small to moderate palms, inflorescences protogynous and branched to 1 or 2 orders, triads decussately arranged. New Guinea and Australia.

1. *Hydriastele wendlandiana* (F.Muell.) Wendland & Drude (1875: 209). *Kentia wendlandiana* Mueller (1870: 102). Type:—AUSTRALIA. Northern Territory: Liverpool River, 1867, *Gulliver s.n.* (holotype MEL!, isotypes BRI!, K!)

Hydriastele wendlandiana var. *microcarpa* Wendland & Drude (1875: 210). Type:—AUSTRALIA. Queensland: O'Connell River, *Nernst s.n.* (holotype MEL!).

Nenga geelvinkiana Beccari (1877: 28). *Adelonenga geelvinkiana* (Becc.) Beccari (1885: 82). *Hydriastele geelvinkiana* (Becc.) Burret (1937b: 484). Type:—INDONESIA. Papua Province: Geelvinck Bay, April 1875, *Beccari s.n.* (holotype FI!, isotype K!).

Hydriastele douglasiana Bailey (1897: 232). Type:—AUSTRALIA. Queensland: Cape York Peninsula, Somerset, Polo Creek, June 1897, *Jardine s.n.* (holotype BRI!; see Baker & Loo [2004]).

Kentia microspadix Warb. ex Schumann & Lauterbach (1900: 206). *Adelonenga microspadix* (Warb. ex K.Schum. & Lauterb.) Beccari (1914: 26). *Hydriastele microspadix* (Warb. ex K.Schum. & Lauterb.) Burret (1937b: 484). Lectotype (designated by Baker & Loo [2004]):—PAPUA NEW GUINEA. Madang Province: Hatzfeldhafen, *Warburg s.n.* (FI!).

Ptychosperma beccarianum Warb. ex Schumann & Lauterbach (1900: 208), *nom. nud.*

Hydriastele beccariana Burret (1928: 292). Type:—INDONESIA. Papua Province: Noord-Rivier [Lorentz River], 4°37'S, 138°43'E, 25 August 1907, *Versteeg 1662* (holotype B†, isotypes BO, FI!, K!, L!).

Hydriastele carrii Burret (1936d: 326). Type:—PAPUA NEW GUINEA. 1935, *Carr s.n.* (holotype B†). Neotype (designated by Petoe *et al.* [2018]):—PAPUA NEW GUINEA. Central Province: Koitaki, 22 August 1935, *Carr 12657* (K!, isoneotypes A!, L!, NY!, SING!).

Hydriastele rostrata Burret (1937b: 484). Type:—Cultivated in Bogor Botanic Gardens ex New Guinea, VI 4, April–May 1936, *Furtado SFN 31139* (holotype B†, isotypes A!, K!, L!, SING).

Hydriastele lepidota Burret (1939: 204). Type:—PAPUA NEW GUINEA. Western Province: Tarara, Wassi Kussa River, 8°55'S, 141°55'E, January 1937, *Brass 8701A* (holotype A!, isotypes BRI, L).

Figure 2 (line drawing). Figure 3 (photo plate). Figure 4 (map).

Solitary or clustering palm forming clumps of as many as 10 stems, slender to moderate, to 17 m tall, bearing 5–12 leaves per crown. **Stem** 2–10 cm in diam. **Leaf** 1–2.5 m long including petiole; sheath 40–73 cm long; petiole (2–)10–80 cm long; leaflets 12–30 per side, usually irregularly arranged with a group of closely spaced leaflets in different planes in the middle of rachis, ± cuneate, truncately praemorse apically, with rammenta usually present on the basal portion of the abaxial side of the midrib. **Inflorescence** (16–)21–50 cm long including 2.5–7 cm peduncle, with (1–)2(–3) orders of branching, protogynous; primary branches 8–15, to 46 cm long, bearing up to 5 rachillae each; triads opposite and decussate. **Staminate flower** 8–10 × 3–5 mm in bud; stamens (5–)6(–8). **Pistillate flower** 1.8–3 × 1.8–2.5 mm in bud, with free sepals and free, ± rounded, low petals. **Fruit** 7–9(–11) × 6–8 mm when ripe, globose to ovoid, purple to reddish, with inconspicuous stigmatic apical remains lacking encircling dark sclerotic zone. **Seed** 5–7 × 5–6.2 mm, globose to ovoid; endosperm homogeneous to ruminant.

Distribution:—Widespread in New Guinea, parts of Queensland and Northern Territory in Australia, and in between islands.

Habitat:—Primary or secondary lowland rainforest in a variety of subhabitats, and premontane primary rainforest, on limestone and shales, limestone karst and volcanic soils, 0–1000 m.

Uses:—Used for flooring, roofing, bed construction, arrows and spears, harpoons and chicken coop. The young shoots are consumed. Locally planted as an ornamental.

Vernacular names:—*Kanrabel*, *Inpsal* (Kanum), *Honggomi*, *Patani*, *Sanggum* (Wondama), *Sal* (Amele), *Kitat* (Daga), *Kenege* (Kutubu), *Upo* (Meko), *Lai* (Matbat), *Sirata* (Sayal), *Kelkal* (Aru Islands), *Bil* (Mianmin), *Koeyauw* (Yei), *Befer* (Marap), *Kava Kava* (Patep, Buangs), *Sapuh* (Maprik), *Morr* (Gal), *Salvaik* (Sempi), *Fabu* (Ambakanja), *Ndzip* (Timbunke), *Kanyaweni* (Konti-unai), *Kaikinei* (Woi).

Conservation status:—Least Concern (LC; Petoe *et al.* 2018).

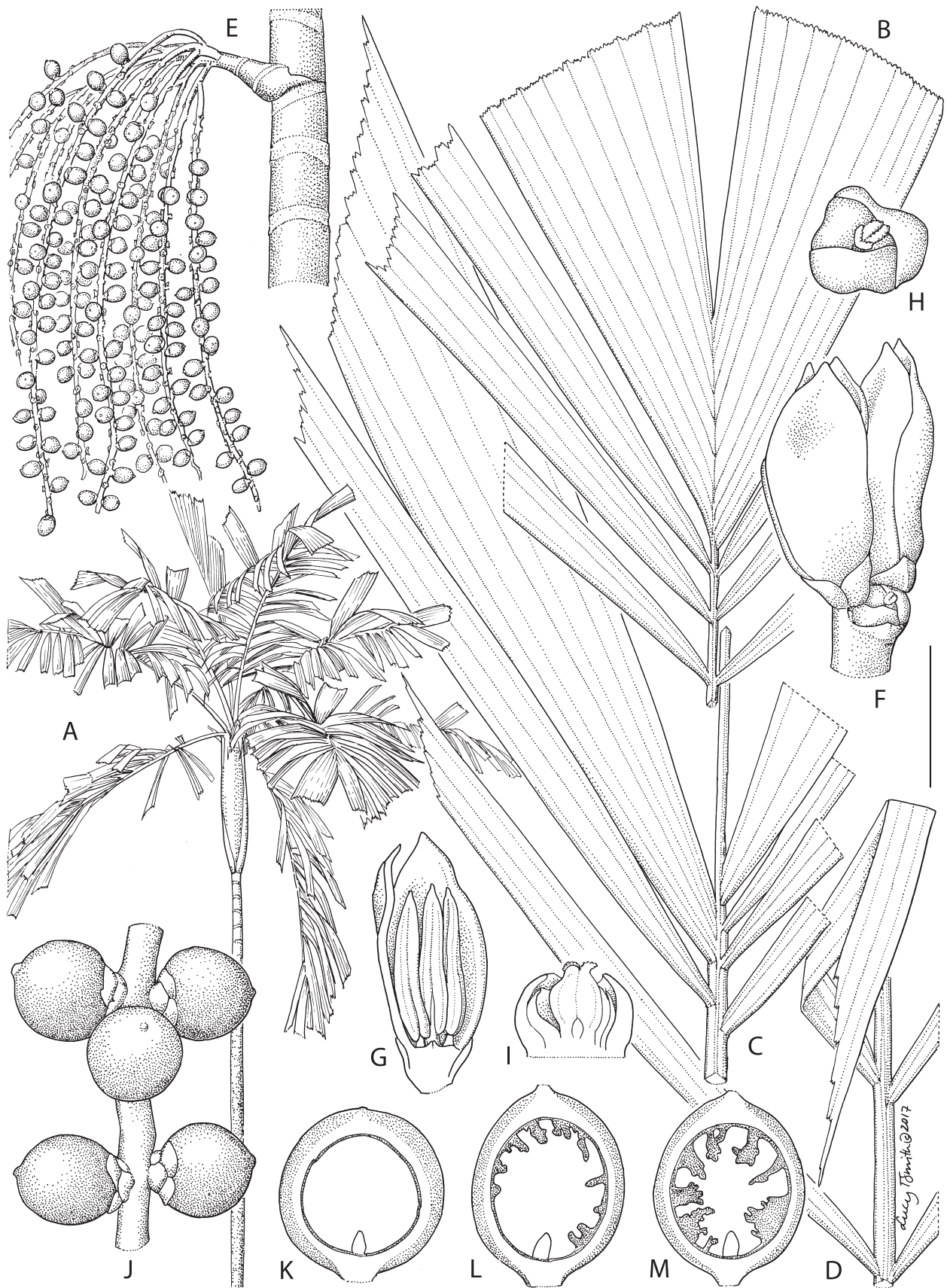


FIGURE 2. *Hydrastele wendlandiana*. A. Habit. B. Leaf apex. C. Mid-leaf portion. D. Leaf base. E. Infructescence. F. Triad. G. Staminate flower in longitudinal section. H. Pistillate flower whole. I. Pistillate flower in longitudinal section. J. Portion of rachilla with fruit. K, L, M. Fruit in longitudinal section (K. Homogeneous endosperm. L. Shallowly ruminant endosperm. M. Ruminant endosperm). Scale bar: A = 70 cm; B–D = 8 cm; E = 6 cm; F–G = 5 mm; H–I = 2.5 mm; J = 1.5 cm; K–M = 7 mm. A, F–I from *Baker et al. 1106*; B–E, M from *Klappa 151*; J–K from *Baker et al. 1065*; L from *Baker et al. 573*. Drawn by Lucy T. Smith.



FIGURE 3. *Hydriastele wendlandiana*. A. Crown. B. Leaves. C. Inflorescences with immature fruit. D. Portions of rachillae with fruit. A from Baker *et al.* 1106; B from Baker *et al.* 1043; C cultivated palm, Lae, Papua New Guinea; D from Baker *et al.* 607. All photos: W.J. Baker.

Specimens examined:—Locality and date info lacking: *Wally 1040* (K!). AUSTRALIA. **Northern Territory:** Liverpool River, 1867, *Gulliver s.n.* (BRI, K!, MEL!); Arnhem Land, Gulumarri, Elcho Island, 11°56'S, 135°49'E, 18 July 1975, *Latz 6269* (CANB, DNA, K!, NSW); Arnhem Land, Giddy River Crossing, 12°22'S, 136°42'E, 20 June 1972, *Maconochie 1550* (DNA, K!); Arnhem Land, N side of Tomkinson R. ca. 13 km S of Maningrida, 12°10'S, 134°15'E, 1974, *Rodd 2912* (DNA, K!); Robins Falls, 105 km SSE of Darwin, 13°21'S, 131°7'E, 1974, *Rodd 2908* (K!, NSW); Same locality as preceding, 13°21'S, 131°7'E, 1974, *Rodd 2909* (K!, NSW); **Queensland:** Coconut creek, 8 km upstream from Beagle North Camp ca. 45 km NNE of Aurukun, 50 m, 12°57'S, 141°49'E, 27 May 1982, *Clarkson 4356* (BRI, K!); Cape Sidmouth, 13°24'S, 143°35'E, 1876, *Candie s.n.* (K!); Cape York, 1875, *Hill 5* (K!); Cape York Peninsula, Somerset, Polo Creek, June 1897, *Jardine s.n.* (BRI!); Cape York Peninsula, Bamaga Mission, 11.2 km SW of Cape York, E to mill and beyond, stony red hill, 10°53'S, 142°24'E, 24 October 1965, *Smith 12413* (BRI, K!, L!); Cape York Peninsula, Newcastle Bay, 2.5 miles south of Somerset, 20 m, 10°47'S, 142°33'E, 9 May 1948, *Brass 18722* (A, K!, L!); Cape York Peninsula, Iron Range, 150 m, 12°43'S, 143°12'E, 18 June 1948, *Brass 19250* (A, K!, L!). INDONESIA. **Maluku Province:** Aru Islands, Pulau Trangan, 6 km south of Sia, 10 m, 6°50'S, 134°17'E, 22 October 1994, *van Balgooy 6588* (K!, L!); **Papua Province:** Noord R., 4°37'S, 138°43'E, 25 August 1907, *Versteeg 1662* (B†, BO, FI!, K!, L!); Geelvinck Bay, April 1875, *Beccari s.n.* (FI!, K!); Keerom Regency, Arso Distr., Tami river, Yusfowor, 100 m, 2°51'S, 140°48'E, 11 March 2002, *Gusbager 1* (K!, LAE, MAN); Central Mamberamo Regency, Taritatu River, 6 km SW of Bernhard camp, 1050 m, 3°30'S, 139°5'E, March 1939, *Brass 13045* (A!, L!); Nabire Regency, Samabusa, 10 m, 3°18'S, 135°35'E, 10 February 2001, *Heatubun 343* (AAU, K!, MAN); Nabire Regency, Km-45 road PT, Kaltim Utama, 100 m, 3°28'S, 134°52'E, 2 February 2001, *Heatubun 333* (AAU, K!, MAN); Nabire Regency, Napan, Makimi, Sungai Musairo, 5 m, 3°3'S, 135°45'E, 3 May 1985, *Mogea 5529* (BO, K!, L); Mamberamo Raya Regency, Albatross Biv., 75 m, 2°18'S, 138°2'E, November 1926, *van Leeuwen 11201* (K!, L!); Mimika Regency, Timika, Km 64.5 on road to Tembagapura, 380 m, 4°18'S, 136°59'E, 7 February 1998, *Dransfield 7654* (BH, BO, K!, L, MAN); Yapen Islands Regency, Yapen Island, Jalan trans Yapen, 700 m, 1°45'S, 136°15'E, 26 October 1998, *Maturbongs 613* (BO, FTG, K!, L, MAN); Yapen Islands Regency, Yapen island, Konti-unai village, near trans-yapen main road, 700 m, 1°45'S, 136°5'E, 21 October 1998, *Maturbongs 596* (BO, K!, L, MAN, NY); Yapen Islands Regency, Yapen island, Konti-unai village, 600 m, 1°45'S, 136°5'E, 21 October 1998, *Maturbongs 591* (BO, FTG, K!, L, MAN); Yapen Islands Regency, Yapen Island, Konti-unai village, trans-Yapen main road, 800 m, 1°45'S, 136°5'E, 21 October 1998, *Maturbongs 600* (BO, FTG, K!, MAN); Jayapura Regency, Tanjung Elmo, on the edge of Sentani lake, 90 m, 2°37'S, 140°30'E, 19 September 1998, *Maturbongs 575* (BO, FTG, K!, MAN); Jayapura Regency, Angkasa, Cyclops Mts., Jayapura, 385 m, 2°31'S, 140°43'E, 9 August 1998, *Heatubun 269* (BO, FTG, K!, MAN); Jayapura Regency, Cyclops Mts., Jayapura, 190 m, 2°30'S, 140°30'E, 16 August 1998, *Heatubun 281* (BO, FTG, K!, L, MAN, NY); Jayapura, North Cyclops Mts., 20 m, 2°30'S, 140°32'E, 31 January 2001, *Desianto 08* (AAU, K!, MAN); Jayapura, Dessa Tami-Monding, mouth of the river Tami, 15 m, 2°37'S, 140°55'E, 16 March 1956, *Kalkman 3399* (CANB!, L); Jayapura and vicinity, 7 July 1938, 2°37'S, 140°40'E, *Brass 8963* (A!); Jayapura and vicinity, 100 m, 2°32'S, 140°42'E, June 1938, *Brass 8982* (A!, BRI, L!); Jayapura and vicinity, 60 m, 2°32'S, 140°42'E, June 1938, *Brass 8891* (A!, BRI, L!); Merauke Regency, Kwell village, 30 September 2000, 7°10'S, 140°50'E, *Maturbongs 652* (AAU, BO, K!, MAN); Merauke Regency, Yanggandur village, Wasur, 2000, 8°32'S, 140°52'E, *Maturbongs 658* (AAU, BO, K!, MAN); **West Papua Province:** Rajah Ampat Regency, N Misool Island, about 20 km W of Waigama Village near Motlol Camp, 10 m, 1°53'S, 129°44'E, 22 January 2002, *Maturbongs 701* (BO, FTG, K!, L, LAE, MAN); South Sorong Regency, Sayal village, Maampow forest, 10 m, 1°28'S, 131°53'E, 21 February 2003, *Heatubun 416* (BO, K!, MAN); Sorong, Makbalim, Aimas (SP4), 50 m, 1°4'S, 131°24'E, 1 July 1997, *Heatubun 152* (K!); Manokwari Distr., mountains S of Arfak Plains, steep ridges between the Arfak plains and Gunung Itsiwei, 625 m, 0°51'S, 133°37'E, 26 April 1994, *Sands 6354* (BO, K!, MAN); Manokwari Distr., Tatbei Ridge above Warmare, 495 m, 0°47'S, 133°58'E, 24 August 1995, *Zona 688* (BO, FTG, K!, MAN); Manokwari Regency, Manokwari Distr., Warmare, Prafi River Valley, 375 m, 0°47'S, 133°58'E, 25 August 1995, *Zona 690* (BO, FTG, K!, MAN); Manokwari Regency, Manokwari, Cultivated, in the front of a mosque within the university area, Amban, 120 m, 0°51'S, 134°4'E, 13 August 1995, *Keim 3* (K!); Teluk Wondama Regency, Wasior Distr., Wandammen Peninsula, near Dotir village, 11 km north of Wasior, near the confluence of the Mawoi River and the Yoisi River, 50 m, 2°37'S, 134°29'E, 20 February 2000, *Baker et al. 1043* (BO, K!, MAN); Teluk Wondama Regency, Wasior Distr., Vicinity of Wosimi river, Sikama river, 3 km SE of Senderawoi village, 26 km SSE of Wasior, 150 m, 2°57'S, 134°34'E, 26 February 2000, *Baker et al. 1065* (MAN, BO, K!, L); Teluk Wondama Regency, Wasior Distr., Wandammen peninsula, near Wondiwoi Village, ca. 9 km south of Wasior, 2°48'S, 134°32'E, 23 February 2000, *Rustiarni 36* (BO, K!, L, MAN); Teluk Bintuni Regency, Merdey Subdistr., 600 m, 1°35'S, 133°20'E, 2 August 1998, *Wally 844* (BO, K!, MAN). PAPUA NEW GUINEA. **Central Province:** Koitaki, 22 August 1935, *Carr 12657* (A!, K!, L!, NY!, SING!); Abau Distr., Waeana Swamp, 5 km E of

More River Bridge, 30 m, 10°2'S, 148°32'E, 23 February 2004, *Gideon 20333* (K!, UPNG); 12 km N of Amazon Bay, 60 m, 10°11'S, 149°32'E, 14 June 1969, *Pullen 7588* (CANB!, L!, LAE); Mori river, Cape Rodney, 15 m, 10°0'S, 148°32'E, 28 August 1969, *Pullen 8137* (CANB!, LAE); Kairuku Subdistr., Maipa airstrip, 50 m, 8°20'S, 146°33'E, 4 September 1962, *Darbyshire 880* (CANB!, LAE); **East Sepik Province:** Maprik Subdistr., Wewak-Angoram Area, Prince Alexander range, SE side of Mt. Turu above Ambakanja Village, 600 m, 3°37'S, 143°22'E, 20 August 1959, *Pullen 1520* (CANB!); 31 km N of Ambunti, 80 m, 3°56'S, 142°48'E, 12 August 1966, *Heyligers 1537* (CANB!); Maprik Subdistr., Prince Alexander Range, southern side of Mt. Turu, 700 m, 3°38'S, 143°20'E, 25 August 1959, *Pullen 1601* (CANB!, LAE); 5 miles N of Timbunke, 30 m, 4°7'S, 143°31'E, 12 September 1959, *Pullen 1713* (CANB!, L!, LAE); old airstrip at But, 75 m, 3°24'S, 143°14'E, 1 August 1959, *Pullen 1387* (CANB!, L!, LAE); Ambunti, Waskuk Hills, area around Langu and Garuka Villages, 100 m, 4°11'S, 142°44'E, 28 June 1995, *Regalado 1431* (A, K!, L); **Gulf Province:** Kikori Distr., TFI logging concession near Morere village, 38 km NE of Kikori, 120 m, 7°10'S, 144°29'E, 22 November 2000, *Baker et al. 1106* (AAU, K!, LAE, NY); **Madang Province:** Hatzfeldhafen, *Warburg s.n.* (FI!); Madang, Baitabag Village; Baitabag village conservation area, near to Christensen Research Institute, 30 m, 5°8'S, 145°46'E, 10 January 1996, *Baker et al. 566* (BH, BO, K!, KEP); North Ambenob, Baiteta Village, 100 m, 5°1'S, 145°45'E, 11 January 1996, *Baker et al. 573* (BH, FTG, K!, L); Ohu Village Conservation Area, 150 m, 5°12'S, 145°41'E, 9 November 1996, *Barfod 350* (AAU!, K!); Baitabag Village, 2 November 1999, 5°8'S, 145°46'E, *Cizek 18* (K!); Josephstaal FMA area, along footpath towards Morasapa, W of expedition Camp 1 ('Kumamdeber') and to lower slopes N of the trail, 160 m, 9°38'S, 149°20'E, 29 July 1999, *Takeuchi 13523* (A!, K!); near Merap Village, 10 m, 4°45'S, 145°40'E, 9 October 1958, *Pullen 1193* (CANB!, LAE); Lower Ramu, half mile north of Josephstaal airstrip, 75 m, 4°44'S, 145°1'E, 4 October 1958, *Pullen 1100* (L!, LAE, CANB!); **Milne Bay Province:** Raba Raba Subdistr., Kwagira River, Peria Creek, 50 m, 9°42'S, 149°23'E, 30 August 1953, *Brass 24255* (A, CANB!, L!, LAE); Raba Raba Subdistr., Kwagira River, Peria Creek, 50 m, 9°38'S, 149°20'E, 5 July 1972, *Essig 55219* (CANB!, LAE); end of logging road, 0 m, 10°22'S, 150°7'E, 2 March 2000, *Barfod 458* (AAU, BRI, CANB, K!, LAE); Rossel Island, Abaleti, 100 m, 11°22'S, 154°9'E, 29 September 1956, *Brass 28256* (A!, K!, L!, LAE); **Morobe Province:** Kaniaia Wildlife Management Area, shoreline along Bulili ridge near Lababia, ultrabasics, 0 m, 7°18'S, 147°8'E, 20 February 2001, *Takeuchi 15142* (A!); NW of Waria River, near Yai Village, 200 m, 7°57'S, 147°35'E, 7 June 2001, *Takeuchi 13213* (A, K!); below Red Hill, along Lae-Bulolo road 18 miles W of Lae, 30 m, 6°50'S, 146°36'E, 3 September 1964, *Hartley 13082* (A, CANB!, L!, LAE); Busu River, 6°30'S, 146°55'E, 15 October 1957, *White 9553* (K!, L!, LAE); Along Bulolo road, near Markham Bridge, 15 m, 6°45'S, 147°0'E, 15 September 1971, *Essig 55001* (BH, CANB!, L, LAE); Oomsis, 150 m, 6°41'S, 146°48'E, 18 April 1959, *Brass 29249* (K!, L!, LAE); Anamapi Creek, Dengalu, Wau Subdistr., 1050 m, 7°10'S, 146°39'E, 18 January 1964, *Millar 23072* (A, BRI!, K!, L, LAE!); Lae, Wafok, near Nadzab, 500 m, 6°33'S, 146°42'E, 30 January 1996, *Baker et al. 607* (FTG, K!, LAE); Oomsis, near Lae, 100 m, 6°45'S, 147°0'E, 1 March 1959, *White 10460* (BRI!, K, LAE!); Oomsis, near Lae, 450 m, 6°45'S, 147°0'E, July 1958, *White 10194* (A, K!, LAE); Lae, 6°44'S, 147°0'E, 21 July 1939, *Clemens 10465* (K!, MICH); **Sandaun Province:** Vanimo Distr., Krisa Village, Kilimeri CD, 2°51'S, 141°16'E, 21 May 1999, *Klappa 151* (K!); Bewani, 0 m, 3°1'S, 141°8'E, 19 March 2000, *Barfod 501* (AAU, BRI, CANB, K!, LAE); Wutung Subprovince, Oenake Range, foothills of Mt. Bougainville, 530 m, 2°37'S, 141°0'E, 7 September 1982, *Kerenga 56434* (CANB, K!, L!, LAE); Telefomin, Kak Valley, Gentry transect on slope above Nenem SE of Mianmin, 940 m, 5°8'S, 141°35'E, 27 October 1993, *Frodin 3154* (K!); near Ambunti, 90 m, 4°14'S, 142°52'E, 8 June 1966, *Hoogland 10241* (BH, BRI, CANB, K!, L!, LAE); **Southern Highlands Province:** Mubi River, Lake Kutubu divide near Tage, 900 m, 6°21'S, 143°18'E, 27 September 1961, *Schodde 2284* (A, CANB!, L!, LAE); Mt. Bosavi, near Bosavi Mission (also known as Dudessa or Ludessa Village), WWF Integrated Conservation and Development Project Area, 750 m, 6°28'S, 142°53'E, 5 February 1996, *Baker et al. 632* (BH, K!, LAE); Lake Kutubu, Wanunuku, near Tugiri, WWF Integrated Conservation and Development Project Area, 900 m, 6°21'S, 143°13'E, 13 February 1996, *Baker et al. 667* (BH, K!, LAE); **Western Province:** Tarara, Wassi Kussa River, 8°55'S, 141°55'E, January 1937, *Brass 8701A* (A!, BRI); 2 miles north of Kiunga, 90 m, 6°5'S, 141°18'E, 11 September 1967, *Pullen 7302* (CANB!, L!, LAE); Oroville Camp, Fly River, 30 m above D'Albertis Junction, 5°43'S, 141°7'E, August 1936, *Brass 7402* (A!, BRI); Gaima, Lower Fly River, 8°19'S, 142°59'E, November 1936, *Brass 8333* (A!, BRI, L!); Lake Daviumbu, Middle Fly River, 7°36'S, 141°17'E, August 1936, *Brass 7592* (A!, BRI, L!); Tarara, Wassi Kussa River, 8°55'S, 141°55'E, January 1937, *Brass 8701* (A!, BRI, L!); North Fly Distr., Tabubil-Kiunga road, 11km SE of Tabubil, 360 m, 5°20'S, 141°17'E, 11 December 2000, *Baker et al. 1127* (AAU, K!, LAE, NY). CULTIVATED. MALAYSIA. **Sarawak:** Kuching Semenggoh Arboretum, 2 May 1981, *Dransfield 5987* (K!). INDONESIA. **West Java:** Bogor Botanic Gardens ex New Guinea, VI 4, April–May, 1936, *Furtado SFN 31139* (A!, B†, K!, L!, SING); SINGAPORE. Singapore Botanic Gardens, Lawn Y 152B, 18 September 1979, *Mohd Shah s.n.* (K!); Singapore Botanic Gardens, Palm Valley, Lawn W, Acc. no.: w/25/88/92, 27

April 2001, *Loo 305* (K!); Singapore Botanic Gardens, Palm Valley, Lawn W, Acc. no.: Y152, 27 April 2001, *Loo 306* (K!); UNITED KINGDOM. Royal Botanic Gardens, Kew, Acc. no.: 079-64.07901, *Womersley s.n.* (K!); Royal Botanic Gardens, Kew, Acc. no.: 486-66.48601 (K!); Royal Botanic Gardens, Kew, Acc. no.: 486-66.48601 (K!); UNITED STATES. **Florida:** Fairchild Tropical Garden, Miami-Dade county, Coral Gables, Plot 112. 79-257A, 4 April 2001, *Zona 890* (K!); same locality as preceding, Plot 143. 81-608A, 4 April 2001, *Zona 896* (K!).

Notes:—*Hydriastele wendlandiana* is a widespread and common understorey to midstorey palm distinguished by its leaves with 12–30 irregularly arranged, truncately praemorse leaflets on each side of the rachis, leaf sheaths longer than 40 cm, inflorescences bearing 8–15 primary branches, and variable endosperm condition. *Hydriastele wendlandiana* is most similar to *H. kasesa*, but that species differs in being of a generally shorter stature, having leaves with 6–13 leaflets on each side of the rachis, leaf sheaths that do not exceed 30 cm in length, and inflorescences bearing 5–10 primary branches. Rarely, leaflets of *H. wendlandiana* are regularly arranged prompting comparison with *H. variabilis* and *H. rheophytica*, but *H. variabilis* usually has shorter inflorescences (10–25 cm long as opposed to normally 21–50 cm in *H. wendlandiana*), and *H. rheophytica* has pliable stems and flexible leaves. In addition, both *H. variabilis* and *H. rheophytica* have basal leaflets that are obliquely praemorse or pointed at their tips, rather than truncately praemorse.

Petoe *et al.* (2018) describe the taxonomy and morphology of *H. wendlandiana* in more detail.

In addition to being a *nomen nudum*, the name *Ptychosperma beccarianum* Warb. ex K.Schum. & Lauterb. was also linked to a specimen of mixed gathering (Burret 1928) shown by Baker & Loo (2004) to contain fragments of *Hydriastele wendlandiana* and *Rhopaloblaste ceramica* Burret (1928: 288). Although not strictly a synonym due to its being invalidly published, we nonetheless justify listing *Ptychosperma beccarianum* as such here, in order to effectively pin down the name.

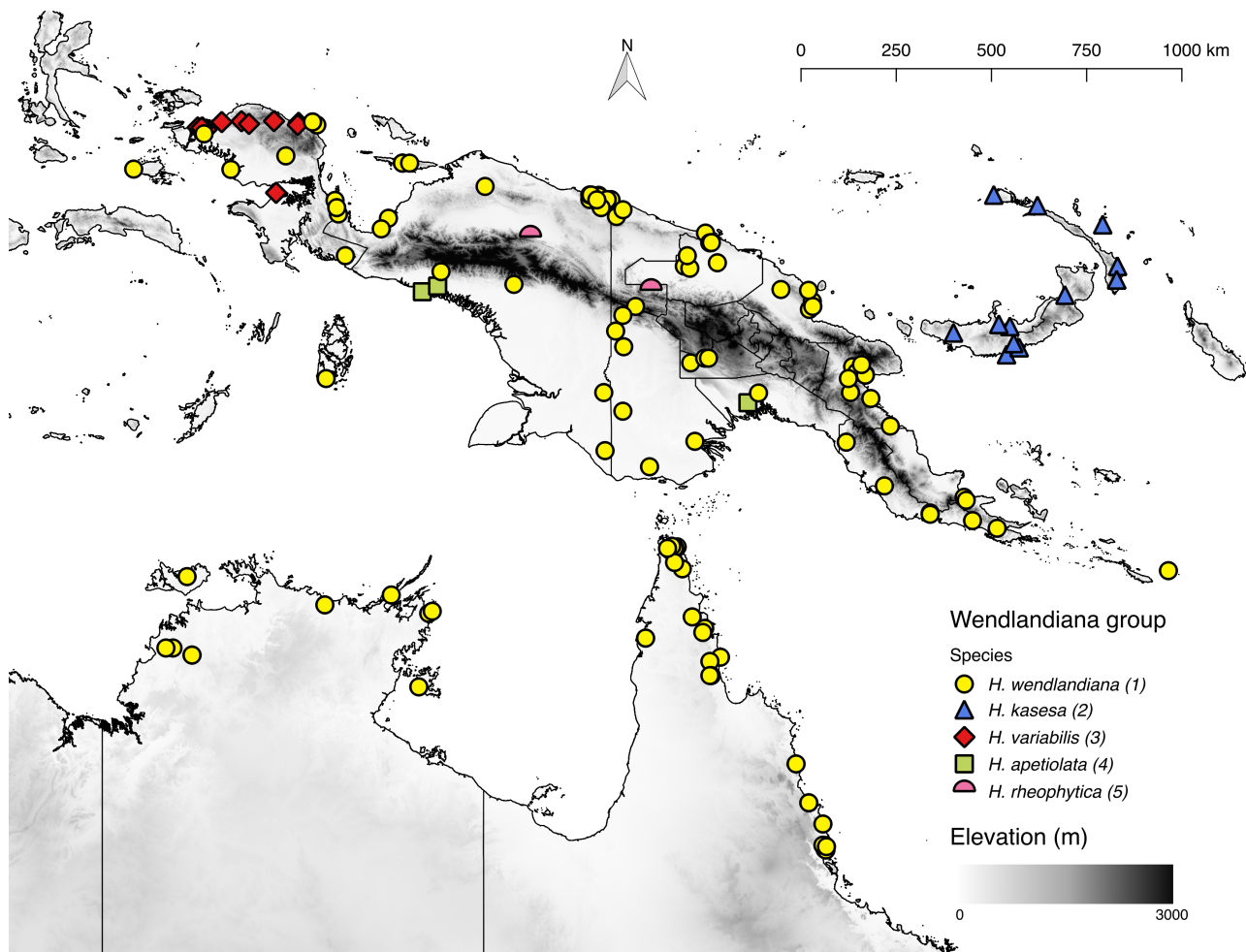


FIGURE 4. Distribution map of the species of the Wendlandiana group of *Hydriastele*.

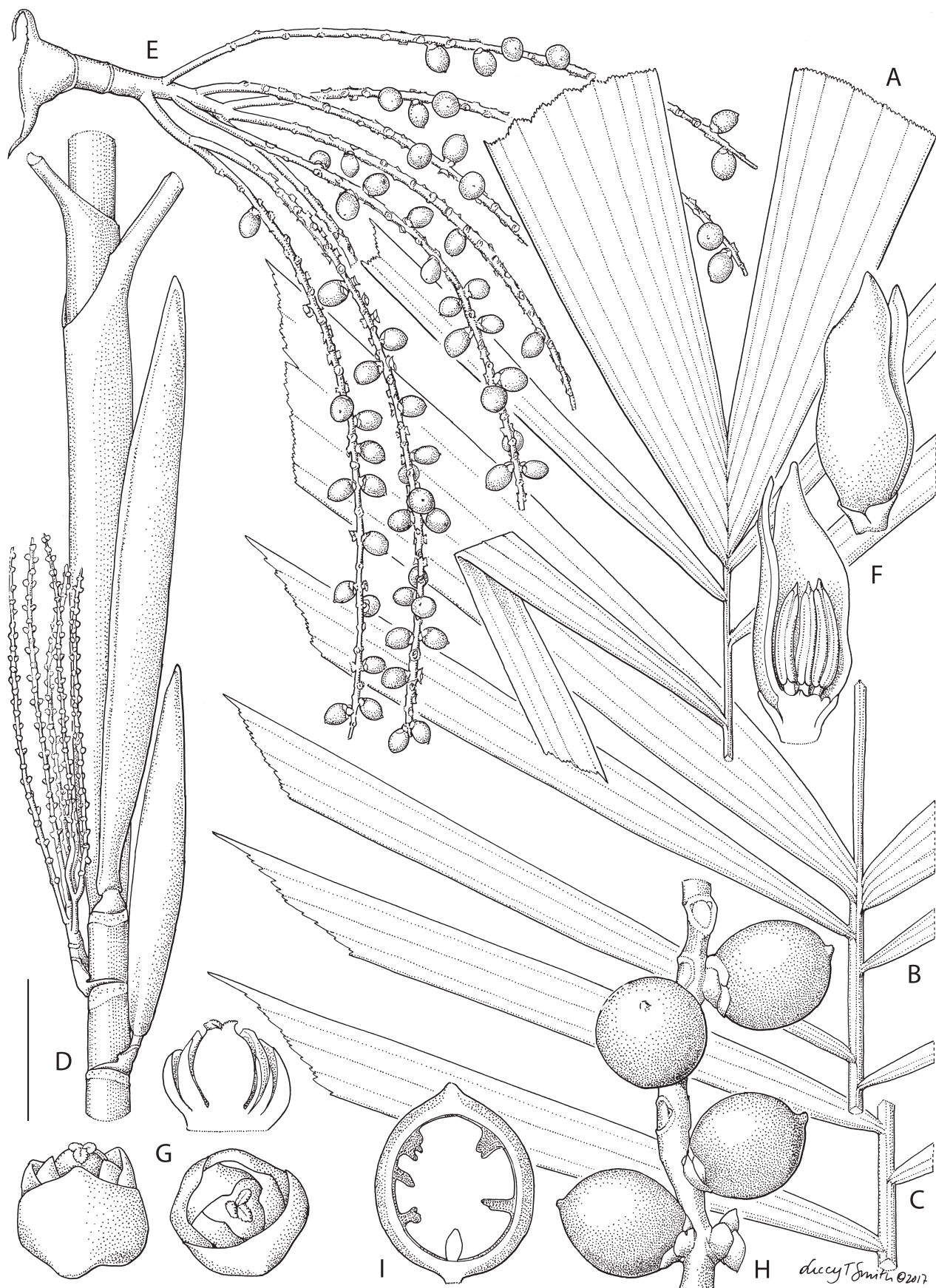


FIGURE 5. *Hydrastele kasesa*. A. Leaf apex. B. Mid-leaf portion. C. Leaf base. D. Leaf sheaths and inflorescences. E. Infructescence. F. Staminate flower whole and in longitudinal section. G. Pistillate flower whole, two views, and in longitudinal section. H. Portion of rachilla with fruit. I. Fruit in longitudinal section. Scale bar: A–C = 8 cm; D = 6 cm; E = 4 cm; F = 5 mm; G = 2.2 mm; H = 1 cm; I = 7 mm. All from *Takeuchi 9902*. Drawn by Lucy T. Smith.

2. *Hydriastele kasesa* (Lauterb.) Burret (1937b: 484). *Ptychosperma kasesa* Lauterbach (1911: 357). *Adelonenga kasesa* (Lauterb.) Beccari (1914: 26). Type:—PAPUA NEW GUINEA. New Ireland Province: Namatanai, *Peekel 109* (holotype B†, isotype FI!)

Figure 5 (line drawing). Figure 4 (map).

Solitary or clustering palm forming clumps of as many as 15 stems, slender, to 6 m tall, bearing 6–8 leaves per crown. **Stem** 1.5–3.8 cm in diam. **Leaf** 70–150 cm long including petiole; sheath 15–30 cm long; petiole 15–40 cm; leaflets 6–13 per side, arranged irregularly, with a group of closely spaced leaflets in different planes in the middle of rachis, ± cuneate, truncately praemorse apically, ramenta seemingly lacking. **Inflorescence** 17–30 cm long including 2–4 cm peduncle, branched to 1 or 2 orders, protogynous; primary branches 5–10, to 23.5 cm long, bearing up to 3 rachillae each; triads opposite and decussate. **Staminate flower** 8 × 3–4 mm in bud (when dry); stamens 6. **Pistillate flower** ca. 2.5 × 2.5 mm in bud (when dry), with free sepals and free, ± rounded, low petals. **Fruit** ca. 12 × 9 mm when ripe, ovoid to subglobose, red, with inconspicuous stigmatic apical remains lacking encircling dark sclerotic zone. **Seed** ca. 6.7 × 5.4 mm (when dry), ovoid; endosperm ruminant.

Distribution:—New Britain and New Ireland in the Bismarck Archipelago.

Habitat:—Lowland tropical primary rainforest, occasionally on swampy ground or near stream banks, and premontane mixed forest on slopes and ridges, 0–800 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Least Concern (LC; Petoe *et al.* 2018).

Specimens examined:—PAPUA NEW GUINEA. **East New Britain Province:** Rabaul Subdistr., Matanakunei, 0 m, 4°52'S, 151°43'E, 29 March 1968, *Ridsdale 38004* (BH, BRI, CANB, L!); **New Ireland Province:** Namatanai, *Peekel 109* (B†, FI!); Namatanai Subdistr., Hans Meyer Range, Danfu River Valley about 8 km west and upstream of the Danfu bridge nr. Manga, 800 m, 4°11'S, 152°57'E, 14 February 1970, *Sands 866* (K!, L, LAE); inland from Lossuk to Bagaterra, 0 m, 2°45'S, 151°4'E, 3 February 1967, *Coode 29729* (LAE!); near the junction of the Niagara and Weitin River, 240 m, 4°30'S, 152°56'E, 19 January 1994, *Takeuchi 9902* (A!); near the junction of the Niagara and Weitin River, 240 m, 4°30'S, 152°56'E, January 1994, *Takeuchi 9994* (A!); Subdistr. Lamet, West New Hanover, 2 km E of Metemulai village, 50 m, 2°30'S, 150°2'E, 7 October 1974, *Croft 65490* (BH, L!, LAE); Namatanai Subprovince, Lihir Island, Mt. Tementa above Palie Mission, 600 m, 3°12'S, 152°36'E, 7 November 1984, *Gideon 57205* (L!, LAE, USP); **West New Britain Province:** Eiliak, 15 m, 5°45'S, 149°5'E, 7 May 1958, *White 10070* (BRI, CANB!, L!, LAE); Gasmata Subdistr., Gasmata patrol post, 40 m, 6°15'S, 150°19'E, 30 May 1987, *Kerenga 62320* (LAE!); Gasmata Subdistr., 6 miles east of Fullerborn Harbour, 300 m, 6°6'S, 150°38'E, 8 May 1973, *Isles 34405* (A, BRI, K!, L!, LAE, CANB!); Talasea Subdistr., Koimumu-Lavege Road, 5°36'S, 150°25'E, 17 April 1959, *White 10889* (A, BRI, K!, LAE); Talasea Subdistr., Kimbe, 0 m, 5°33'S, 150°9'E, 26 April 1972, *Essig 55214* (LAE!); Mt. Klangal, 25 miles NNE of Gasmata, 800 m, 6°00'S, 150°30'E, 15 May 1973, *Croft 15567* (BH, L!, LAE).

Notes:—*Hydriastele kasesa* is a slender understory palm distinguished by its leaves with 6–13 irregularly arranged leaflets on each side of the rachis, leaf sheaths up to 30 cm long, and inflorescences bearing 5–10 primary branches. *Hydriastele kasesa* is most similar to *H. wendlandiana* to which it is no doubt closely related, but *H. wendlandiana* is usually taller and less slender, has leaves with 12–40 leaflets on each side of the rachis (rarely 12–13 leaflets per side), leaf sheaths longer than 40 cm, and inflorescences with 8–15 primary branches.

Hydriastele kasesa is described in more detail by Petoe *et al.* (2018).

3. *Hydriastele variabilis* (Becc.) Burret (1937b: 483). *Nenga variabilis* Beccari (1877: 26). *Adelonenga variabilis* (Becc.) Beccari (1885: 82). Type:—INDONESIA. West Papua Province: Ramoi, 1872, *Beccari PP426* (holotype FI!, isotype K!)

Nenga variabilis var. *sphaerocarpa* Beccari (1877: 27). *Hydriastele variabilis* var. *sphaerocarpa* (Becc.) Burret (1937: 483). Type:—INDONESIA. West Papua Province: Amberbakin, 1872, *Beccari s.n.* (holotype FI!, isotype K!).

Figure 6 (line drawing). Figure 7 (photo plate). Figure 4 (map).

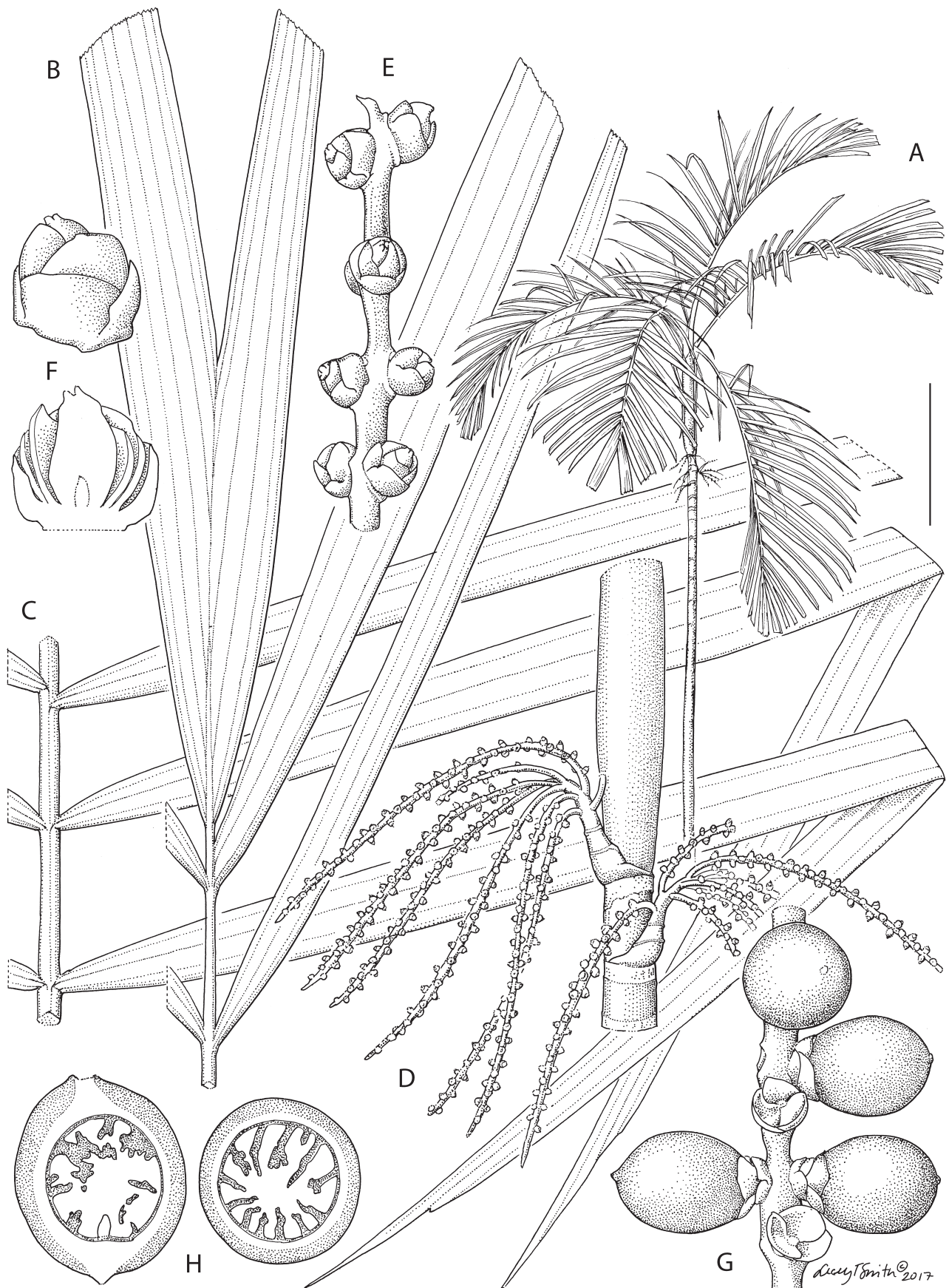


FIGURE 6. *Hydrastele variabilis*. A. Habit. B. Leaf apex. C. Mid-leaf portion. D. Inflorescences with pistillate flowers; E Portion of rachilla with pistillate flowers. F. Pistillate flower whole and in longitudinal section. G. Portion of rachilla with fruit. H. Fruit in longitudinal and transverse section. Scale bar: A = 40 cm; B–C = 4; D = 6 cm; E = 1 cm; F = 3 mm; G = 1.5 cm; H = 7 mm. A, D–F from Gardiner 424; B–C, G–H from Baker *et al.* 1369. Drawn by Lucy T. Smith.



FIGURE 7. *Hydriastele variabilis*. A–B. Habit. C. Inflorescences with pistillate flowers. D. Inflorescence with immature fruit. A, C from Gardiner 424; B, D from Aifat, Bird’s Head Peninsula, western New Guinea. Photos A, C: W.J. Baker; B, D: C.D. Heatubun.

Clustering, slender palm to 8 m tall, bearing 4–7 leaves per crown. **Stem** 2–4 cm in diam. **Leaf** 95–140 cm long including petiole; sheath 27–45 cm long; petiole 9–30 cm long; leaflets 11–23 per side, arranged regularly to subregularly, linear; basal leaflets single-fold, pointed or obliquely praemorse apically; terminal leaflets comprising 4–11 folds, truncately praemorse apically; **Inflorescence** 10–25 cm long including 2–2.5 cm peduncle, branched to 1 or 2 orders, protogynous; primary branches 6–11, to 22 cm long, bearing up to 1 rachilla each; triads opposite and decussate. **Staminate flower** not seen. **Pistillate flower** 2–2.5 × 2–3 mm in bud (when dry) with free sepals and free, ± rounded, low petals. **Fruit** 10–12 × 6.3–7.8 mm when ripe, ellipsoid to ovoid with ends ± tapering when dry, red, with inconspicuous stigmatic apical remains lacking encircling dark sclerotic zone. **Seed** 7–8.2 × 5–6 mm, ovoid; endosperm deeply ruminant.

Distribution:—Northern Bird’s Head Peninsula and the adjacent Bomberai Peninsula in West Papua Province, western New Guinea.

Habitat:—Primary or secondary lowland tropical rainforest or premontane primary rainforest on soils with a varying composition of clay, sand, humus and fibrous roots, 0–1200 m.

Uses:—None recorded.

Vernacular names:—*Sagarofa* (Sumuri), *Pinang Oetan* (Malay).

Conservation status:—*Least Concern* (LC; Petoe *et al.* 2018).

Specimens examined:—INDONESIA. **West Papua Province:** Ramoi, 1872, *Beccari PP426* (FI!, K!); Amberbakin, 1872, *Beccari s.n.* (FI!, K!); Manokwari Distr., Bintuni Subdistr., beside trail between Saengga & Tanah Merah Villages, 20 m, 2°27’S, 133°7’E, 13 February 2002, *Maturbongs 712* (BO, K!, LAE, MAN); Manokwari Distr., Bintuni Subdistr., near Saengga Village, 20 m, 2°27’S, 133°6’E, 13 February 2002, *Sambas 17* (BO, K!, LAE, MAN); Manokwari, around a construction main road of Manokwari-Sorong, between Wariori River and Waramoi River, 400 m, 0°48’S, 133°38’E, 26 April 1994, *Mogea 6305* (AAU, BO, BRI, K!, L, MAN, NY); Manokwari, Kebar, Kebar Valley, trail from Andjai to G. Nettoti near base camp ‘N’ on ridge at 1000m, 1240 m, 0°46’S, 133°3’E, 3 May 1995, *Davis 726* (BO, BRI, K!, MAN, NY); Sorong, Klasaman, Km27, Intimpura Camp, 120 m, 0°58’S, 131°28’E, 20 September 1995, *Maturbongs 292* (K!); Sorong, Klasaman, KM14, 40 m, 0°55’S, 131°22’E, 15 September 1995, *Wally 464* (K!); Sorong, Roefei river N of Sorong, ca. 2 miles from the sea on northern bank, 90 m, 0°51’S, 131°15’E, 24 March 1954, *van Royen 3155* (CANB!, L!); Sorong Distr., Klasaman, Klabainem, 10 m, 0°55’S, 131°21’E, 29 February 2002, *Heatubun 375* (K!, MAN); Tamrau Mountains, Sorong-Manokwari road, beyond Bamus Buma, towards Fef and Manokwari, 950 m, 0°45’S, 132°17’E, 28 January 2013, *Gardiner 424* (BO, K!, L, MAN); Tambrouw Regency, Fef Distr.; Pass above Fef, 700 m, 0°49’S, 132°27’E, 24 January 2013, *Baker et al. 1369* (BO, K!, L, MAN); Sorong Regency, Klaso Distr.; Kalalin, near Megame, 100 m, 0°46’S, 131°49’E, 31 January 2013, *Baker et al. 1390* (BO, K!, L, MAN); Locality info lacking, recently collected, *Iwanggin 134* (MAN, K!).

Notes:—*Hydriastele variabilis* is a slender understory to midstorey palm bearing leaves with regularly to subregularly arranged, linear leaflets. The species is distinguished by its leaves with a well-defined petiole, basal leaflets with pointed to obliquely praemorse tips, and a terminal leaflet pair comprising 4–11 folds. The infructescence is rather distinctive in being branched to one or two orders, and bearing fruits that become somewhat fusiform upon drying. *Hydriastele variabilis* is superficially similar to *H. kasesa* in the slender habit but that species has irregularly arranged leaflets. While *H. apetiolata* and *H. rheophytica* both are regularly pinnate, the former species is less slender with apetiolate adult leaves, while the latter is a rheophyte with pliable stems and terminal leaflets comprising 2 or 3 folds. Rarely, the leaflets in *H. wendlandiana* can be regularly arranged prompting comparison with *H. variabilis* but *H. wendlandiana* has basal leaflets with truncately praemorse tips.

Hydriastele variabilis is described in more detail by Petoe *et al.* (2018).

4. *Hydriastele apetiolata* Petoe & W.J.Baker in Petoe *et al.* (2018: 17). Type:—INDONESIA. Papua Province: Mimika Regency, Timika, Nursery: Kuala Kencana, 50 m, 4°47’S, 136°33’E, 27 February 1998, *Baker et al. 884* (holotype K!, isotypes BH, BO, L, MAN)

Figure 8 (line drawing). Figure 9 (photo plate). Figure 4 (map).

Clustering, moderately slender palm to 6 m tall, bearing 7–10 leaves per crown. **Stem** 4.5–6 cm in diam. **Leaf** to 125 cm long; sheath ca. 60 cm long; petiole lacking; leaflets 23–26 per side, arranged regularly; basal leaflets single-fold, linear and somewhat grouped, obliquely or truncately praemorse apically; terminal leaflets comprising 4–6 folds, cuneate, truncately praemorse apically; juvenile leaves entire-bifid, with or without petiole, with lamina 100–130 cm long. **Inflorescence** 25–35 cm long including 3.5–5.5 cm peduncle, branched to 2 orders, protogynous; primary branches ca. 8, to 27.5 cm long, bearing up to 3 rachillae each; triads opposite and decussate. **Staminate flower** 11–12 × 5–6 mm



FIGURE 8. *Hydrastele apetiolata*. A. Leaf apex. B. Mid-leaf portion. C. Leaf base with sheath. D. Juvenile leaf. E. Infructescence. F. Portion of rachilla with triads. G. Staminate flower in longitudinal section. H. Pistillate flower whole and in longitudinal section. I. Portion of rachilla with fruit. J. Fruit in longitudinal section. Scale bar: A–C = 6 cm; D = 12 cm; E = 6 cm; F = 7 mm; G = 5 mm; H = 3.3 mm; I = 1.5 cm; J = 1 cm. All from Baker et al. 884. Drawn by Lucy T. Smith.



FIGURE 9. *Hydrastele apetiolata*. A–B, D. Habit. C. Inflorescence. All from Baker *et al.* 884. All photos: W.J. Baker.

in bud; stamens 6–8. **Pistillate flower** 2–3 × 2.5–3 mm in bud, with free sepals and free, ± rounded, low petals. **Fruit** 7.4–9.4 × 6.6–8.2 mm when ripe, subglobose, red, with inconspicuous stigmatic apical remains lacking encircling dark sclerotic zone. **Seed** 5.1–7.2 × 5–6.8 mm, globose to subglobose; endosperm ruminant.

Distribution:—Known from two distinct localities on the southern coast of New Guinea.

Habitat:—Primary or secondary lowland rainforest, 20–50 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data Deficient (DD; Petoe *et al.* 2018)

Specimens examined:—INDONESIA. **Papua Province:** Mimika Regency, Timika, Nursery, Kuala Kencana, ca. 50 m, 4°47'S, 136°33'E, 27 February 1998, *Baker et al.* 884 (BH, BO, K!, L, MAN); Mimika Regency, Timika, East Levee by drowned forest, 5 km S of Kpg Kali Kopi, Loc 11, 20 m, 4°39'S, 136°55'E, 18 February 1998, *Witono 20* (BH, BO, K!, L!, MAN); Mimika Regency, Timika, East Levee by drowned forest, 5 km S of Kpg Kali Kopi, Loc 11, 20 m, 4°39'S, 136°55'E, 18 February 1998, *Witono 21* (BO, K!, MAN). PAPUA NEW GUINEA. **Gulf Province:** Kikori Distr., Kopi-Kikori road, 3 km NW of Kikori, 40 m, 7°24'S, 144°13'E, 21 November 2000, *Baker et al.* 1103 (AAU, BRI, K!, L, LAE, NY).

Notes:—*Hydriastele apetiolata* is a midstorey palm with a slender stem, distinguished by its regularly pinnate, apetiolate adult leaves and entire-bifid juvenile leaves (petiolate or apetiolate in the juvenile). The combination of entire juvenile leaves and pinnate adult leaves is not known from other slender understory to midstorey species of *Hydriastele* although a similar pattern in leaf dimorphism is reported for some of the bigger tree taxa, e.g. *Hydriastele manusii* (Fig. 45) and *H. boumae* (Baker & Loo 2004). More details are given by Petoe *et al.* (2018).

5. *Hydriastele rheophytica* Dowe & Ferrero (2000b: 195). Type:—INDONESIA. Papua Province: Idenburg River [Taritatu River], Araucaria Creek, 3°29'S, 139°6'E, March 1939, *Brass 13700* (holotype A!, isotype L!)

Figure 10 (line drawing). Figure 11 (photo plate). Figure 4 (map).

Clustering, rheophytic palm forming clumps of as many as 30 stems, slender, to 6 m tall, bearing 4–12 leaves per crown. **Stem** 2–2.5 cm in diam., pliable and mostly leaning. **Leaf** ca. 95–120 cm long including petiole; sheath 40–45 cm long, petiole 20–30 cm long, pliable; leaflets 18–32 per side, arranged regularly, linear, thin and soft; basal leaflets single-fold, obliquely praemorse apically; terminal leaflets comprising 2 or 3 folds, truncately praemorse apically. **Inflorescence** 16–30 cm long including 2.5–7 cm peduncle, branched to 1 or 2 orders, protogynous; rachillae 5–15 per inflorescence; triads opposite and decussate. **Staminate flower** 6–8 × 3–4 mm (when dry); stamens 6. **Pistillate flowers** 2–2.5 × 2 mm in bud (when dry), with free sepals and free, ± rounded, low petals. **Fruit** ca. 7 mm long, globose to broadly ellipsoid, with inconspicuous stigmatic apical remains lacking encircling dark sclerotic zone. **Seed** globose; endosperm shallowly ruminant.

Distribution:—Known from the Idenburg River and its upper tributaries in Papua Province, western New Guinea. Also reported from the Frieda River in the adjacent Sandaun Province of Papua New Guinea (Dowe & Ferrero 2000b).

Habitat:—Stream and river banks frequently subjected to inundation, ca. 850 m.

Uses:—Cultivated as an ornamental following introduction to Australia in the 1980s (Dowe & Ferrero 2000b).

Vernacular names:—None recorded.

Conservation status:—Data Deficient (DD; Petoe *et al.* 2018).

Specimens examined:—INDONESIA. **Papua Province:** Idenburg River [Taritatu River], Araucaria Creek, 4 km SW of Bernhard camp, 850 m, 3°29'S, 139°6'E, March 1939, *Brass 13700* (A!, L!); Same locality as preceding, 850 m, 3°29'S, 139°6'E, March 1939, *Brass 13608* (A!, L!). CULTIVATED. UNITED STATES. **Hawaiian Islands:** Hawai'i, Floribunda Palms, November 2017, *Baker et al.* 1436 (K!).

Notes:—*Hydriastele rheophytica* is restricted to riverbanks where it forms large clumps of pliable, somewhat leaning stems. Only one other member of the genus, *H. simbiakii*, has a similar habitat preference although that species belongs to the Nengella group. *Hydriastele rheophytica* is distinguished by its leaves with numerous thin and soft, linear leaflets, the basal ones of which are obliquely praemorse at their tips, and a terminal leaflet pair comprising 2 or 3 folds. This species is most similar to *H. variabilis*, but that species has erect, non-pliable stems and terminal leaflets comprising 4–11 folds and it is not rheophytic.



FIGURE 10. *Hydrastele rheophytica*. A. Habit. B. Leaf apex. C. Mid-leaf portion. D. Leaf base. E. Inflorescence. F. Portion of rachilla with pistillate flowers. G. Staminate flower whole and in longitudinal section. H. Pistillate flower whole and in longitudinal section. I. Fruit whole and in longitudinal section. Scale bar: A = 70 cm; B–D = 6 cm; E = 4 cm; F–G = 5 mm; H = 2.5 mm; I = 5 mm. A, I from Dowe 536; B–H from Brass 13700. Drawn by Lucy T. Smith.

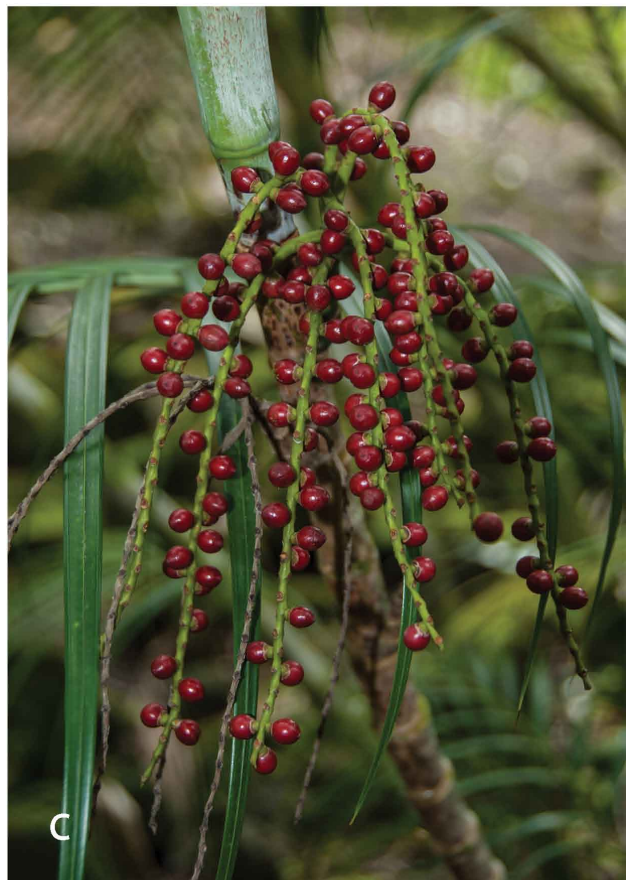


FIGURE 11. *Hydiastele rheophytica*. A. Habit. B. Inflorescence and infructescences. C. Infructescence. All from *Baker et al. 1436* (cultivated specimen). All photos: W.J. Baker.

A Brass photo showing *H. rheophytica* in its native habitat was reproduced in *Rheophytes of the World* (van Steenis 1981). The species is described in more detail by Dowe & Ferrero (2000b) and Petoe *et al.* (2018).

NENGELLA GROUP

Small to moderate palms, inflorescences protandrous and branched to 0 (spicate) or 1 order, triads spirally arranged (except in *H. aprica* where they are decussately arranged). New Guinea.

6. *Hydriastele pinangoides* (Becc.) Baker & Loo (2004: 66). *Nenga pinangoides* Beccari (1877: 28). *Leptophoenix pinangoides* (Becc.) Beccari (1885: 82). *Nengella pinangoides* (Becc.) Burret (1936c: 315). *Gronophyllum pinangoides* (Becc.) Essig & Young (1985: 135). Lectotype (designated by Essig & Young (1985) based on an annotation by H. E. Moore in Florence, 1956):—INDONESIA. West Papua Province: Ramoi, 1972, *Beccari 430* (FI!)

Nenga affinis Beccari (1877: 29). *Leptophoenix affinis* (Becc.) Beccari (1885: 82). *Nengella affinis* (Becc.) Burret (1936c: 316). *Gronophyllum affine* (Becc.) Essig & Young (1985: 136). *Hydriastele affinis* (Becc.) Baker & Loo (2004: 62). Type:—INDONESIA. West Papua Province: Kapaor, April 1872, *Beccari s.n.* (holotype FI!, isotype K!).

Nenga calophylla Schumann & Lauterbach (1900: 208). *Nengella calophylla* (K.Schum. & Lauterb.) Beccari (1914: 27). Type:—PAPUA NEW GUINEA. Morobe Province: Sattelberg, *Lauterbach 564* (holotype B†, type photo FI!).

Leptophoenix minor Beccari (1905: 298). *Nengella minor* (Becc.) Burret (1936c: 315). Type:—PAPUA NEW GUINEA. Mekeo Distr., San Giuseppe R., 10 November 1892, *Loria s.n.* (holotype FI!).

Gronophyllum densiflorum Ridley (1916: 232). *Leptophoenix densiflora* (Ridl.) Burret (1936b: 205). *Nengella densiflora* (Ridl.) Burret (1936c: 316). Type:—INDONESIA. Papua Province: Mt. Carstensz [Mt. Jayawijaya], 1913, *Kloss s.n.* (holotype BM, isotype K!).

Leptophoenix incompta Beccari (1923: 452). *Nengella incompta* (Becc.) Burret (1936c: 316). Type:—PAPUA NEW GUINEA. East Sepik Province: Ettapenberg, *Ledermann 9017* (holotype B†).

Leptophoenix mayrii Burret (1933: 709). *Nengella mayrii* (Burret) Burret (1936c: 314). *Gronophyllum cyclopense* Essig & Young (1985: 136). *Hydriastele cyclopensis* (Essig & B.E.Young) Baker & Loo (2004: 64). Type:—INDONESIA. West Papua Province: Arfak Mts., *Mayr 24* (holotype B†, isotype BO).

Leptophoenix micrantha Burret (1933: 710). *Nengella micrantha* (Burret) Burret (1936c: 314). *Gronophyllum micranthum* (Burret) Essig & Young (1985: 136). *Hydriastele micrantha* (Burret) Baker & Loo (2004: 65). Type:—INDONESIA. Papua Province: Wandammen Mts., 8 July 1928, *Mayr 253* (holotype B†, isotype BO!).

Leptophoenix pterophylla Beccari (1934: 131). *Nengella pterophylla* (Becc.) Burret (1936c: 316). Type:—Cultivated in Bogor Botanic Gardens ex New Guinea, X D 114 (holotype FI!).

Leptophoenix yulensis Beccari (1934: 130). *Nengella yulensis* (Becc.) Burret (1936c: 316). Type:—PAPUA NEW GUINEA. Central Province: towards Mt. Yule, 8 December 1890, *von Mueller s.n.* (holotype MEL!, isotype FI!).

Leptophoenix macrocarpa Burret (1935: 340). *Nengella macrocarpa* (Burret) Burret (1936c: 316). Type:—PAPUA NEW GUINEA. Central Province: Mafulu, 1933, *Brass 5299* (holotype B†, isotypes BRI!, NY!).

Leptophoenix brassii Burret (1935: 339). *Nengella brassii* (Burret) Burret (1936c: 316). *Gronophyllum leonardii* Essig & Young (1985: 134). Type:—PAPUA NEW GUINEA. Western Province: Kubuna, 1933, *Brass 5631* (holotype A, isotypes BO!, BRI!, NY!).

Leptophoenix microcarpa Burret (1935: 342). *Nengella microcarpa* (Burret) Burret (1936c: 316). Type:—PAPUA NEW GUINEA. Central Province: Dieni, 9 May 1933, *Brass 3998* (holotype B†, isotypes A!, NY, BRI, BO!).

Nengella rhomboidea Burret (1939: 207). Type:—PAPUA NEW GUINEA. Western Province: Palmer R., July 1936, *Brass 7201* (holotype A!, isotype BRI).

Figure 12 (line drawing). Figure 13 (photo plate). Figure 14 (map).

Solitary or clustering, slender understorey or midstorey palm to 7(–10) m tall, bearing 5–10 leaves per crown. **Stem** (0.8–)1.5–7.5 cm in diam. **Leaf** 50–157 cm long including petiole; sheath 15–52 cm long; petiole 15–54 cm long; leaflets 5–10(–13) per side, very variable in size and shape, irregularly arranged usually in 2 or 3 widely spaced groups, occasionally with portions of the lamina regularly pinnate, or very rarely the entire blade regularly pinnate, single- or multi-fold, broadly (rarely narrowly) cuneate, praemorse apically. **Inflorescence** (13–)18–30 cm long including 1.5–3 cm peduncle, branched to 1 order, protandrous; rachillae 2–5(–6), pink; triads spirally arranged. **Staminate flower** 6–8 × 1–3 mm in bud (when dry), reddish; stamens 6. **Pistillate flower** ca. 4 × 3.5 mm at fruiting stage, crimson, with

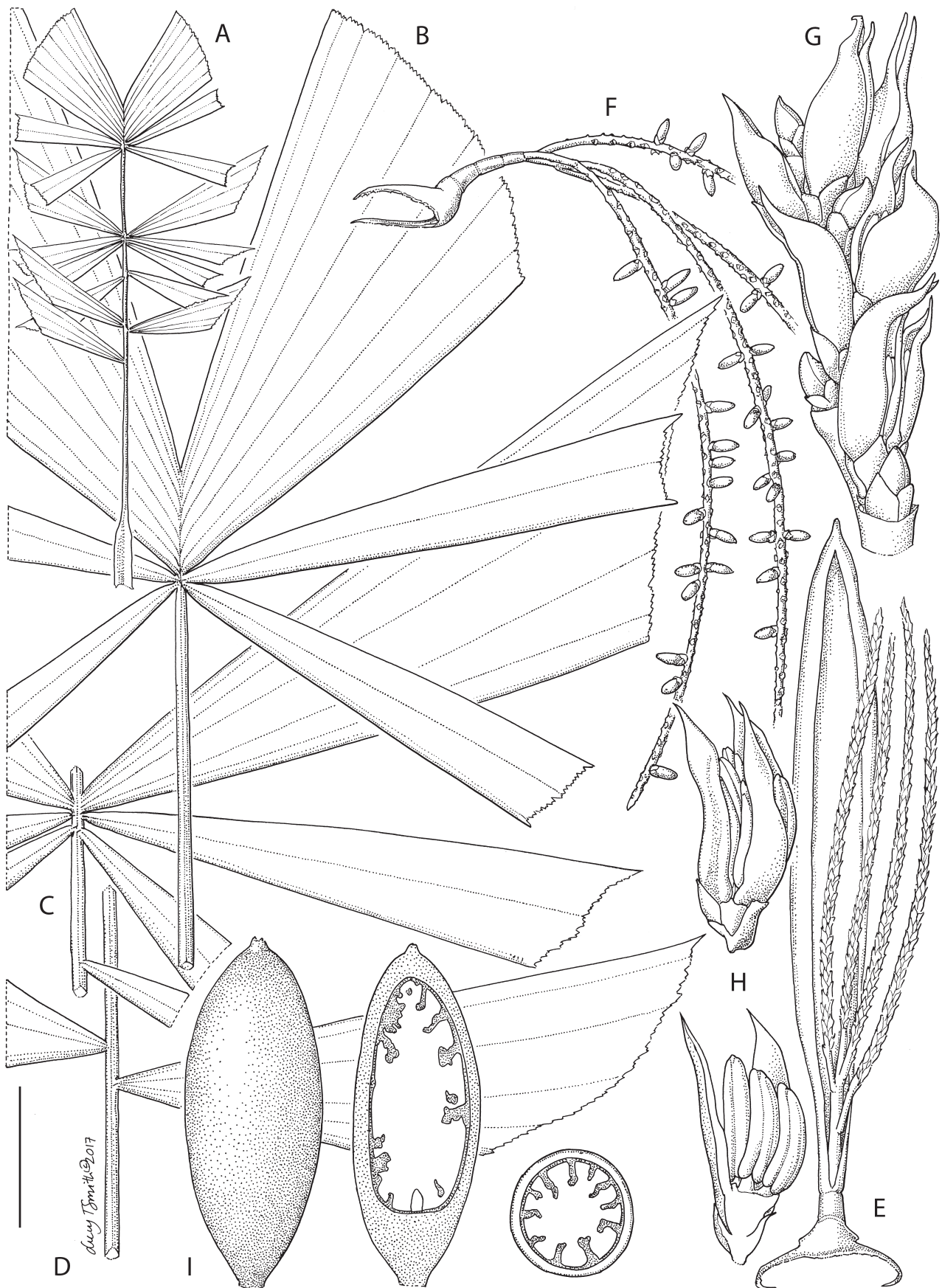


FIGURE 12. *Hydiastele pinangoides*. A. Leaf diagram. B. Leaf apex. C. Mid-leaf portion. D. Leaf base. E. Inflorescence with attached peduncular bract. F. Infructescence. G. Portion of rachilla with triads. H. Staminate flower whole and in longitudinal section. I. Fruit whole, in longitudinal section, and in transverse section. Scale bar: A = 24 cm; B–D = 8 cm; E–F = 4 cm; G–H = 5 mm; I = 7 mm. A–H from Pullen 5767; I from Baker *et al.* 1057. Drawn by Lucy T. Smith.



FIGURE 13. *Hydriastele pinangoides*. A. Habit. B. Portions of rachillae with triads. C. Infructescence. D. Portion of rachilla with fruit. A, C from Baker *et al.* 665; B, D from Baker *et al.* 1377. All photos: W.J. Baker.

free sepals and free petals with conspicuous, triangular tips. **Fruit** 10–16 × 4–8 mm when ripe, ellipsoid or cylindrical to fusiform, pink, red, purple or blackish, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam.). **Seed** 6–10 × 2–4 mm, ellipsoid; endosperm ruminant.

Distribution:—New Guinea and the islands of Misool, Waigeo, and Kobroor in the Aru archipelago.

Habitat:—Lowland or premontane rainforest on well-drained to water-logged soil. Primary or secondary forest on clay, limestone karst and volcanic soils, 0–1350 m.

Uses:—Stems used for spears, spearheads, bow material, arrowheads and for sewing thatch, the foliage used as roofing material. Planted as an ornamental and used for magic.

Vernacular names:—*Tapolo* (Pawaian), *Gilaia* (Waskuk), *Kobu* (Wagu), *Ugarreh* (Daga), *Mara* (Ambakanjah), *Kupal* (Gal), *Tegradri* (Irarutu), *Bim*, *Kabim* (Matbaat), *Yali* (Biyal), *Seraach* (Maibrat), *Séméngbrè* (Hattam). *manggam* (Maprik, unknown dialect), *tooma* (Western Province, unknown dialect).

Conservation status:—Least Concern (LC; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **Maluku Province:** Aru Islands, Pulau Kobroor, 0 m, 6°15'S, 134°17'E, 6 November 1994, *van Balgooy 6855* (K!, L!); **West Papua Province:** Ramoi, 0°57'S, 131°20'E, 1872, *Beccari 430* (FI!, K!); Andai, 1872, *Beccari 551* (FI!); Kabupaten Pegunungan Arfak, Arfak Mountains, Minyambou, Mt. Nerimbau, 1600 m, 1°8'S, 133°51'E, 19 May 1962, *Koster BW 13879* (L!, LAE!, MAN); Kabupaten Teluk Bintuni, Concession of PT. Manokwari Mandiri Lestari, Blok RKT 2010, Jalur 22 Petak 18Y, 250 m, 18 July 2010, *Heatubun CH 1040* (K!, MAN); Kabupaten Kaimana, Teluk Arguni, Distrik Arguni Bawah, Kampung Jawera, Hutan Manggai, 0 m, 3°4'S, 133°40'E, 3 October 2010, *Heatubun CH 1074* (K!, MAN); Kabupaten Teluk Wondama, Distrik Wombu (Wasior Barat), Wosimi, Kambi Forest, 50 m, 3°0'S, 134°32'E, 18 August 2006, *Heatubun CH 777* (BO, K!, MAN); Kabupaten Manokwari, Warmare; Valley of River Prafi, new road to Manyambo, 350 m, 0°47'S, 133°58'E, 25 August 1995, *Dransfield JD 7605* (BO, K!); Manokwari, Kebar, Kebar Valley, forest immediately due N of Andjai in valley, 550 m, 0°55'S, 133°3'E, 30 April 1995, *Davis 685* (K!); Manokwari Distr., Warmare, Prafi R. valley, new road to Manyambo, 350 m, 0°47'S, 133°58'E, 25 August 1995, *Zona 689* (FTG, K!); Manokwari Distr., Nuni, Sungei Asai, between Mt. Manggombo and Mt. Marwadibau, 0 m, 0°45'S, 133°56'E, 15 August 1995, *Zona 671* (FTG, K!); Vogelkop Peninsula, Segior, North west side of Lake Ajamaru, 250 m, 1°14'S, 132°12'E, 10 March 1962, *Vink BW 15285* (A, K!, L!); Sorong, Tourism Park, Klasaman, KM14, 50 m, 0°55'S, 131°22'E, 25 July 1996, *Wally 490* (K!, MAN); Sorong, Waifo village, Waigeo Island, Raja Ampat Islands, 200 m, 0°14'S, 130°50'E, 25 June 1997, *Wally 702* (K!, MAN); Sorong, Waifo Village, Waigeo Island, Raja Ampat Islands, 400 m, 0°14'S, 130°50'E, 25 June 1997, *Maturbongs RAM 506* (K!, MAN); Sorong, Mamiyai, Waigeo Island, 50 m, 0°20'S, 131°9'E, 25 June 1997, *Heatubun 87* (K!, MAN); Manokwari, Cultivated, in the front of a mosque within the university area, 100 m, 0°51'S, 134°4'E, 13 August 1995, *Keim AK 2* (K!); Wandammen Peninsula, Wasior Distr., Manokwari Regency, Kowi, near Wondiwoi village (formerly Kobiari Village), ca. 9 km S of Wasior, 900 m, 2°48'S, 134°32'E, 24 February 2000, *Baker et al. 1057* (BO, K!, MAN); Siwi village, Ransiki Subdistr., Manokwari, 1°30'S, 134°2'E, 28 January 1999, *Heatubun CH 290* (BO, FTG, K!, MAN); Raja Ampat Regency, Misool Island, Motlol, 0 m, 1°53'S, 129°44'E, 22 January 2002, *Heatubun CH 358* (K!, MAN); Sorong Distr., Cape Seget, Seget Camp, 0 m, 1°20'S, 131°0'E, 26 January 2002, *Heatubun CH 367* (K!, MAN); Sorong Distr., around Wavari Logging Camp, 10 km SW of Limalas village, 0 m, 21 January 2002, *Wanggai 04* (BO, K!, LAE, MAN); Sorong Distr., N Misool Island, about 20 km W of Waigama village, near Motlol Camp, 0 m, 1°53'S, 129°44'E, 22 January 2002, *Maturbongs 699* (BO, K!, LAE, MAN); Sorong Distr., Warsamson, Warsamson R., 0 m, 0°49'S, 131°23'E, 28 January 2002, *Heatubun 373* (K!, MAN); Tambrouw Regency, Fef Distr.; Forest above Fef, 550 m, 0°48'S, 132°27'E, 26 January 2013, *Baker 1377* (BO, K!, L, MAN); **Papua Province:** Wandamen Mts., 1400 m, 8 July 1928, *Mayr 253* (BO!); Kapaor, April 1872, *Beccari s.n.* (FI!, K!); Fak-Fak, Timika, Road to Kali Kopi from mile 38. Loc 35, 100 m, 4°25'S, 136°56'E, 6 February 1998, *Baker et al. WJB 819* (BH, BO, K!, MAN); Fak-Fak, Timika, between Timika and port, peat lens (plot 22) Loc 20, 0 m, 4°47'S, 136°51'E, 16 February 1998, *Witono JK 17* (BH, BO, K!, L, MAN); Jayawijaya, Snow Mountains region, E of the Baliem Valley, Kab. Jayawijaya, Kec. Kurima, vicinity of Panggema village, 1350 m, 4°10'S, 139°20'E, October 1992, *Milliken 1423* (K!); Mt. Carstenz [Mt. Jayawijaya], 4°5'S, 137°11'E, 12 January 1912, *Kloss s.n.* (K!); Jayapura, North Cyclops Mts., 150 m, 2°30'S, 140°32'E, 30 January 2001, *Desianto BD 03* (AAU!, K!, MAN); Cyclops Mts., on grassy slope above Ifar, 400 m, 2°33'S, 140°31'E, 31 December 1954, *Mackee 1868* (L!); Fak Fak, Kaimana distr., Kroy village, 100 m, 3°38'S, 135°42'E, 27 November 2000, *Mehen SM 08* (AAU, CANB, K!, LAE, MAN); 4 km SW of Bernhard Camp, Idenburg R., 900 m, 3°29'S, 139°6'E, March 1939, *Brass 13095* (A!, L!); Same locality as preceding, 850 m, 3°29'S, 139°6'E, March 1939, *Brass 13434* (A!); 6 km SW of Bernhard Camp, Idenburg R., 1200 m, 3°30'S, 139°5'E, February 1939, *Brass 12872* (A!, L!); Same locality as preceding, 1100 m, 3°30'S, 139°5'E, February 1939, *Brass 12953* (A!, L!); Same locality as preceding, 1150 m, 3°30'S, 139°5'E, February 1939, *Brass 12998* (A!, L!); Same locality as

preceding, 1100 m, 3°30'S, 139°5'E, February 1939, *Brass 12952* (A!, L!); Same locality as preceding, 1100 m, 3°29'S, 139°6'E, February 1939, *Brass 12997* (A!). PAPUA NEW GUINEA. **Central Province:** Mafulu, 1250 m, 8°33'S, 147°7'E, September 1933, *Brass 5299* (BRI!, NY!); Dieni, Ononge Road, 500 m, 8°37'S, 146°50'E, April 1933, *Brass 3998* (A!, BO!, BRI, NY); Veimauri logging site, 9°2'S, 147°3'E, 5 September 1984, *Naoni UPNG 6146* (LAE!, US); Kubuna, 100 m, 8°42'S, 146°45'E, November 1933, *Brass 5631* (A!, BO!, BRI, NY); Head of Goldie R. some 4 km from the National walking track entrance, 400 m, 9°21'S, 147°31'E, August 1981, *Naoni UPNG EKN s.n.* (LAE!); Kairuku Subdistr., near Mipa Airstrip, Maipa village, 50 m, 8°20'S, 146°33'E, 18 September 1962, *Darbyshire 973* (CANB!); Sogeri Plateau, 550 m, 9°25'S, 147°26'E, 1 August 1962, *Pullen 3460* (CANB!); Pourt Moresby Subdistr., logging road between Kuriva & Veimauri Rivers, 50 m, 9°5'S, 147°5'E, 27 February 1972, *Essig LAE 55185* (LAE!); Port Moresby Subdistr., Owers Corner, Kokoda Trail, 9°25'S, 147°30'E, 1 March 1972, *Essig LAE 55187* (BH, LAE!); Towards Mt. Yule, 8 December 1890, *Mueller s.n.* (FI!, MEL!); **Chimbu Province:** Crater Mt, Wildlife Management Area, near Haia village, Wara O., 650 m, 6°43'S, 145°0'E, 3 March 1997, *Takeuchi 11697* (A!, GH); **East Sepik Province:** Maprik Subdistr., Prince Alexander Range, SE side of Mt. Turu, near Yangoru Patrol Post, Wewak-Angoram Area, 600 m, 3°37'S, 143°22'E, 19 August 1959, *Pullen 1504* (CANB!, LAE!); Ambunti Subdistr., eastern ridge of Sumset (Mt. Hunstein), 1200 m, 4°30'S, 142°39'E, 17 August 1966, *Hoogland 11052* (CANB!, LAE!); **Gulf Province:** Purari Delta, 32.5 km E of Baimuru, 0 m, 7°29'S, 145°6'E, 24 March 1974, *Croft LAE 61091* (BH, L!, LAE!); Baimuru Subdistr., Purari R., delta area 32.5 km east of Baimuru, 0 m, 7°31'S, 145°7'E, 24 March 1974, *Croft LAE 61085* (LAE!); Baimuru Subdistr., Vailala R., 70 km at 110 degrees from Baimuru, 50 km at 318 degrees from Kerema, 50 m, 7°38'S, 145°28'E, 4 April 1974, *Croft LAE 61279* (BH, LAE!); **Milne Bay Province:** Raba Raba Subdistr., Junction Ugat and Mayu Rivers, near Mayu, 350 m, 9°37'S, 149°10'E, 30 June 1972, *Streimann NGF 28658* (LAE!); Same locality as preceding, 350 m, 9°37'S, 149°10'E, 13 July 1972, *Streimann NGF 28835* (BH, BRI, L!, LAE!); Maiyu R., E of Mt. Suckling, 450 m, 9°40'S, 149°10'E, 14 June 1972, *Pullen 8296* (BH, CANB!, L!, LAE!); N slopes of Mt. Dayman, Maneau Range, 700 m, 9°41'S, 149°17'E, 15 July 1953, *Brass 23422* (A!); Raba Raba Subdistr., Mayu camp site I, Mt. Suckling, 400 m, 9°37'S, 149°10'E, 9 June 1972, *Leach NGF 33288* (BH, LAE!); **Morobe Province:** Sattelberg, *Lauterbach 564* (B†, FI!); Sattelberg, 6°29'S, 147°47'E, 17 September 1935, *Clemens 135* (L!); same locality as preceding, 6°29'S, 147°47'E, 13 January 1936, *Clemens 1623* (L!); same locality as preceding, 6°29'S, 147°47'E, June 1936, *Clemens 298* (L!); Kwaimengu, Aseki patrol area, 1150 m, 7°21'S, 146°12'E, 23 April 1966, *Craven 1424* (CANB!, L!, LAE!); Kumbok Mt, N of Busu R., 300 m, 6°33'S, 146°59'E, 26 January 1993, *Takeuchi 8691* (A!, L!, F); Same locality as preceding, 400 m, 6°33'S, 146°49'E, 20 January 1993, *Takeuchi 8680* (A!); Between Gobadik and Gawam, 350 m, 6°33'S, 146°59'E, 5 February 1993, *Takeuchi 8743* (A!); Lae Subdistr., along Mo R., a few miles SW of Ana village, 50 m, 7°49'S, 147°32'E, 29 Jan 1972, *Essig LAE 55167* (BH, LAE!); Lae Subdistr., along small stream, ca. 1/2 mile NW of Ana Village, 50 m, 7°48'S, 147°33'E, 27 January 1972, *Essig LAE 55155* (BH, LAE!); Menyamyia Subdistr., 2 miles SE of Aseki Patrol Post on Aseki-Koki Rd, 1200 m, 7°20'S, 146°14'E, 9 January 1972, *Essig LAE 55140* (BH, LAE!); Huon Peninsula, Masba Creek area, ca. 3 miles S of Pindiu, 600 m, 6°27'S, 147°31'E, 22 May 1964, *Hoogland 9030* (CANB!); Lae Distr., Lae Botanic Garden, 0 m, 6°45'S, 147°0'E, 29 April 1974, *Katik NGF 38000* (LAE!); Lae Subprovince, Lae Botanical Garden, 0 m, 6°45'S, 147°0'E, 9 April 1978, *Young LAE 74011* (BH, LAE!); Mumeng, Gurakor, along Bulolo Road, 450 m, 6°45'S, 147°0'E, 15 September 1971, *Essig LAE 55005* (BH, LAE!); **Oro Province:** Managalase area, Near Pongani Falls SE of Sila, 600 m, 9°5'S, 148°23'E, 21 August 1964, *Pullen 5767* (CANB!); **Sandaun Province:** Wutung Subprovince, Oenake Range, foothills of Mt. Bougainville, 550 m, 2°37'S, 141°0'E, 7 September 1982, *Kerenga LAE 56427* (L!, LAE!); Telefomin, Delongkim Creek, Old village site on bank of Delongkim Creek near junction with Hak River, 750 m, 5°8'S, 141°35'E, 16 October 1993, *Morren 3059* (K!); Telefomin Subprovince, Carpentaria Exploration Company, Frieda R. Camp, 50 m, 4°40'S, 139°55'E, 26 April 1978, *Essig LAE 74050* (BH, LAE!); **Southern Highlands Province:** Lake Kutubu, side of Mendi track, 6°9'S, 143°39'E, 23 May 1956, *Gray NGF 8135* (A, BRI!, LAE!); Mount Bosavi, Kolok, near Bona Village, WWF Integrated Conservation and Development Project Area, 700 m, 6°26'S, 142°47'E, 2 February 1996, *Baker et al. WJB 616* (BH, K!, LAE!); near Waro airstrip, 20 km SSW of Kutubu, 500 m, 6°31'S, 143°10'E, 15 October 1973, *Jacobs s.n.* (L!); Lake Kutubu, Wanunuku, near to Tugiri, WWF Integrated Conservation and Development Project Area, 900 m, 6°21'S, 143°13'E, 12 February 1996, *Baker et al. 665* (BH, K!, LAE!); Waro and Ubogo Villages, Kutubu dist., 450 m, 6°32'S, 143°12'E, 14 September 1993, *Takeuchi 9242* (A, LAE!); Mt. Bosavi, Northern side, 1000 m, 6°26'S, 142°50'E, 23 October 1973, *Jacobs 9405* (L!, LAE!); **Unknown Province:** Mt. Belford, 1100 m, *Armit s.n.* (MEL!); San Giuseppe, 10 November 1892, *Loria s.n.* (FI!); **Western Highlands Province:** Kopiago Subdistr., Batane, off Tari Rd, 9 miles from Kopiago, 1350 m, 5°22'S, 142°33'E, 30 October 1968, *Womersley NGF 37233* (LAE!); **Western Province:** Palmer R., 2 miles below junction with Black R., 5°47'S, 141°42'E, July 1936, *Brass 7201* (A!, BRI); North Fly Distr., Junction of Harvey Creek and Ok Mani R., 10

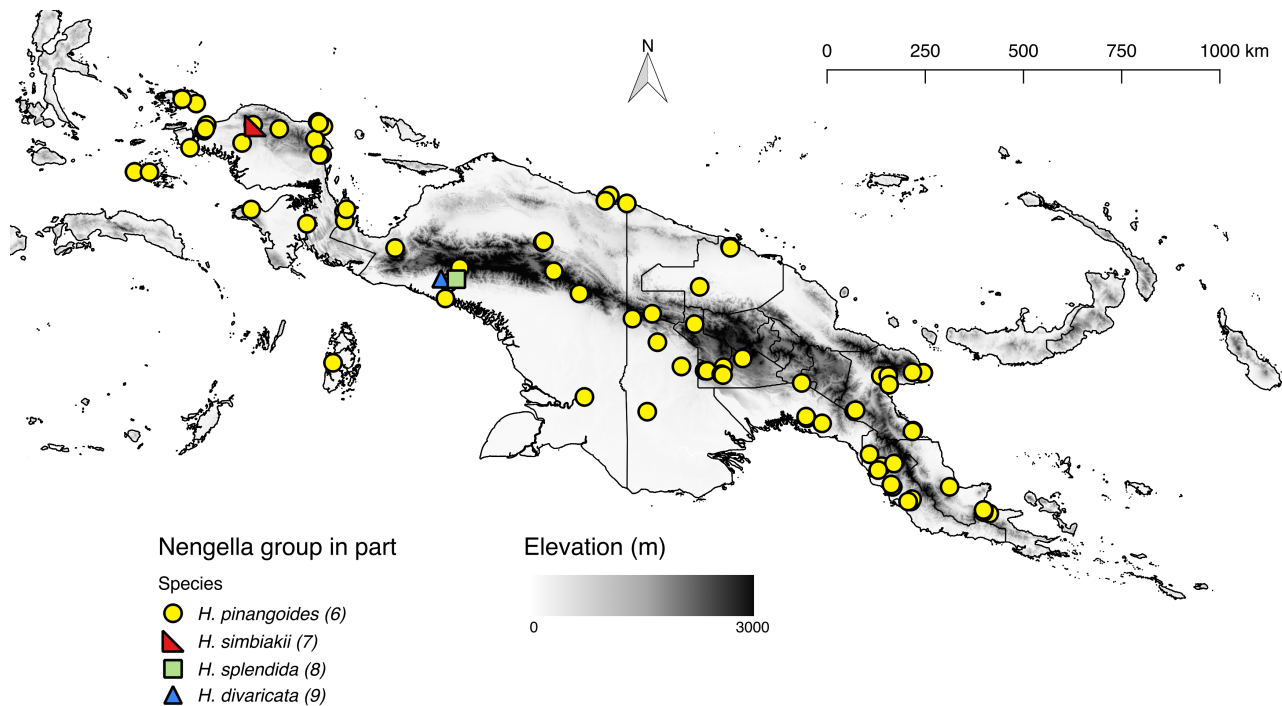


FIGURE 14. Distribution map of part of the species of the Nengella group of *Hydriastele*.

km WNW of Tabubil, 750 m, 5°14'S, 141°8'E, 14 December 2000, *Baker et al. 1137* (K!, LAE); Kiunga, Fly River (Bulge), 200 m, 7°2'S, 140°2'E, 28 March 1968, *Millar NGF 35430* (A, BH, BO, BRI, CANB, K!, L!, LAE!, NSW); Nomad Subprovince, across R., 2 km from Nomad, 6°20'S, 142°15'E, 18 April 1978, *Essig LAE 74029* (BH, LAE!); Same locality as preceding, 152 m, 6°20'S, 142°15'E, 18 April 1978, *Essig LAE 74028* (BH, LAE!); Kiunga, 50 km NE of Ningerum, 650 m, 7°22'S, 141°28'E, *HYN 212* (LAE!). CULTIVATED. INDONESIA. **West Java Province:** Bogor Botanic Gardens ex New Guinea, X D 114 (FI!). UNITED STATES. **Hawaiian Islands:** Kauai, 20 August 2002, *Chapin 80* (K!, PTBG).

Notes:—*Hydriastele pinangoides* is a common, slender understorey to midstorey palm. It is distinguished by its leaves, which typically have 5–10 broadly cuneate leaflets on each side of the rachis arranged in 2 or 3 distinct groups, in combination with 18–30 cm long inflorescences (rarely as short as 13 cm) comprising 2–6 rachillae, and ruminant endosperm. Rarely, the leaflets can be more-or-less regularly arranged and narrowly cuneate prompting comparison with *Hydriastele divaricata* and *H. simbiakii*, but *H. divaricata* has divaricate leaflets and inflorescences with 1–2 rachillae, while *H. simbiakii* has flexible, usually leaning stems and 14–16 leaflets on each side of the rachis. *Hydriastele pinangoides* can be confused with some pinnate leaved forms of *H. flabellata* although this species has a shorter inflorescence (up to 15 cm long), spicate or with 2 rachillae (up to 3 rachillae is known from cultivation), and homogeneous endosperm.

Heatubun *et al.* (2018) discuss the morphology and delimitation of *H. pinangoides* in more detail.

7. *Hydriastele simbiakii* Heatubun, Petoe & W.J. Baker (2018: 18). Type:—INDONESIA. West Papua Province: Tambrau Regency, Fef Distr., Sungai Sujak (Sungai Eyei), river bank near bridge, 400 m, 0°50'S, 132°30'E, 23 January 2013, *Baker et al. 1365* (holotype K!, isotypes AAU!, BO!, L!, MAN!)

Figure 15 (line drawing). Figure 16 (photo plate). Figure 14 (map).

Clustering, very slender rheophytic palm forming clumps of often numerous stems, to 5–6 m tall, bearing ca. 6–7 leaves per crown. **Stem** 1.5–2.5 cm in diam., pliable, shorter stems erect, longer stems leaning over river. **Leaf** 64–104 cm long including petiole; sheath 26–36 cm long; petiole 12–25 cm long; leaflets 14–16 per side, regularly arranged, single- or multi-fold, linear, praemorse apically. **Inflorescence** 13–17 cm long including 1.5–3 cm peduncle, branched to 1 order, protandrous; rachillae 3–4, scarlet; triads spirally arranged. **Staminate flower** 10–11 × 5–6 mm at anthesis, pink; stamens 6. **Pistillate flower** 4–5.5 × 2–3 mm post-anthesis, white with pinkish tinge, with free sepals and free

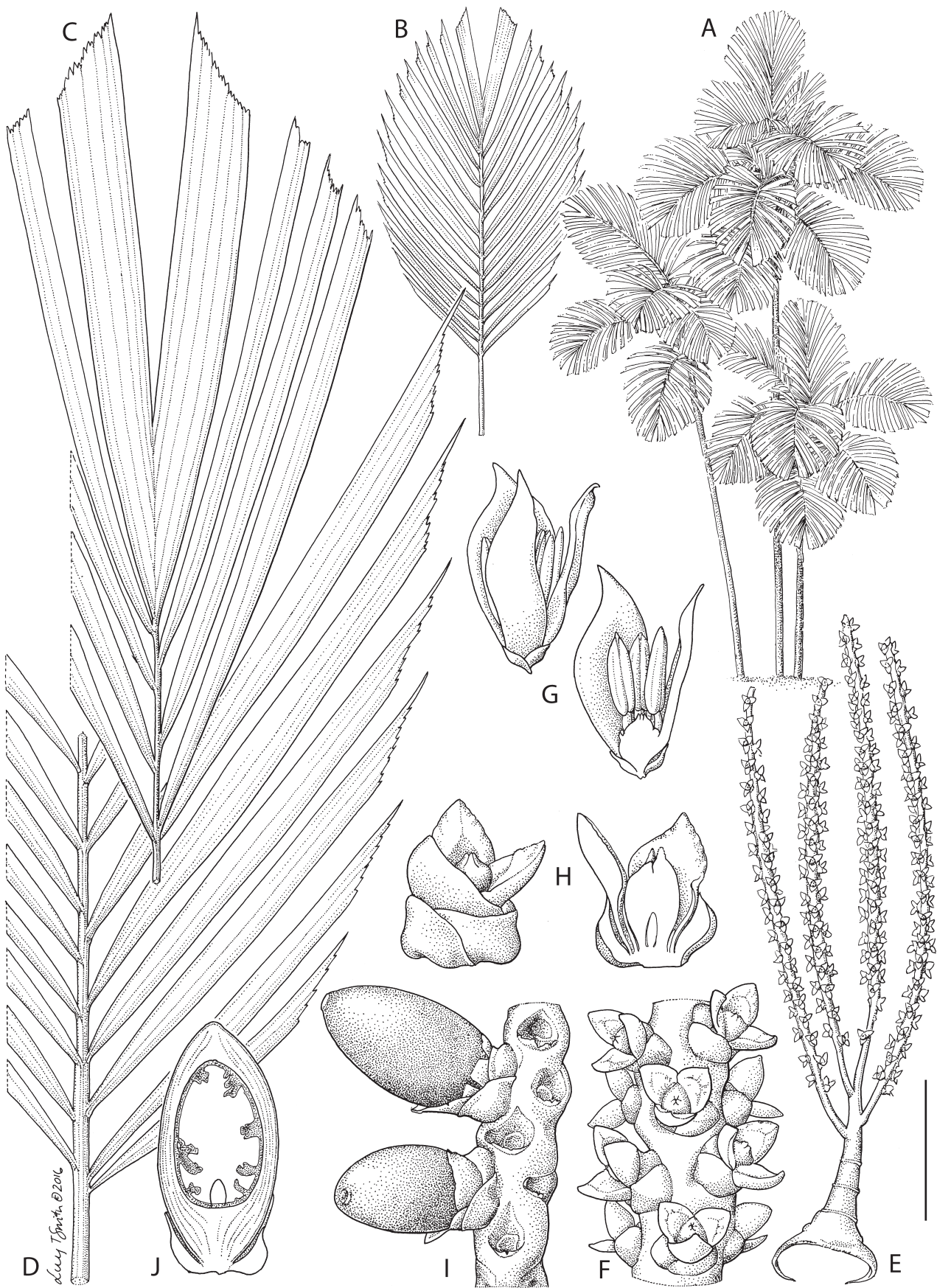


FIGURE 15. *Hydrastele simbiakii*. A. Habit. B. Leaf diagram. C. Leaf apex. D. Leaf base. E. Inflorescence with pistillate flowers. F. Portion of rachilla with pistillate flowers. G. Staminate flower whole and in longitudinal section. H. Pistillate flower whole and in longitudinal section. I. Portion of rachilla with fruit. J. Fruit in longitudinal section. Scale bar A = 60 cm; B = 24 cm; C–D = 6 cm; E = 4 cm; F–G, I = 8 mm; H = 4 mm; J = 7 mm. All from Baker *et al.* 1365. Drawn by Lucy T. Smith.



FIGURE 16. *Hydiastele simbiakii*. A. Habit. B. Inflorescences with pistillate flowers (left) and complete triads (right). C. Portions of rachillae with pistillate flowers. All from *Baker et al. 1365*. All photos: W.J. Baker.

petals with conspicuous, triangular tips. **Fruit** 8–12 × 4–5 mm when ripe, ellipsoid, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam.). **Seed** 7–8 × 4 mm, ellipsoid; endosperm ruminant.

Distribution:—Known only from the type locality in the Tamrau Mountains of the Bird's Head Peninsula in western New Guinea.

Habitat:—Steep, rocky river margin in the flood zone ca. 1–2 m above fast flowing water, 400 m.

Uses:—Stems used for making spears.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **West Papua Province:** Tambrau Regency, Fef Distr., Sungai Sujak (Sungai Eyei), river bank near bridge, 400 m, 0°50'S, 132°30'E, 23 January 2013, *Baker et al.* 1365 (AAU!, BO!, K!, L!, MAN!).

Notes:—*Hydriastele simbiakii* is one of two strictly rheophytic species known from the genus *Hydriastele*, the other being *H. rheophytica* from the Wendlandiana group. *Hydriastele simbiakii* forms distinctive clumps of pliable stems, the taller ones becoming leaning and is further distinguished by displaying 14–16 regularly arranged, linear leaflets on each side of the rachis, and ruminant endosperm. *Hydriastele simbiakii* is most easily confused with rare forms of *H. pinangoides* displaying regularly pinnate leaves and similar inflorescences, but *H. simbiakii* is distinguished from these forms by its ecological preference and leaves with more numerous leaflets. *Hydriastele simbiakii* is described in more detail by Heatubun *et al.* (2018).

8. *Hydriastele splendida* Heatubun, Petoe & W.J. Baker (2018: 18). Type:—INDONESIA. Papua Province: Mimika Regency (Previously Fakfak Regency), Timika, PT. Freeport Indonesia Area of Work, Km 63 road to Tembagapura, 435 m, 4°21'S, 136°58'E, 7 February 1998, *Baker et al.* 820 (holotype K!, isotypes AAU!, BH!, BO!, L!, MAN!)

Figure 17 (line drawing). Figure 18 (photo plate). Figure 14 (map).

Solitary or clustering, slender understorey palm to 4 m tall, bearing ca. 4–5 leaves per crown. **Stem** 1.5–2 cm in diam. **Leaf** ca. 100 cm long including petiole; sheath ca. 30 cm long; petiole ca. 20 cm long; lamina ca. 80 × 40 cm, entire-bifid, obovate, distal half of margin rounded and praemorse. **Inflorescence** ca. 18 cm long including ca. 2 cm peduncle, branched to 1 order, protandrous; rachillae 3–4 per inflorescence (as many as 6 known from cultivation), scarlet; triads spirally arranged. **Staminate flower** not seen. **Pistillate flower** ca. 4–5 × 3 mm post-anthesis (when dry), crimson, with free sepals and free petals with conspicuous, triangular tips. **Fruit** ca. 1 cm long when ripe, cylindrical, pink, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam. when dry). **Seed** ca. 7 × 1.5 mm (when dry), turbinate; endosperm ruminant.

Distribution:—Known only from the lower slopes of the Mt. Jaya region (Dransfield *et al.* 2000) in Papua Province, western New Guinea.

Habitat:—Heath forest on outwashed sands and gravels on steep and mossy slopes with many fallen trees (Dransfield *et al.* 2000), 435 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **Papua Province:** Mimika Regency (Previously Fakfak Regency), Timika, PT. Freeport Indonesia Area of Work, Km 63 road to Tembagapura, 435 m, 4°21'S, 136°58'E, 7 February 1998, *Baker et al.* 820 (AAU!, BH!, BO!, K!, L!, MAN!). **CULTIVATED.** UNITED STATES. **Hawaiian Islands:** Hawai'i, Floribunda Palms, November 2017, *Baker et al.* 1443 (K!).

Notes:—*Hydriastele splendida* is a slender understorey palm, immediately recognisable on account of its entire-bifid leaves in combination with inflorescences comprising 3–4 rachillae and ruminant endosperm. The species is similar to *H. pinangoides* in habit and reproductive morphology, but is easily distinguished from this by its entire leaves. *Hydriastele splendida* is more readily confused with entire-leaved forms of *H. flabellata*, but *H. flabellata* differs in its inflorescences with one (spicate) or two rachillae (three rachillae known from cultivation) and homogeneous endosperm.

Hydriastele splendida appears to be already well established in cultivation, often erroneously named *H. flabellata*. The species is described in greater detail by Heatubun *et al.* (2018).

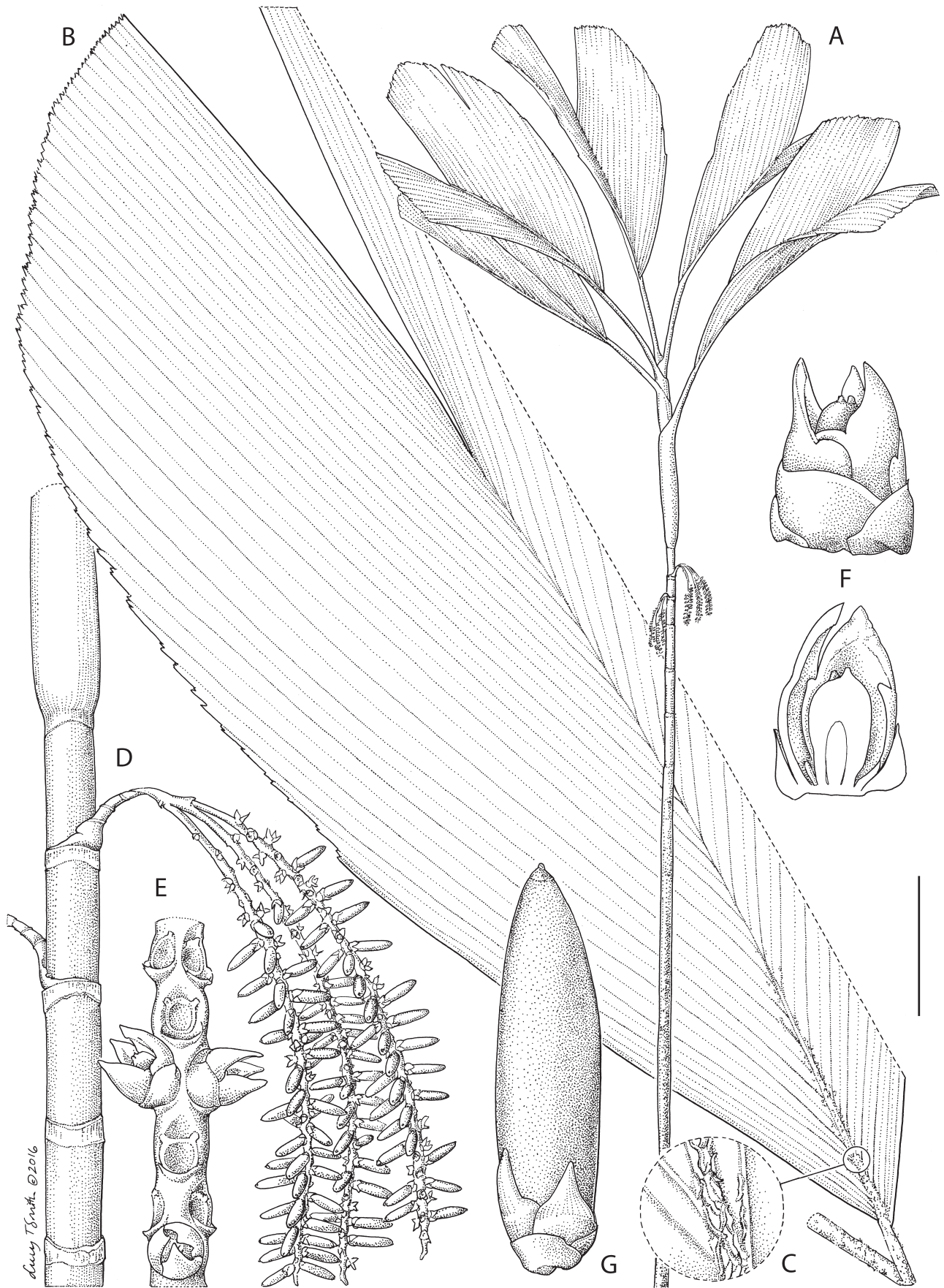


FIGURE 17. *Hydiastele splendida*. A. Habit. B. Leaf. C. Detail of leaf indumentum. D. Portion of stem with infructescence. E. Portion of rachilla with pistillate flowers. F. Pistillate flower whole and in longitudinal section. G. Fruit. Scale bar A = 40 cm; B = 8 cm; C = 1.5 cm; D = 4 cm; E = 7 mm; F = 3.3 mm; G = 5 mm. All from *Baker et al.* 820. Drawn by Lucy T. Smith.



FIGURE 18. *Hydrastele splendida*. A–B. Habit. C. Portions of rachillae with pistillate flowers. D. Infructescence. A from *Baker et al.* 820; B–D from *Baker et al.* 1443 (cultivated specimen). All photos: W.J. Baker.

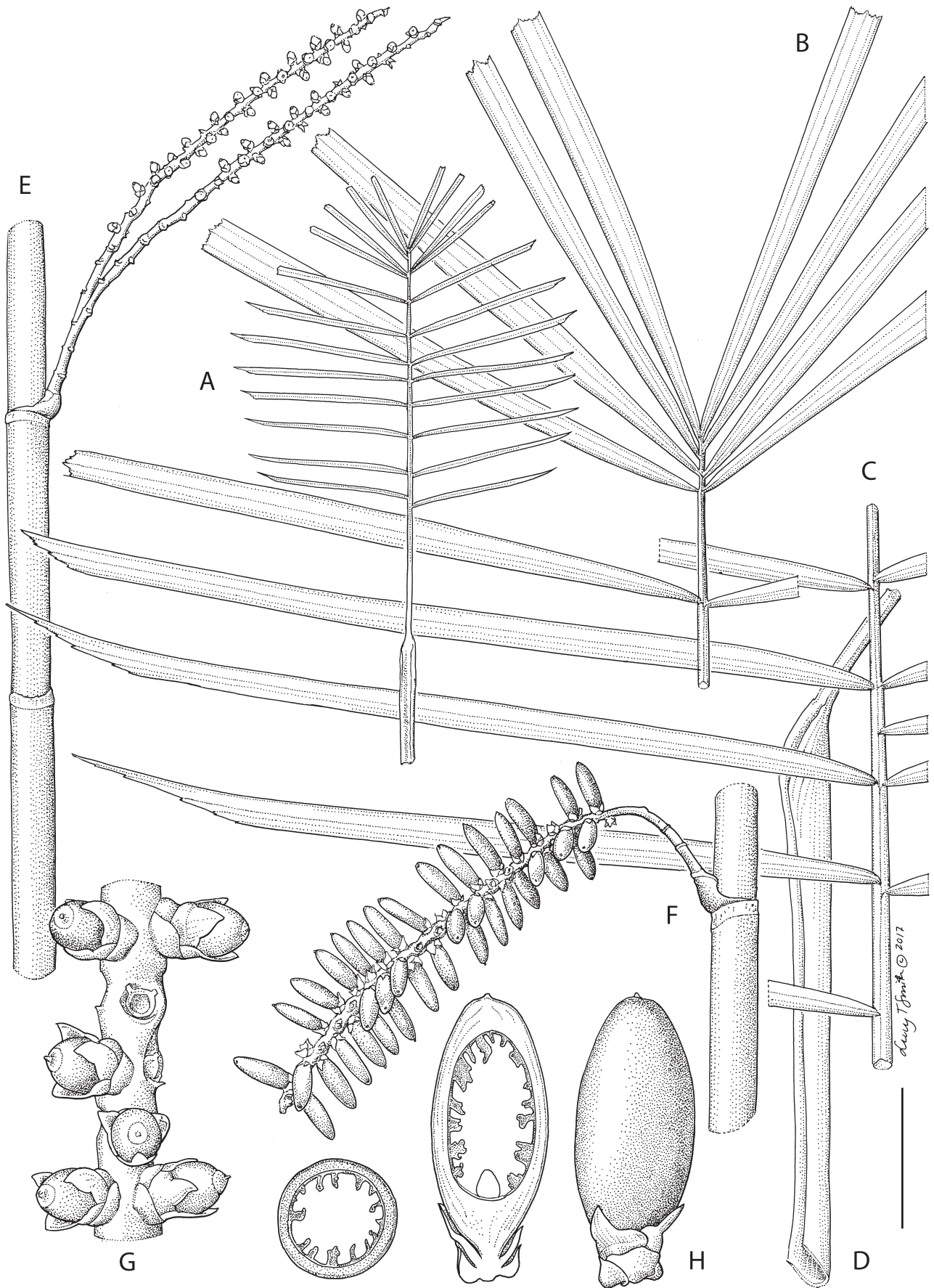


FIGURE 19. *Hydiastele divaricata*. A. Leaf diagram. B. Leaf apex. C. Mid-leaf portion. D. Leaf base on sheath. E. Inflorescence with pistillate flowers. F. Infructescence. G. Portion of rachilla with immature fruit. H. Fruit whole, in longitudinal section, and in transverse section. Scale bar: A = 30 cm; B–D = 6 cm; E–F = 3 cm; G–H = 7 cm. All from Baker *et al.* 876. Drawn by Lucy T. Smith.



FIGURE 20. *Hydiastele divaricata*. Habit. From Nong Nooch Tropical Botanical Garden (cultivated specimen). Photo: Scott Zona. Figure 19 (line drawing). Figure 20 (photo plate). Figure 14 (map).

9. *Hydriastele divaricata* Heatubun, Petoe & W.J. Baker (2018: 18). Type:—INDONESIA. Papua Province: Mimika Regency (Previously Fakfak Regency), Timika, PT. Freeport Indonesia Area of Work, Mile 39, 100 m, 4°20'S, 136°58'E, 23 February 1998, *Baker et al.* 876 (holotype K!, isotypes BH!, BO!, L!, MAN!)

Clustering, very slender understorey palm forming clumps of ca. 5 stems, to 4.5 m tall. **Stem** ca. 9–17 mm in diam. **Leaf** ca. 80 cm long including petiole; sheath ca. 25 cm long; petiole ca. 27–30 cm long; leaflets 8–12 per side, irregularly to subregularly arranged, divaricate in the basal and middle portion of the leaf, single- or bi-fold, narrowly linear, praemorse apically. **Inflorescence** 10–12 cm long including 2–2.5 cm peduncle, spicate or branched to 1 order, protandrous; rachillae 1–2; triads spirally arranged. **Staminate flower** not seen. **Pistillate flower** 4–4.5 × 3–3.3 mm at early fruiting stage, with free sepals and free petals with conspicuous, triangular tips. **Fruit** ca. 12 × 3 mm when ripe, cylindrical, pale green to pinkish, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam.). **Seed** ca. 8 × 2 mm, elongate to cylindrical; endosperm shallowly ruminant.

Distribution:—Known only from the type locality on the lower slopes of the Mt. Jaya region (Dransfield *et al.* 2000) near to Timika in Papua Province, western New Guinea.

Habitat:—The transition zone between lowland alluvial rain forest and heath forest, 100 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **Papua Province:** Mimika Regency (Previously Fakfak Regency), Timika, PT. Freeport Indonesia Area of Work, Mile 39, 100 m, 4°20'S, 136°58'E, 23 February 1998, *Baker et al.* 876 (BH!, BO!, K!, L!, MAN!).

Notes:—*Hydriastele divaricata* is a very slender understorey palm distinguished by its narrowly linear leaflets, which are widely spreading (divaricate) in the basal and middle section of the leaf. The limited available material displays inflorescences consisting of just one (spicate) or two rachillae, prompting comparison with *H. flabellata* and *H. montana*, but these two species have homogeneous endosperm whereas *H. divaricata* has ruminant endosperm. *Hydriastele divaricata* is described in more detail by Heatubun *et al.* (2018).

10. *Hydriastele flabellata* (Becc.) Baker & Loo (2004: 64). *Nengella flabellata* Beccari (1877: 34). *Gronophyllum flabellatum* (Becc.) Essig & Young (1985: 134). Type:—INDONESIA. West Papua Province: Sorong, Ramoi, 0°57'S, 131°20'E, 1872, *Beccari* 427 (holotype FI!)

Nengella calophylla var. *montana* Beccari (1914: 27). *Nengella pleurocarpa* Burret (1936c: 314). *Gronophyllum pleurocarpum* (Burret) Essig & Young (1985: 136). *Hydriastele pleurocarpa* (Burret) Baker & Loo (2004: 67). Type:—PAPUA NEW GUINEA. Madang Province: 12 July 1907, *Schlechter* 16251 (holotype B†, isotype FI!).

Nengella calophylla var. *rhopalocarpa* Beccari (1914: 28). *Nengella rhopalocarpa* (Becc.) Burret (1936c: 314). *Gronophyllum rhopalocarpum* (Becc.) Essig & Young (1985: 136). *Hydriastele rhopalocarpa* (Becc.) Baker & Loo (2004: 67). Type:—PAPUA NEW GUINEA. Morobe Province: Waria River, 7°58'S, 147°28'E, 13 March 1908, *Schlechter* 17466 (holotype B†, isotypes FI!, K!).

Nengella gracilis Burret (1939: 206). *Gronophyllum gracile* (Burret) Essig & Young (1985: 134). *Hydriastele gracilis* (Burret) Baker & Loo (2004: 65). Type:—PAPUA NEW GUINEA. Western Province: Palmer River, 2 min. below junction Black River, 100 m, 5°47'S, 141°42'E, June 1936, *Brass* 7083 (holotype A!).

Gronophyllum cariosum Dowe & Ferrero (2000a: 161). *Hydriastele cariosa* (Dowe & M.D.Ferrero) Baker & Loo (2004: 63). Type:—PAPUA NEW GUINEA. Sandaun Province: Bewani Mts., Nuli River, 120 m, 3°58'S, 141°10'E, 12 February 1998, *Dowe* 514 (holotype BRI).

Figure 21 (line drawing). Figure 22 (photo plate). Figure 23 (map).

Clustering, very slender understorey palm to 4 m tall, bearing 4–8 leaves per crown. **Stem** 1–2 cm in diam. **Leaf** 35–90 cm long including petiole; sheath 8–23 cm long; petiole 10–30 cm; lamina 20–65 cm long, entire-bifid, bijugate or more finely dissected with up to 6 leaflets per side, ramenta apparently lacking; leaflets (when present) regularly or irregularly arranged, single- or multi-fold, cuneate, praemorse apically. **Inflorescence** 8–15 cm long including 1–3 cm peduncle, spicate or branched to 1 order, protandrous; rachillae 1–2 (up to 3 rachillae known from cultivation), green to yellow; triads spirally arranged. **Staminate flower** 8–10 × 2–3 mm in bud, cream to violet; stamens 6. **Pistillate flower** 3–5 × 2–3.5 mm in bud, cream to light green or lavender, with free sepals and free petals with conspicuous,



FIGURE 21. *Hydriastele flabellata*. A. Habit. B. Portion of crown. C, D, E, F. Leaf diagrams. G. Prophyll. H. Inflorescence with triads. I. Portion of rachilla with triads. J. Staminate flower in longitudinal section. K. Pistillate flower in longitudinal section. L. Fruit whole, in longitudinal section, and in transverse section. Scale bar: A = 20 cm; B = 6 cm; C–F = 18 cm; G–H = 2 cm; I = 5 mm; J = 4 mm; K = 3 mm; L = 7 mm. A–C, G–K from Baker *et al.* 879; D from Schlechter 17466; E–F from Baker *et al.* 643; L from Heatubun 406. Drawn by Lucy T. Smith.



FIGURE 22. *Hydiastele flabellata*. A–B. Habit. C. Inflorescence with triads. D. Infructescences. A, C from *Baker et al. 879*; B from *Baker et al. 1448* (cultivated specimen); D from Timika, western New Guinea. All photos: W.J. Baker.

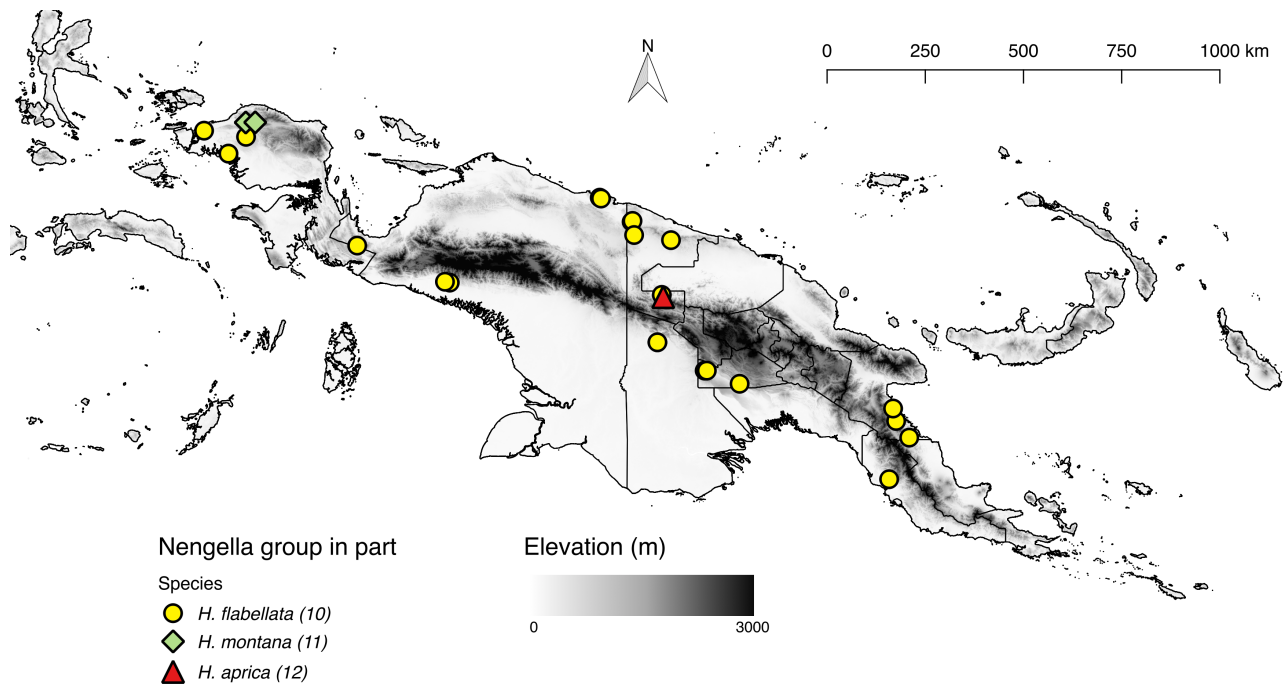


FIGURE 23. Distribution map of part of the species of the Nengella group of *Hydriastele*.

triangular and valvate tips. **Fruit** 12–15 × 5–8 mm when ripe, ellipsoid to fusiform, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 1.5 mm in diam.). **Seed** 10–12 × 4–7 mm, ellipsoid; endosperm homogeneous.

Distribution:—Scattered across New Guinea from the Bird’s Head Peninsula in western New Guinea to Central Province in Papua New Guinea.

Habitat:—Primary rainforest, mainly lowland, on slopes, ridges and riverbanks. On waterlogged alluvium, limestone karst and volcanic soils, 0–700 m.

Uses:—Leaves used as food wrapping, stems used for making arrow shafts and fish spear handles.

Vernacular names:—*Mplemonik* (Sayal), *Filiawoi Yamu* (Bewani).

Conservation status:—Least Concern (LC; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **West Papua Province:** Sorong, Ramoi, 0°57’S, 131°20’E, 1872, *Beccari* 427 (FI!); Sorong Selatan Regency, Sayal, Maampow Forest, 10 m, 1°28’S, 131°53’E, 21 February 2013, *Heatubun* 406 (K (spirit)!, MAN!); same locality as preceding, 10 m, 1°28’S, 131°53’E, 21 February 2013, *Heatubun* 426 (K (spirit)!, MAN!); Kaimana Regency, Teluk Etna, Waribun, Km-27 road to Kaltim Utama, 100 m, 31 January 2001, *Heatubun* 329 (K!, MAN!); Surroundings of Ayawasi, 450 m, 1°5’S, 132°17’E, 16 January 1996, *Polak* 1000 (BO, L!); **Papua Province:** Maribu village, Cyclops Mts. Nature Reserve, 850 m, 2°29’S, 140°23’E, 21 September 1998, *Maturbongs* 576 (BO, K!, MAN,); Mimika Regency, Timika, Kali Kopi, 95 m, 4°26’S, 136°57’E, 24 February 1998, *Baker et al.* 879 (BO!, K!, MAN!); Kuala Kencana, 50 m, 4°25’S, 136°51’E, 19 February 1998, *Witono* 23 (BH, BO!, K!, MAN!); Jayapura, Cyclops Mts., path to Ormu, 700 m, 2°26’S, 140°37’E, 18 August 1998, *Heatubun* 285 (BO, FTG, K!, L, MAN). PAPUA NEW GUINEA. **Central Province:** Aroa R., 8°55’S, 147°0’E, 29 July 1898, *Armit s.n.* (MEL!); **Morobe Province:** Morobe Subprovince, Mayama village, 100 m, 7°35’S, 147°10’E, 17 June 1981, *Katik LAE* 74935 (BRI, L!, LAE, NSW, USF); Kamiali Wildlife Management Area, ridge to Blue Mt, near starting point of the Nembehah PABITRA plot, 650 m, 7°17’S, 147°5’E, 28 February 2005, *Takeuchi* 18982 (K!, LAE); Waria R., 7°58’S, 147°28’E, 13 March 1908, *Schlechter* 17466 (B†, FI!, K!); **Madang Province:** 12 July 1907, *Schlechter* 16251 (B†, FI!); **Sandaun Province:** Roundhouse village, 200–250 m, 3°2’S, 141°7’E, 27 November 1996, *Barfod* 413 (AAU!, LAE); Bewani, 0 m, 3°1’S, 141°8’E, 19 March 2000, *Barfod* 499 (AAU!, K!, LAE); Lumi Subdistr., Karataiem, off road between Lumi Govt. Station and Karataiem Catholic Mission, 3°27’S, 142°1’E, January 1974, *Frodin s.n.* (K!, UPNG); Telefomin Subdistr., Prospect Creek near Frieda R., 500 m, 4°42’S, 141°48’E, 23 June 1969, *Henty NGF* 42555 (BH, LAE!); Amanab Subdistr., Imonda, along road to Bapi R., 300 m, 3°20’S, 141°10’E, 25 November 1971,

Essig LAE 55094 (BH, CANB!, LAE!); **Southern Highlands Province:** Kutubu patrol area, Waro, 500–600 m, 3 August 1991, *Takeuchi 7284* (A!, LAE); same locality as preceding, 500–600 m, 3 August 1991, *Takeuchi 7312* (A!, LAE); Kantobo, 470 m, 6°44'S, 143°35'E, 9 February 1996, *Baker et al. 643* (K!, LAE!); Mt. Bosavi, Wasaso, Bona village, 700 m, 6°26'S, 142°47'E, 2 February 1996, *Baker et al. 611* (BH, FTG, K!, LAE); Mt. Bosavi, northern side, 900 m, 6°26'S, 142°50'E, 26 October 1973, *Jacobs 9470* (L!, LAE); **Western Province:** Palmer R., 2 min. below junction Black R., 100 m, 5°47'S, 141°42'E, June 1936, *Brass 7083* (A!); Same locality as preceding, 100 m, 5°47'S, 141°42'E, June 1936, *Brass 7368* (A!). CULTIVATED. UNITED STATES. **Hawaiian Islands:** Hawai'i, Floribunda Palms, November 2017, *Baker et al. 1448* (K!).

Notes:—*Hydriastele flabellata* is an understorey palm with a distinctive, highly variable leaf morphology ranging from entire-bifid to pinnate with up to six cuneate leaflets on each side of the rachis. The species is further distinguished by its inflorescences, which are 8–15 cm long and consist of one (spicate) or two rachillae (up to three rachillae is known from cultivation [*Baker 1448*]), and homogeneous endosperm. *Hydriastele flabellata* might be confused with *H. montana*, which is similar in inflorescence morphology but has leaves with 9–11 narrowly linear leaflets on each side of the rachis, or with *H. pinangoides*, which can have similar looking foliage but is usually taller and displays 18–30 cm long inflorescences with 2–6 rachillae and ruminant endosperm.

Heatubun *et al.* (2018) discuss the morphology and delimitation of *H. flabellata* in more detail.

11. *Hydriastele montana* (Becc.) Baker & Loo (2004: 66). *Nengella montana* Beccari (1877: 33). *Kentia beccarii* Mueller (1880: 163), *nom. superfl.* & *nom. illeg.* *Gronophyllum montanum* (Becc.) Essig & Young (1985: 134). Type:—INDONESIA. West Papua Province: Tamrau Mts., Gunon [Gunung] Morait, 1300–1500 m, 0°45'S, 132°30'E, July 1875, *Beccari s.n.* (holotype FI!, isotype K!).

Figure 24 (line drawing). Figure 25 (photo plate). Figure 23 (map).

Clustering and gregarious understorey palm to 1.5 m tall, very slender, bearing 4–5 leaves per crown, forming suckers by vigorous rhizomatous growth. **Stem** 5–8 mm in diam. **Leaf** 25–50 cm long including petiole; sheath 10–15 cm long; petiole 3–8 cm long; leaflets ca. 9–11 per side, regularly arranged, single- or bi-fold, narrowly linear, praemorse or pointed apically, ramenta apparently lacking. **Inflorescence** 7–9 cm long including 1–1.5 cm peduncle, spicate, protandrous; spike yellowish to green; triads spirally arranged. **Staminate flower** 9–10 × 1.5–2.5 mm in bud; stamens 6. **Pistillate flower** 4–4.5 × 3–3.5 mm in bud, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** ca. 12–19 × 4 mm when ripe (when dry), fusiform, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam.). **Seed** ca. 12–14 × 3 mm (when dry), elongate to turbinate; endosperm homogenous.

Distribution:—The Tamrau Mountains of the Bird's Head Peninsula, western New Guinea.

Habitat:—Premontane rainforest on ridges and slopes, 950–1300(–1500) m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD; Heatubun *et al.* 2018).

Specimens examined:—INDONESIA. **West Papua Province:** Kabupaten Tambrauw, Gunon [Gunung] Morait, 1300–1500 m, 0°45'S, 132°30'E, July 1875, *Beccari s.n.* (FI!, K!); Kabupaten Tambrauw, Bamusbama distr., road to Fef, 950 m, 0°46'S, 132°16'E, 28 January 2013, *Baker et al. 1380* (AAU!, BO!, K!, L!, MAN!); Locality info lacking, recently collected, *Iwanggin 132* (MAN, K!).

Notes:—*Hydriastele montana* is a slender understorey palm with a gregarious habit, resulting from the production of multiple running rhizomes. It is distinguished by its leaves with 9–11 narrowly linear leaflets on each side of the rachis in combination with a spicate inflorescence and homogeneous endosperm. *Hydriastele montana* is most similar to *H. divaricata* and *H. flabellata*, but the former species has leaves with irregularly to subregularly arranged, divaricate leaflets and ruminant endosperm while the latter displays an entire-bifid leaf lamina or the blade is pinnate with up to six cuneate leaflets on each side of the rachis. *Hydriastele montana* is described in more detail by Heatubun *et al.* (2018).



FIGURE 24 . *Hydrastele montana*. A. Stem basal portion with running rhizomes and roots. B. Leaf diagram. C. Apical and mid-leaf portion. D. Inflorescences with pistillate flowers. E. Portion of rachilla with pistillate flowers. F. Pistillate flower whole and in longitudinal section. Scale bar: A, C = 4 cm; B = 18 cm; D = 2 cm; E = 7 mm; F = 4 mm. All from *Baker et al. 1380*. Drawn by Lucy T. Smith.



FIGURE 25. *Hydiastele montana*. A–B. Habit. C. Inflorescence. A, C from Aifat, Bird’s Head Peninsula, western New Guinea; B from Baker *et al.* 1380. Photos A, C: C.D. Heatubun; B: W.J. Baker.

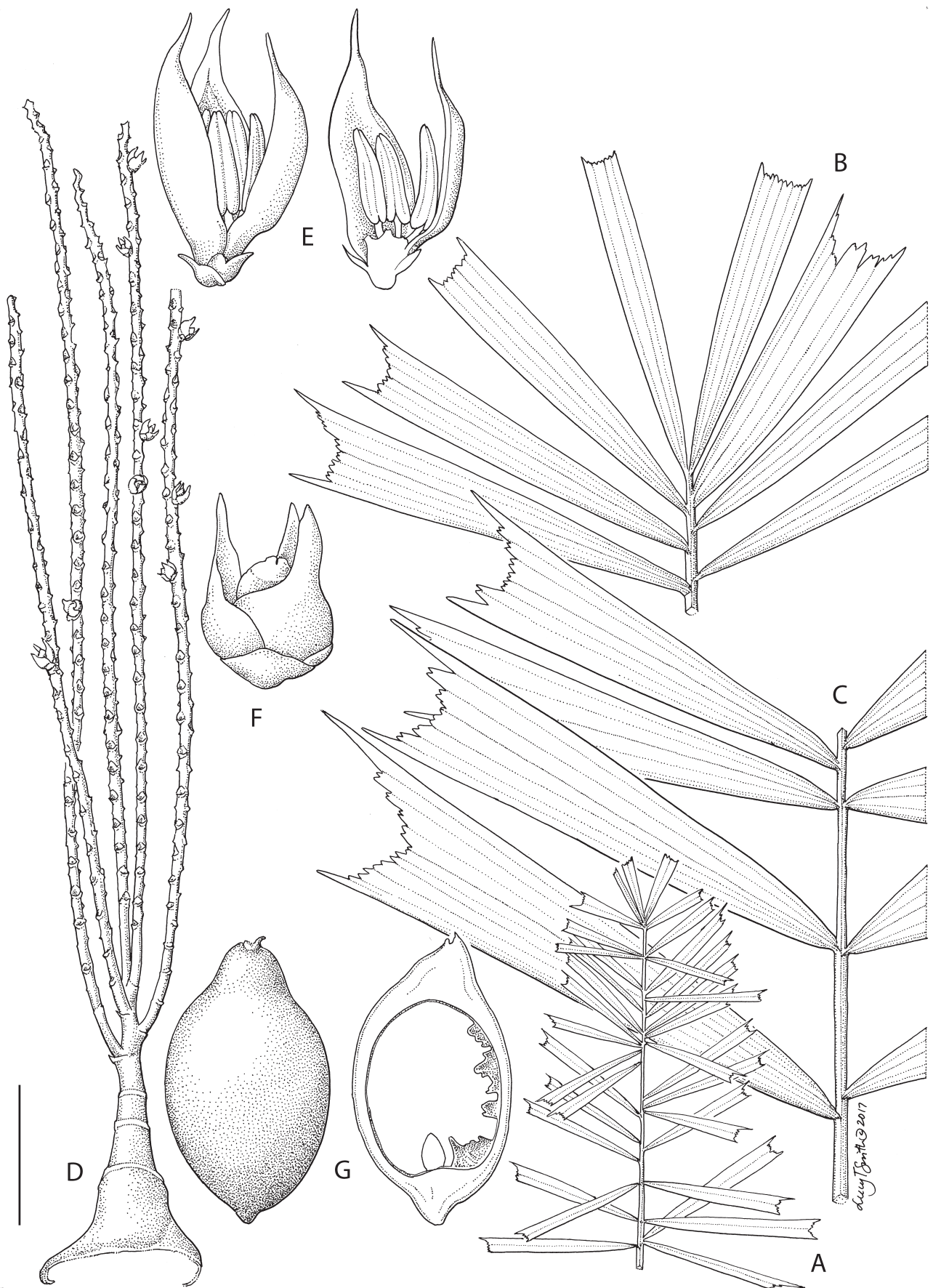


FIGURE 26. *Hydriastele aprica*. A. Leaf diagram. B. Leaf apex. C. Mid-leaf portion. D. Inflorescence with pistillate flowers. E. Staminate flower whole and in longitudinal section. F. Pistillate flower. G. Fruit whole and in longitudinal section. Scale bar: A = 18 cm; B–C = 4 cm; D = 3 cm; E–G = 4 mm. A, F–G from Essig & Young LAE 74049; B–E from Essig & Young LAE 74072. Drawn by Lucy T. Smith.

12. *Hydriastele aprica* (B.E. Young) Baker & Loo (2004: 62). *Gronophyllum apricum* Young (1985: 139). Type:—PAPUA NEW GUINEA. Sandaun Province: Telefomin Subprovince, rainforest below Carpentaria Exploration Co. helipad K-27 on exposed ridge, 900 m, 4°45'S, 141°50'E, 1 May 1978, *Essig & Young LAE 74082* (holotype LAE!, isotype BH)

Figure 26 (line drawing). Figure 23 (map).

Solitary, slender palm to 5 m tall, bearing ca. 7 leaves in crown. **Stem** ca. 3 cm in diam. **Leaf** 48–80 cm long including petiole; sheath 21–23 cm long; petiole 12–18 cm long; leaflets 15–23 per side, irregularly arranged, drooping, cuneate, concavely praemorse apically, with ramenta present on the abaxial side of the midrib. **Inflorescence** 15–26 cm long including 3.2–5.5 cm peduncle, branched to 1 order, protandrous; rachillae 4–6; triads opposite and decussate. **Staminate flower** 3–7 × 0.5–3 mm in bud (when dry), cream with purplish tips; stamens 6. **Pistillate flower** 1.5–7 × 1–2 mm in bud (when dry), dark purple, with free sepals and petals with long and thin, valvate tips. **Fruit** ca. 8 × 7 mm, subglobose, red, apical stigmatic remains not seen. **Seed** ca. 5 × 4 mm; endosperm homogeneous.

Distribution:—Northern central New Guinea.

Habitat:—Montane forest on sun-exposed limestone ridges, 300–1200 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD; Heatubun *et al.* 2018).

Specimens examined:—PAPUA NEW GUINEA. **Sandaun Province:** Telefomin Subprovince, on ridge above junction of “clear-water” stream with Frieda R., ca. 2 km upstream from Carpentaria Exploration Company airstrip camp, 300 m, 26 April 1978, *Essig & Young LAE 74049* (BH, LAE!, USF); Telefomin Subprovince, rainforest below Carpentaria Exploration Co. helipad K-27 on exposed ridge, 900 m, 4°45'S, 141°50'E, 1 May 1978, *Essig & Young LAE 74082* (BH, LAE!); on exposed ridge near Carpentaria Exploration Co. “Antap Mt” helipad, 1200 m, 4°45'S, 141°50'E, 29 April 1978, *Essig & Young LAE 74072* (BH, LAE!, USF).

Notes:—*Hydriastele aprica* is a highly distinctive, slender palm immediately recognisable on account of its drooping leaflets with concavely praemorse tips. The species is further distinguished by being the only member of the Nengella group with decussately arranged triads. We note that the habitat preference of this species is also unusual within the genus. More details are given by Young (1985) and Heatubun *et al.* (2018).

MICROCARPA GROUP

Moderately slender palms, inflorescences protandrous and branched to 2 orders, triads spirally arranged. The Moluccas and New Guinea.

13. *Hydriastele lurida* (Becc.) Baker & Loo (2004: 65). *Gronophyllum luridum* Beccari (1909: 207). Type:—INDONESIA. Papua Province: Noord-Rivier [Lorentz River], 6 July 1907, *Versteeg 1388* (holotype FI!, isotypes BO, KI, LI)

Gronophyllum brassii Burret (1939: 205). *Hydriastele brassii* (Burret) Baker & Loo (2004: 63). Type:—PAPUA NEW GUINEA. Western Province: Palmer R., June 1936, *Brass 7093* (holotype B†, isotypes A!, BRI, BO!, LI), *synon. nov.*

Figure 27 (line drawing). Figure 28 (photo plate). Figure 29 (map).

Solitary, moderately slender subcanopy palm to 25 m tall, bearing 8–12 leaves in crown. **Stem** (4.5–)6–10(–15) cm in diam. **Leaf** 1.3–2 m long including petiole; sheath 47–105 cm long, conspicuously fibrous at the sheath mouth; petiole 25–100 cm long; leaflets (21–)27–40 per side, arranged irregularly with one or more groups present, closely spaced and held in different planes, single- or multi-fold, linear to narrowly cuneate, truncately praemorse apically, brittle when dry. **Inflorescence** 42–70 cm long including 3–6 cm peduncle, branched to 2 orders, protandrous; rachillae (10–)15–27, yellowish; triads spirally arranged. **Staminate flower** 3–7 × 1–3 mm in bud; stamens 6(–7). **Pistillate flower** 1–4 × 1–3 mm in bud, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** 5–7 × 5–7 mm when ripe, globose, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3.5 mm in diam.). **Seed** 4–5 × 4–5 mm, globose; endosperm ruminant.

Distribution:—Known from various parts of western New Guinea, Gag Island and Biak Island, and from Western Province in Papua New Guinea.

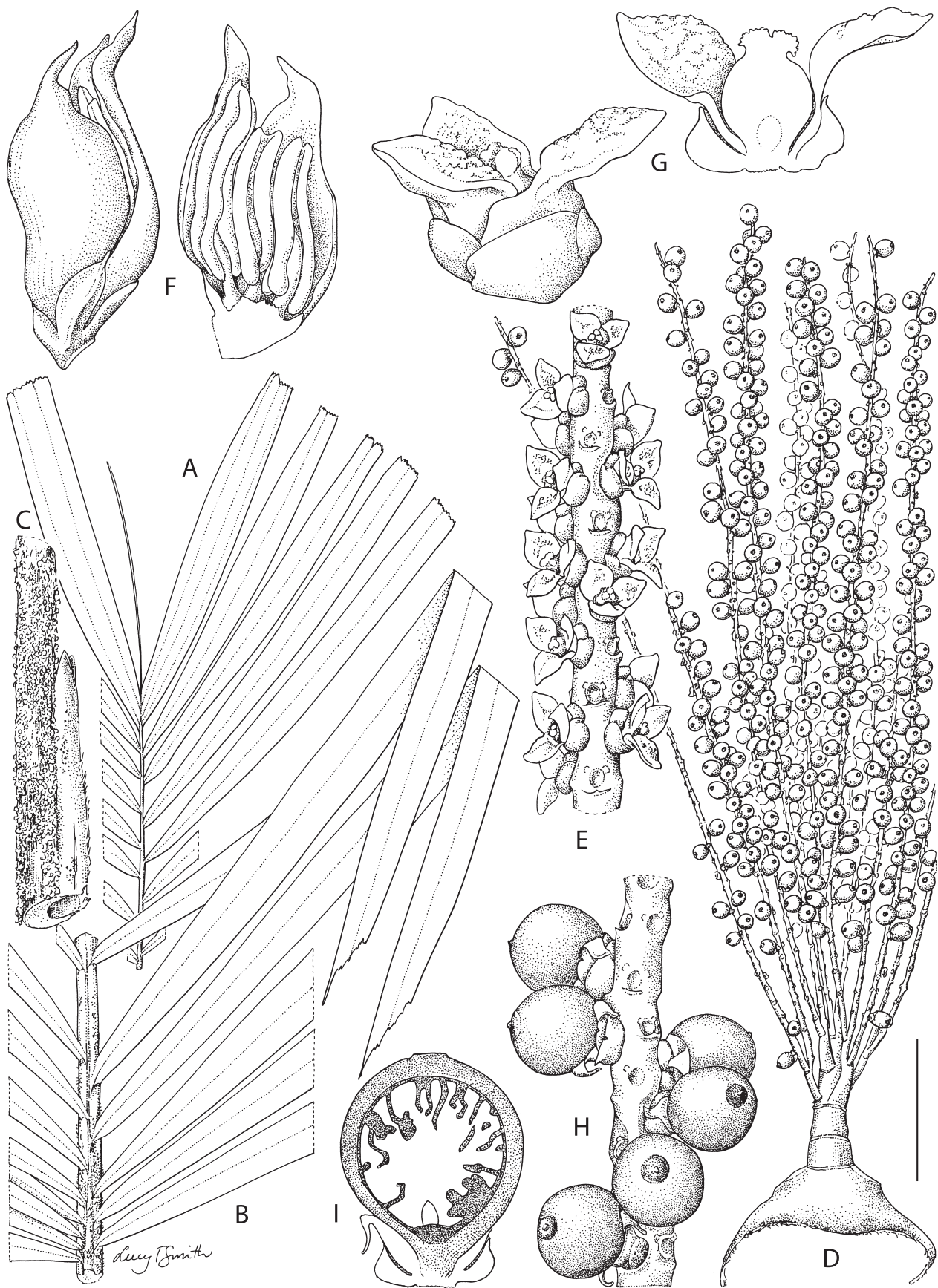


FIGURE 27. *Hydriastele lurida*. A. Leaf apex. B. Mid-leaf portion. C. Petiole base. D. Inflorescence. E. Portion of rachilla with pistillate flowers. F. Staminate flower whole and in longitudinal section. G. Pistillate flower whole and in longitudinal section. H. Portion of rachilla with fruit. I. Fruit in longitudinal section. Scale bar: A–B = 8 cm; C = 3 cm; D = 6 cm; E, H = 1 cm; F–G = 3 mm; I = 5 mm. A–D, H–I from Baker *et al.* 823; E–G from Dransfield 7682. Drawn by Lucy T. Smith.



FIGURE 28. *Hydiastele lurida*. A–B. Crown. C. Sheath mouth. D. Inflorescence. A from Biak Island; B–D from *Baker et al. 1339*. All photos: W.J. Baker.

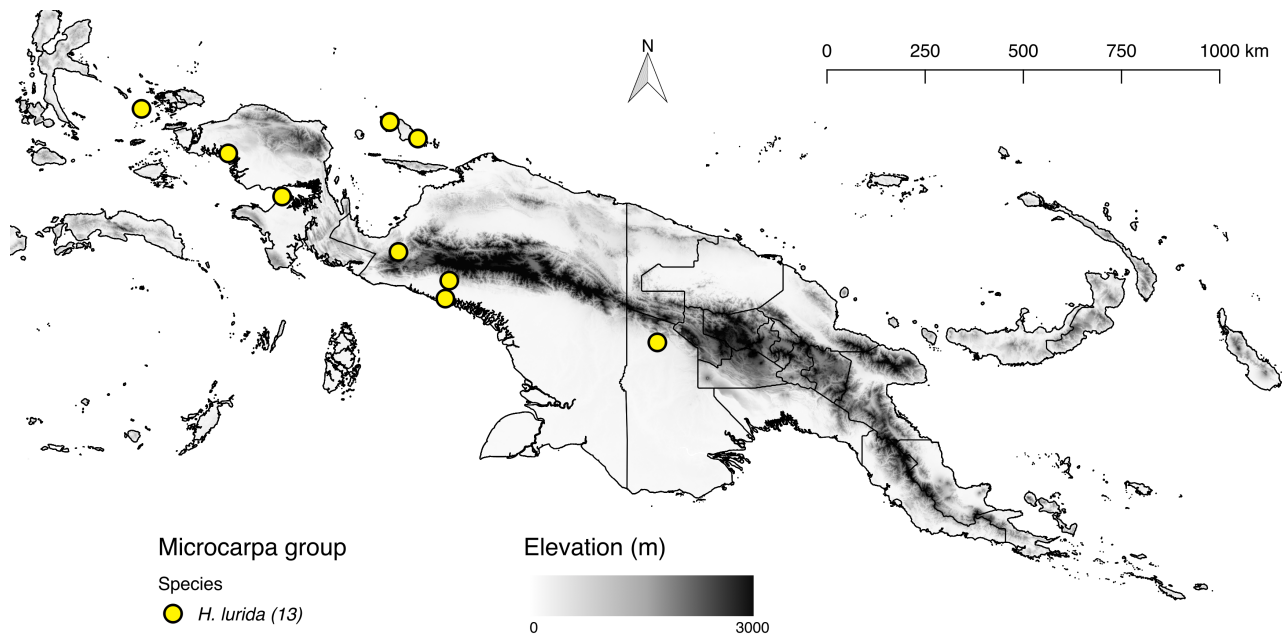


FIGURE 29. Distribution map of the Microcarpa group of *Hydriastele* in New Guinea and adjacent islands.

Habitat:—Lowland swamp and heath forest, occasionally in drier habitats or in disturbed roadside vegetation, 5–500 m.

Uses:—Stems used for making harpoons, floors and beds, leaves used for roofing. Shoot apices consumed.

Vernacular names:—*Ansan* (Soon), *Gulbotom* (Gebe), *Omdar* (Biak), *Sirata* (Sayal).

Conservation status:—Least Concern (LC). This species is widespread (EOO > 258,000 km²) and the relatively low AOO (36 km²) is a conservative estimate expected to increase with more records of *H. lurida*.

Specimens examined:—INDONESIA. **Papua Province:** Biak Island, Fanjur village, North Supiori Nature Reserve, 50 m, 0°45'S, 135°35'E, 12 June 2001, *Maturbongs 679* (AAU, BO, CANB, K!, MAN); Same locality as preceding, 0°45'S, 135°35'E, 13 June 2001, *Maturbongs 685b* (AAU, BO, K!, MAN); Biak Island, near Soon village, 134 m, 1°7'S, 136°13'E, 23 July 2009, *Baker et al. 1339* (AAU, BO, K!, MAN); Noord-Rivier [Lorentz River], 4°40'S, 138°43'E, 6 July 1907, *Versteeg 1388* (FI!, K!, L!); Timika, between Timika and port, peat lens (plot 22), Loc 20, 5 m, 4°47'S, 136°51'E, 16 February 1998, *Dransfield 7682* (BH, BO, K!, L, MAN); Timika, Km 58 on road to Tembapapura, Loc 4, 185 m, 4°22'S, 136°56'E, 8 February 1998, *Baker et al. 823* (AAU, BH, BO, K!, L, MAN); Dalman, 45 km inward of Nabire, 500 m, 2 March 1940, *Kanehira 12126* (A!); **West Papua Province:** Sorong Selatan, Sayal, Maampow, 10 m, 1°28'S, 131°53'E, 21 February 2003, *Heatubun 422* (MAN, K!, BO); Kabupaten Raja Ampat, Gag Island, Swamp forest behind Mining Base Camp, 10 m, 0°27'S, 129°54'E, 2 August 2006, *Heatubun 765* (BO, K!, MAN); Distr. Manokwari, Subdistr. Bintuni, between Saengga & Tanah Merah villages, 9 m, 2°27'S, 133°7'E, 13 February 2002, *Maturbongs 709* (BO, K!, LAE, MAN); PAPUA NEW GUINEA. **Western Province:** Palmer River below junction with Black River 2 m, 100 m, 5°47'S, 141°42'E, June 1936, *Brass 7093* (A, BO!, BRI, L!).

Notes:—*Hydriastele lurida* is a moderately slender subcanopy palm distinguished by its fibrous leaf sheaths, leaves with 27–40 irregularly arranged leaflets on each side of the rachis (rarely as few as 21 leaflets per side), and inflorescences branched to two orders with spirally arranged triads. *Hydriastele lurida* may superficially resemble *H. wendlandiana* in habit, although that species belongs to the Wendlandiana group, does not have conspicuously fibrous leaf sheaths and generally has leaves with fewer leaflets. *Hydriastele lurida* is unlikely to be confused with other species in New Guinea.

Hydriastele lurida most closely resembles *H. microcarpa* (Scheffer 1876: 153) Baker & Loo (2004: 65) and *H. oxypetala* (Burret 1937a: 474) Baker & Loo (2004: 66), which both occur in the Moluccas. Our preliminary work indicates that *H. lurida* can be distinguished from those two species based on its more closely spaced leaflets, having 24 to 39 leaflets per side per meter rachis as opposed to only 16 to 21 leaflets per side per meter rachis in *H. microcarpa* and *H. oxypetala*.

Here we place *H. brassii* in synonymy under *H. lurida*, having thoroughly examined the type material. In his protologue of *H. brassii*, Burret makes comparison to the related *H. microcarpa*, but does not mention *H. lurida*.

SIPHOKENTIA GROUP

Moderate palms, inflorescences protandrous and branched to 1 or 2 orders, triads largely decussately arranged, pistillate sepals and petals uniquely fused in a cup. The Moluccas and the Biak Islands.

14. *Hydriastele dransfieldii* (Hambali, Maturb., Wanggai & W.J. Baker) Baker & Loo (2004: 64). *Siphokentia dransfieldii* Hambali, Maturb., Wanggai & W.J. Baker in Baker *et al.* (2000: 179). Type:—INDONESIA. Papua Province: Biak, *Maturbongs* 555 (holotype K!, isotypes BH, BO, L, MAN)

Figure 30 (line drawing). Figure 31 (photo plate). Figure 32 (map).

Solitary, moderately slender palm to 12 m tall, bearing 6–10 leaves in crown. **Stem** 5–12 cm in diam. **Leaf** 1.3–3 m long including petiole; sheath 35–80 cm long; petiole 10–65 cm long; lamina typically with 3 broad, multi-fold leaflets interspersed with a few single-fold leaflets each side of rachis; leaflets oblong to linear, truncately praemorse apically. **Inflorescence** 37–52 cm long including 2–5 cm peduncle, branched to 1 order, protandrous; rachillae 4–11, yellowish-green; triads largely opposite and decussate. **Staminate flower** 9–11 × 2–5 mm in bud, green to white; stamens (9–)13–16. **Pistillate flower** ca. 9 × 5 mm in bud, with fused, greenish-white sepals forming a cylindrical tube, and white petals fused in lower half with conspicuous, triangular and valvate tips. **Fruit** ca. 18 × 12 mm when ripe, obovoid, red, with a distinct, dark, shallowly concave, sclerotic zone encircling apical stigmatic remains (up to ca. 5 mm in diam.). **Seed** ca. 8 × 7 mm, subglobose; endosperm ruminant.

Distribution:—Biak Islands (Biak, Supiori and Numfoor; Baker & Heatubun 2012).

Habitat:—Lowland, primary or secondary rainforest on rocky limestone ridges and slopes, often with a very thin layer of topsoil, 0–300 m.

Uses:—Leaves used for wrapping food and seeds used as a betel nut substitute.

Vernacular names:—*Ombrush* (Biak).

Conservation status:—Least Concern (LC). This species has a relatively narrow distribution (ca. 6,500 km²) but has been observed to be common in many parts of Biak (Baker & Heatubun 2012) and the AOO (20 km²) is no doubt a low estimate resulting from under-collecting.

Specimens examined:—INDONESIA. **Papua Province:** Biak Island, 50 m, 1°6'S, 136°11'E, 23 July 2009, *Heatubun* 969 (AAU, BO, K!, MAN); Biak Island, forest around road (Jalan Manwaref) cutting through ridge., 90 m, 1°10'S, 136°10'E, 21 July 2009, *Baker et al.* 1331 (AAU, BO, K!, MAN); Biak Island, Sumberker Protected Forest, 110 m, 0°55'S, 135°55'E, 4 September 1998, *Maturbongs* 551 (BO, FTG, K!, L, MAN); Same locality as preceding, 95 m, 0°55'S, 135°55'E, 5 September 1998, *Maturbongs* 553 (BO, K!, MAN, NY); Same locality as preceding, 120 m, 0°55'S, 135°55'E, 5 September 1998, *Maturbongs* 555 (BH, BO, K!, L, MAN); Same locality as preceding, 130 m, 0°55'S, 135°55'E, 5 September 1998, *Maturbongs* 556 (AAU, BO, K!, MAN); Biak Island, Wari Village, Northern Biak, 50 m, 0°51'S, 136°2'E, 10 September 1998, *Maturbongs* 566 (BH, BO, K!, MAN); Biak Island, Adibai, Eastern Biak, 15 m, 6 September 1998, *Maturbongs* 557 (BO, K!, MAN); Biak Island, Sansundi village, North Biak Nature Reserve, 210 m, 0°42'S, 135°50'E, 8 September 1998, *Maturbongs* 561 (AAU, BO, K!, MAN); Same locality as preceding, 210 m, 0°42'S, 135°50'E, 8 September 1998, *Maturbongs* 562 (BO, K!, MAN); Same locality as preceding, 310 m, 0°42'S, 135°50'E, 8 September 1998, *Maturbongs* 563 (BO, FTG, K!, MAN); Same locality as preceding, 230 m, 0°42'S, 135°50'E, 8 September 1998, *Maturbongs* 564 (BO, K!, MAN, NY). CULTIVATED. INDONESIA. **West Java:** Bogor Botanic Gardens ex Biak Island, 1999, *Hambali s.n.* (K!). UNITED STATES. **Florida:** Fairchild Tropical Garden ex Biak Island, 10 September 1999, *Zona* 822 (FTG, K!); same locality as preceding, 26 October 1999, *Zona* 826 (FTG, K!).

Notes:—*Hydriastele dransfieldii* is a moderately slender midstorey palm only known from the Biak Islands in western New Guinea. The species is highly distinctive vegetatively as well as in its reproductive structures. It has leaves usually consisting of three broad, multi-fold leaflets interspersed with a few single-fold leaflets and inflorescences branched to 1 order, which is unusual for *Hydriastele* inflorescences of more than 30 cm in length. The sepals of the pistillate flower are fused forming a conspicuous cup, and similarly the petals are fused at their bases. These features are known in only one other species, *H. beguinii* (Burret) Baker & Loo (2004: 62), from North Maluku Province, which is the sister taxon of *H. dransfieldii* (Loo *et al.* 2006). Previously, the two species were placed in the genus *Siphokentia*, which was subsumed within *Hydriastele* (Baker & Loo 2004). The two species can be separated based on multiple characters of the leaves and inflorescences (see Baker *et al.* 2000).

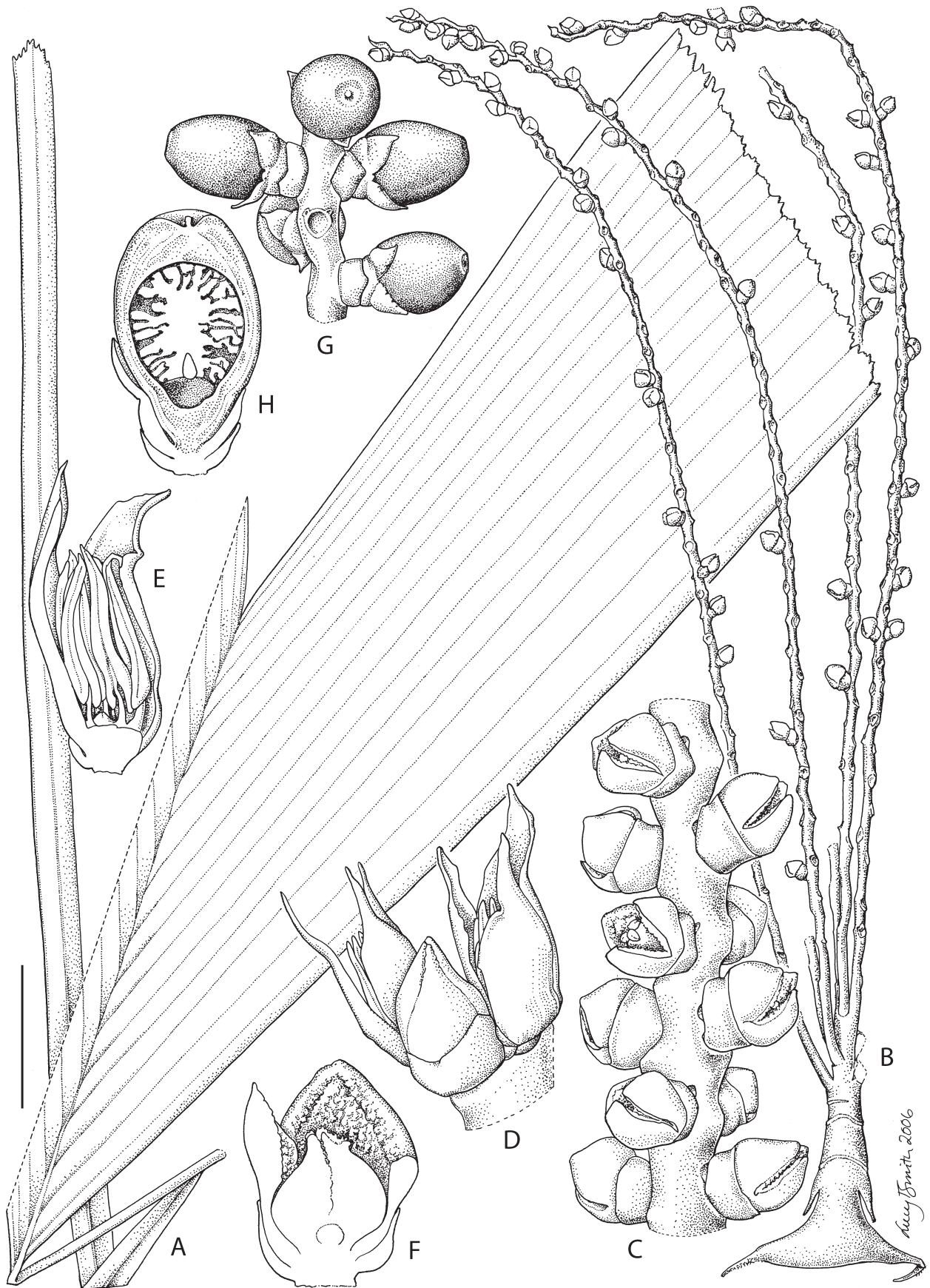


FIGURE 30. *Hydriastele dransfieldii*. A. Leaf apex. B. Inflorescence with pistillate flowers. C. Portion of rachilla with pistillate flowers. D. Triad. E. Staminate flower in longitudinal section. F. Pistillate flower in longitudinal section. G. Portion of rachilla with fruit. H. Fruit in longitudinal section. Scale bar: A = 8 cm; B = 4 cm; C, H = 1 cm; D = 7 mm; E–F = 5 mm; G = 2 cm. A–B from *Maturbongs 555*; C–F from *Zona 826*; D–E from *Zona 822*; G–H from *Hambali s.n.* Drawn by Lucy T. Smith.



FIGURE 31. *Hydiastele dransfieldii*. A–B. Habit. C. Portion of rachilla with pistillate flowers. D. Inflorescence with maturing fruit. E. Portion of rachilla with fruit. A–B from Biak Island; C, E from *Baker et al. 1331*; D cultivated palm, private garden, Bogor, Indonesia. All photos: W.J. Baker.

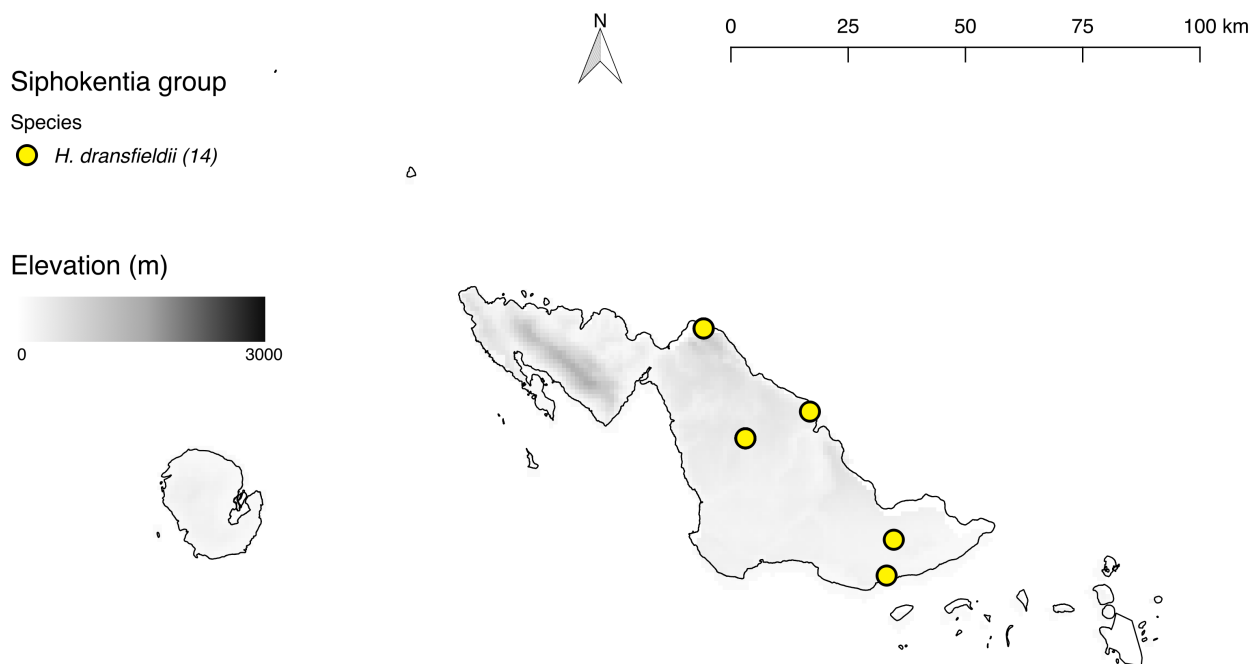


FIGURE 32. Distribution map of the Siphokentia group of *Hydriastele* in Biak Island.

LONGISPATHA GROUP

Robust palms, leaves strongly arching with ascending leaflets in combination with protandrous or protogynous inflorescences or leaves straight to slightly drooping with pendulous leaflets in combination with protandrous inflorescences, staminate flowers with 6–24 stamens enclosed by valvate petals in bud. New Guinea, Manus Island and east Melanesia.

15. *Hydriastele calcicola* W.J.Baker & Petoe, *sp. nov.* Type:—PAPUA NEW GUINEA. Gulf Provine: Kikori Distr., bank of Kikori River near to Kopi, 13 km N of Kikori, 40 m, 7°22'S, 144°14'E, 19 November 2000, *Baker et al. 1096* (holotype K!, isotypes AAU!, BRI, L, LAE, NY)

Diagnosis:—Distinguished by its gregarious habit, the non-ventricose and moderately robust, solitary stem with pithy inner wood, the leaf with a deeply adaxially channelled petiole and multi-fold basal leaflets, and the inflorescence with a short peduncle.

Figure 33 (line drawing). Figure 34 (photo plate). Figure 35 (map).

Solitary and gregarious, moderately robust canopy palm to 30 m tall, bearing 15–20 leaves in crown. **Stem** ca. 15 cm in diam., inner wood very soft and pithy; internode 4–5 cm long. **Leaf** ca. 2.7 m long including petiole; sheath ca. 100 cm long, not seen close up, crownshaft ca. 130 × 14 cm; petiole ca. 60 cm long, deeply channelled adaxially; rachis strongly arcuate; leaflets ca. 46 per side, arranged regularly, ascending, linear, with short, widely spaced ramenta on the abaxial, basal portion of the midrib; basal leaflets comprising ca. 4 folds; middle leaflets ca. 80 × 3 cm, single-fold, obliquely to truncately praemorse apically; terminal leaflets comprising ca. 2 folds, truncately praemorse apically. **Inflorescence** ca. 70 cm long including 3–5 cm peduncle, branched to 2 orders, protandrous; rachillae ca. 26; triads on average 11 mm apart, opposite and decussate. **Staminate flower** 17–19 × 3–6 mm in bud, cream; stamens ca. 13. **Pistillate flower** ca. 6 × 2.5–3 mm in bud, cream, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** ca. 15 × 9 mm when ripe, obovoid to broadly ellipsoid, bright red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3.5 mm in diam.). **Seed** ca. 10–11 × 7.5 mm, obovoid to ellipsoid; endosperm homogeneous.

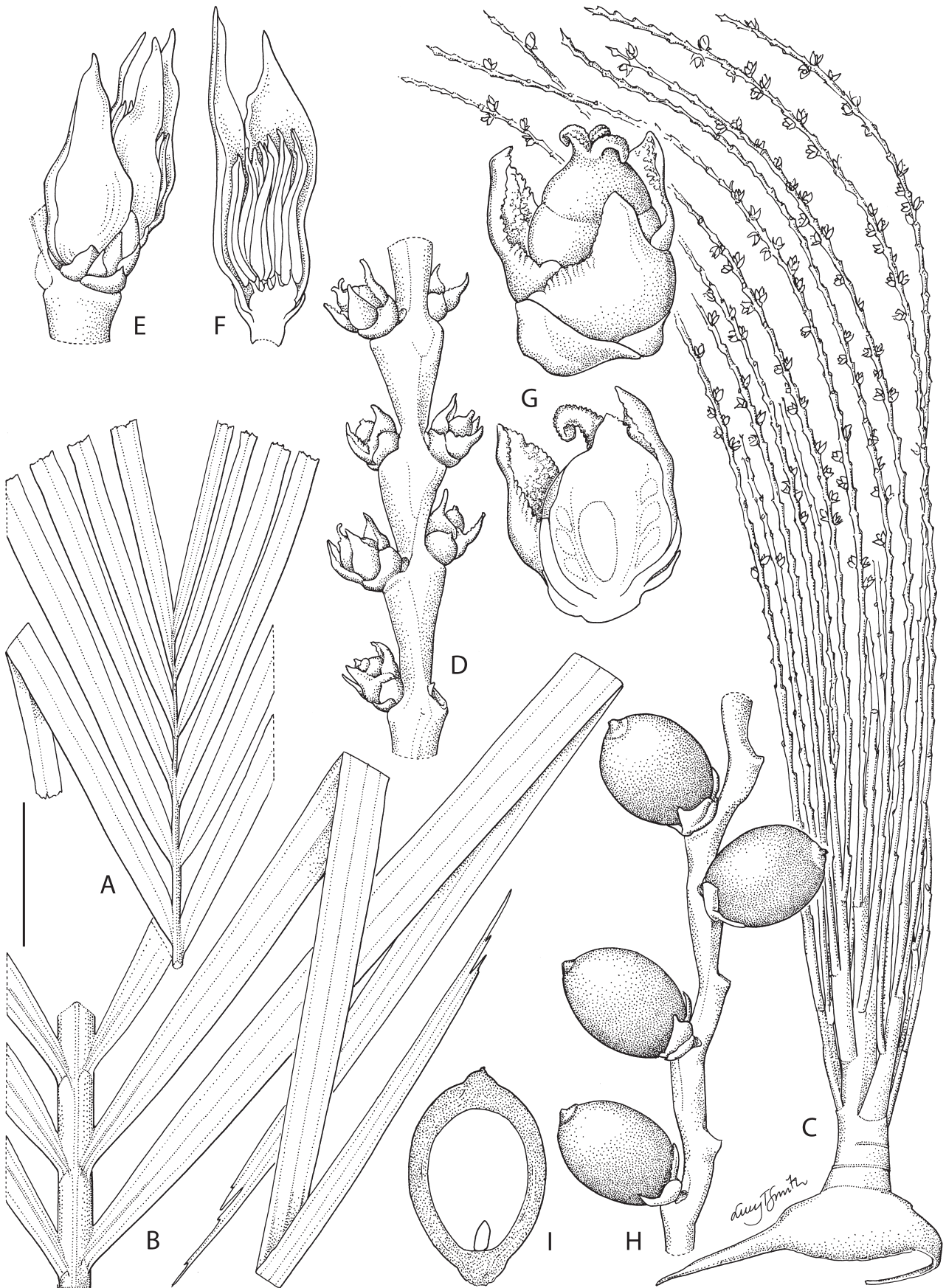


FIGURE 33. *Hydrastele calcicola*. A. Leaf apex. B. Mid-leaf portion. C. Inflorescence with pistillate flowers. D. Portion of rachilla with pistillate flowers. E. Triad. F. Staminate flower in longitudinal section. G. Pistillate flower whole and in longitudinal section. H. Portion of rachilla with fruit. I. Fruit in longitudinal section. Scale bar: A–B = 8 cm; C = 6 cm; D, H = 1.5 cm; E, I = 1 cm; F = 7 mm; G = 4 mm. All from Baker *et al.* 1096. Drawn by Lucy T. Smith.



FIGURE 34. *Hydriastele calcicola*. A–B. Habit. C. Portions of rachillae with triads. D. Portion of rachilla with fruit. All from *Baker et al. 1096*. All photos: W.J. Baker.

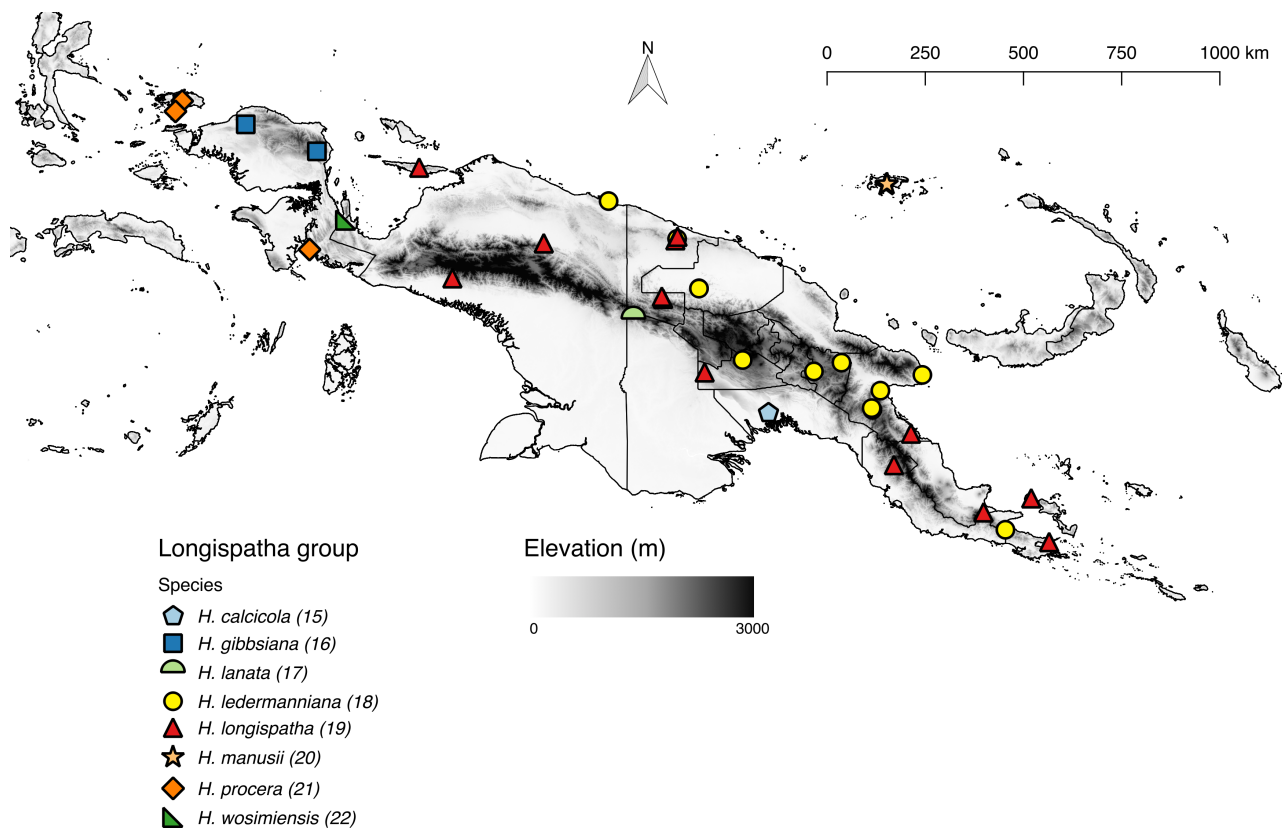


FIGURE 35. Distribution map of the Longispatha group of *Hydrastele* in New Guinea and adjacent islands.

Distribution:—The type locality north of Kikori (Gulf Province) and sight records on the Mubi River (Southern Highlands Province; Baker 1997) of Papua New Guinea.

Habitat:—Lowland tropical rainforest river margins, on karst limestone crags, 40–500 m.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD). More data are needed about the range and abundance of this species.

Specimens examined:—PAPUA NEW GUINEA. **Gulf Province:** Kikori Distr., bank of Kikori River near to Kopi, 13 km N of Kikori, 40 m, 7°22'S, 144°14'E, 19 November 2000, *Baker et al. 1096* (AAU!, BRI, K!, L, LAE, NY).

Notes:—*Hydrastele calcicola* is a moderately robust, tall palm with arching leaves and ascending leaflets. It occurs in large numbers in the Kikori River catchment (Baker, pers. obs.), where it crowds gregariously on limestone outcrops (hence the species epithet). Sometimes the palm emerges directly from near-vertical limestone cliffs. We note that it also occurs at relatively low elevation compared to similar species. *Hydrastele calcicola* is distinguished by its pithy, non-ventricose stem, ca. 15 cm in diameter, by its leaves with deeply adaxially channelled petioles and multi-fold basal leaflets, and inflorescences with 3–5 cm long peduncles. *Hydrastele calcicola* is most similar to *H. gibbsiana* but that species is strongly ventricose and has leaves with adaxially flattened petioles and single-fold basal leaflets.

16. *Hydrastele gibbsiana* (Becc.) Baker & Loo (2004: 65). *Kentia gibbsiana* Beccari (1917: 91). *Gronophyllum gibbsianum* (Becc.) Moore (1963: 264). Type:—INDONESIA. West Papua Province: Arfak Mts., Anggi Lakes, forest slopes and ridges by lake, 2150–2450 m, 1°23'S, 133°55'E, December 1913, *Gibbs 5951* (holotype FI!, isotypes BM! K!, L!)

Figure 36 (line drawing). Figure 37 (photo plate). Figure 35 (map).

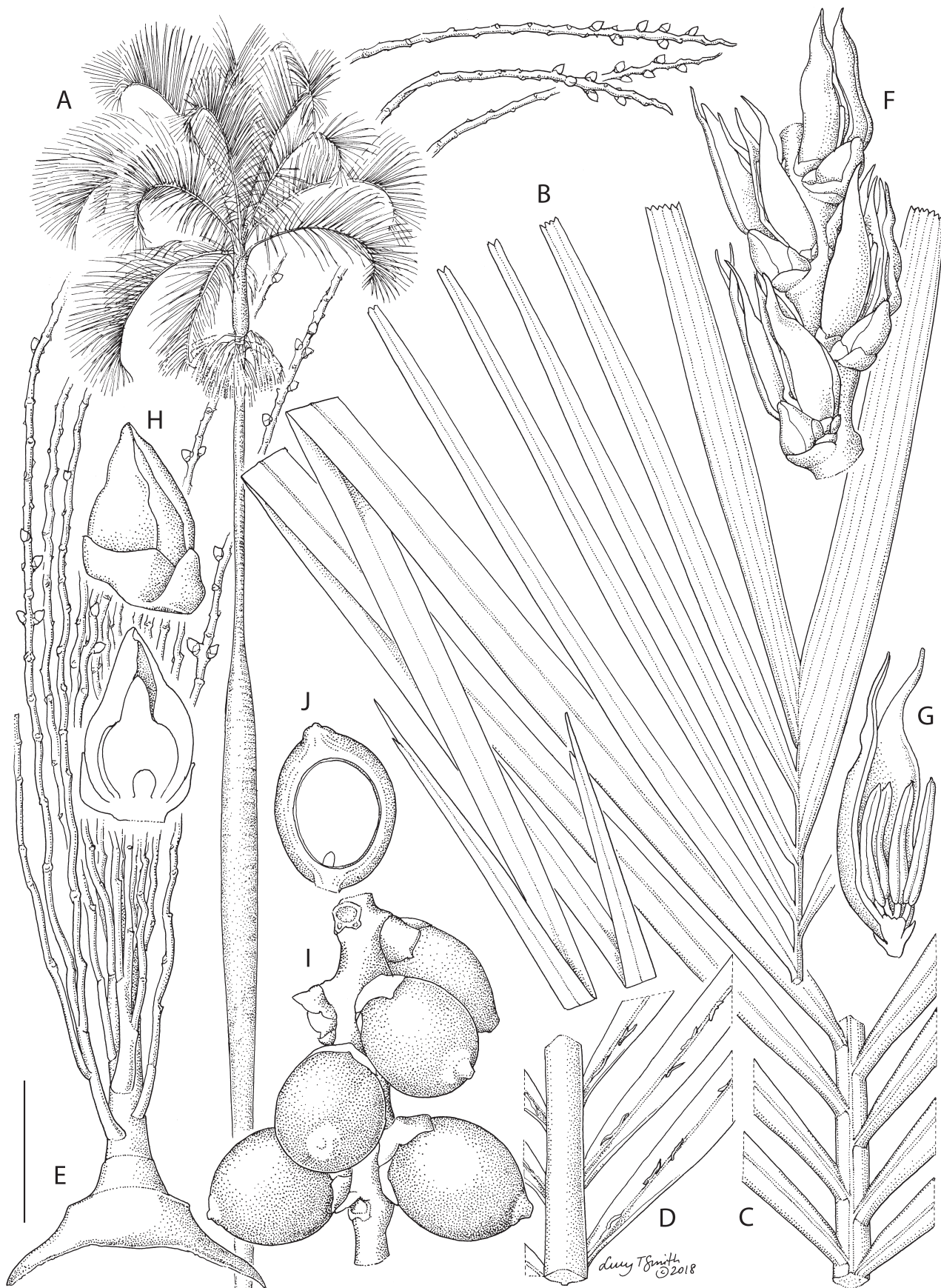


FIGURE 36. *Hydrastele gibbsiana*. A. Habit. B. Leaf apex. C. Mid-leaf portion adaxial side. D. Mid-leaf portion abaxial side. E. Inflorescence with pistillate flowers. F. Portion of rachilla with triads. G. Staminate flower in longitudinal section. H. Pistillate flower whole and in longitudinal section. I. Portion of rachilla with fruit. J. Fruit in longitudinal section. Scale bar: A = 1.5 m; B–D = 6 cm; E = 4 cm; F = 1 cm; G = 7 mm; H = 4 mm; I–J = 1.5 cm. All from *Baker et al. 1379*. Drawn by Lucy T. Smith.



FIGURE 37. *Hydiastele gibbsiana*. A. Habit. B. Inflorescence and infructescence. C. Portions of rachillae with triads. D. Portions of rachillae with fruit. A from the Anggi Lakes of the Arfak Mts., western New Guinea; B–D from the Tamrau Mountains, western New Guinea. Photos A: André Schuiteman; B–D: W.J. Baker.



FIGURE 38. Stems of *Hydriastele gibbsiana* lashed together to form rafts. Used by the Alfueros on both the Anggi Lakes (Gibbs 1917). Photo: A.E. Pratt. Reproduced from Gibbs (1917).

Solitary, moderately robust, emergent palm to 30 m tall, bearing 13–15 leaves in crown. **Stem** strongly ventricose, ca. 10 cm in diam. immediately below crownshaft widening to 20–30 cm in diam. further down, inner wood conspicuously soft and pithy; internode 1.5–6 cm long. **Leaf** 2–2.15 m long including petiole; sheath 60–82 cm long, sparsely or densely covered with a thin layer of lanate, orange-brown indumentum, crownshaft ca. 100 × 15 cm; petiole ca. 30 cm long, flattened adaxially; rachis arcuate; leaflets 50–53 per side, arranged regularly, ascending and ± drooping at their tips, linear, with ramenta on the abaxial, basal portion of the midrib; basal leaflets single-fold, acuminate or obliquely praemorse apically; middle leaflets 50–80 × 2–5 cm, single-fold, obliquely praemorse or acuminate and briefly bifid apically; terminal leaflets comprising 1–5 folds, truncately praemorse. **Inflorescence** 55–60 cm long including 4–5 cm peduncle, branched to 2 orders, protandrous; rachillae 22–28; triads on average 7–8 mm apart, opposite and decussate; inflorescences ca. 13 present. **Staminate flower** 11–16 × 2–4 mm in bud, cream; stamens 6–9. **Pistillate flower** 4–5 × 3–3.5 mm in bud, cream, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** ca. 13.5 × 8 mm when ripe, broadly ellipsoid, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3.5 mm in diam.). **Seed** ca. 9 × 6.5 mm, broadly ellipsoid; endosperm homogeneous.

Distribution:—Tamrau Mountains and Arfak Mountains of the Bird's Head Peninsula, western New Guinea.

Habitat:—Premontane and montane rainforest on slopes and ridge tops, 950–2450 m.

Uses:—The very light and pithy trunks used for making rafts on the Anggi Lakes (Fig. 38; Matthew Jebb pers. comm.) and for flooring in the Tamrau Mountains. Leaves used as thatch.

Vernacular names:—*Syah* (Madik).

Conservation status:—Data deficient (DD). The distribution and abundance of this species are insufficiently known.

Specimens examined:—INDONESIA. **West Papua Province:** Tambrouw Regency, Bamusbama Distr., forest along road to Fef east of Bamusbama, 950 m, 0°45'S, 132°16'E, 28 January 2013, *Baker et al.* 1379 (BO, K!, L, MAN); Arfak Moutains, Anggi Lake, forest slopes and ridges by lake, 2150–2450 m, 1°23'S, 133°55'E, December 1913, *Gibbs 5951* (BM! FI!, K!, L!).

Notes:—*Hydriastele gibbsiana* stands out among all New Guinea palms on account of its strikingly swollen stem. It is also a tall palm with relatively short (2–2.15 m), arching leaves and ascending leaflets with the terminal leaflet pair being multi-fold and truncately praemorse at the tip. The ventricose part of the stem is composed of soft, pithy and light inner wood with very wide vessels, and the inflorescence is relatively short (55–60 cm long) including a short (4–5 cm long) peduncle. *Hydriastele gibbsiana* is most similar to *H. ledermanniana*, although that species does not have a ventricose stem and its leaves and inflorescences are usually larger. Three other species of *Hydriastele* have conspicuously ventricose stems, *H. procera*, *H. wosimiensis* and *H. ramsayi*, but to a lesser extent. Only the two former occur in New Guinea and are distinguishable immediately from *H. gibbsiana* by their more-or-less straight leaves with pendulous leaflets.

On the Anggi Lakes, the stems of *Hydriastele gibbsiana* were, at least until the 90s, lashed together to make rafts, the pithy stems being very light and buoyant when dried (Matthew Jebb pers. comm.). Surprisingly, Gibbs (1917) made no reference to this in her account of the Arfak Mountain flora, but she did include a picture of a loaded raft that appears to be made of the trunks of *H. gibbsiana* (Fig. 38). When Matthew Jebb returned to the Anggi Lakes in June 2017 he could no longer observe the trunks being used in this way (Matthew Jebb pers. comm.). The practice of using the stems for rafts may have contributed to the decline of local populations of this species.

17. *Hydriastele lanata* W.J.Baker & Petoe, *sp. nov.* Type:—PAPUA NEW GUINEA. Western Province: North Fly Distr., road from Tabubil to Ok Tedi Copper Mine, near mill, 10 km NW of Tabubil, 1400 m, 5°12'S, 141°9'E, 13 December 2000, *Baker et al. 1135* (holotype K!, isotypes AAU!, LAE, NY)

Diagnosis:—Distinguished by its thick and dense, lanate and somewhat fluffy indumentum on the leaf sheath, and its inflorescence with a long peduncle (11–12 cm) and relatively few rachillae (17–23). In addition, the leaves and crownshaft seem disproportionately long relative to the modest height (up to 10 m tall) and stem diameter (10 cm) of this species.

Figure 39 (line drawing). Figure 35 (map).

Solitary, moderately robust palm to 10 m tall, bearing 10–12 leaves in crown. **Stem** ca. 10 cm in diam.; internode ca. 15 cm long. **Leaf** ca. 2.4 m long including petiole; sheath ca. 120 cm long, with a thick, dense layer of fluffy, lanate, pale brown indumentum, crownshaft ca. 216 × 10 cm; petiole ca. 32 cm long, channelled adaxially; rachis arcuate; leaflets 43 per side, arranged regularly, ascending and ± drooping at their tips, linear, with ramenta on the abaxial, basal portion of the midrib; basal leaflets single-fold, obliquely praemorse apically; middle leaflets ca. 100 × 4 cm, single-fold, obliquely to truncately praemorse apically; terminal leaflets comprising ca. 4 folds, truncately praemorse apically. **Inflorescence** 65–70 cm long including 11–12 cm peduncle, branched to 2 orders, protandrous; rachillae 17–23; triads on average 9 mm apart, opposite and decussate. **Staminate flower** 13–16 × 3–4 mm in bud, white; stamens 7–10. **Pistillate flower** ca. 6 × 4 mm in bud, white, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** not seen. **Seed** not seen.

Distribution:—Known from the type locality in the northern portion of Western Province in Papua New Guinea.

Habitat:—Montane and somewhat degraded forest on steep slopes with exceptionally high epiphyte load due to unusually high rainfall, at 1400 m elevation.

Uses:—None recorded.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD). The distribution and abundance of this species are insufficiently known.

Specimens examined:—PAPUA NEW GUINEA. **Western Province:** North Fly Distr., road from Tabubil to Ok Tedi Copper Mine, near mill, 10 km NW of Tabubil, 1400 m, 5°12'S, 141°9'E, 13 December 2000, *Baker et al. 1135* (AAU!, K!, LAE, NY).

Notes:—*Hydriastele lanata* is a moderately robust tree palm immediately recognisable on account of the fluffy, lanate, pale brown indumentum on the leaf sheath, hence the choice of species epithet. The species is further distinguished by its inflorescence, which includes a long peduncle (11–12 cm) and relatively few rachillae (17–23). *Hyriastele lanata* is most similar to *H. ledermanniana* but that species is more robust, its sheaths lack thick and fluffy indumentum and it has shorter peduncles relative to the length of its inflorescences, which also comprise more rachillae.



FIGURE 39. *Hydrastele lanata*. A. Habit. B. Leaf apex. C. Mid-leaf portion. D. Inflorescence. E. Portion of rachilla with pistillate flowers. F. Triad. G. Staminate flower in longitudinal section. H. Pistillate flower in longitudinal section. Scale bar: A = 1.8 m; B–C = 8 cm; D = 6 cm; E = 1 cm; F = 7 mm; G = 5 mm; H = 3.3 mm. All from Baker *et al.* 1135. Drawn by Lucy T. Smith.

The type locality of *H. lanata* is adjacent to the Ok Tedi Copper Mine in Western Province, Papua New Guinea. The palm occurred in a sparse population in a rather degraded forest with many fallen trees. The degraded nature of the forest appears to be natural rather than anthropogenic, perhaps a result of local climatic conditions (e.g. high rainfall, wind) or perhaps properties of the soil. Unfortunately, recent satellite imagery available from Google Earth (consulted January 2018) indicates that the type locality is on the verge of destruction due to expansion of the mine site.

18. *Hydriastele ledermanniana* (Becc.) Baker & Loo (2004: 65). *Kentia ledermanniana* Beccari (1923: 442). *Gronophyllum ledermannianum* (Becc.) Moore (1963: 264). Type:—PAPUA NEW GUINEA. East Sepik Province: Hunstein Mts., *Ledermann 11229* (holotype B†). Neotype (designated here):—PAPUA NEW GUINEA. East Sepik Province: Ambunti Subdistr., Eastern ridge of Sumset (Mt. Hunstein), 1350 m, 4°31'S, 142°39'E, 11 August 1966, *Hoogland 10934* (K!, isoneotypes BH, BRI, CANB, L!, LAE)

Kentia mayrii Burret (1933: 707). *Gronophyllum mayrii* (Burret) Moore (1963: 265). *Hydriastele mayrii* (Burret) Baker & Loo (2004: 65). Type:—INDONESIA. Papua Province: Cyclops Mts., 1100 m, 1928, *Mayr 658* (holotype B†, isotype BO!), *synon. nov.*

Kentia chaunostachys Burret (1936d: 328). *Gronophyllum chaunostachys* (Burret) Moore (1963: 264). *Hydriastele chaunostachys* (Burret) Baker & Loo (2004: 63–64). Type:—PAPUA NEW GUINEA. Morobe Province: Sattelberg, 750 m, 21 October 1935, *Clemens 526* (holotype B†, isotype L!), *synon. nov.*

Figure 40 (line drawing). Figure 41 (photo plate). Figure 35 (map).

Solitary, robust to very robust, emergent palm to 30 m tall, bearing 15–19 leaves in crown. **Stem** 20–35 cm in diam.; internode 2.5–10 cm long. **Leaf** 2–3.5 m long including petiole; sheath 58–200 cm long, the upper portion with a thin layer of lanate, orange-brown indumentum, crownshaft 90–250 × 15–40 cm; petiole 30–80 cm long, flattened adaxially; rachis arcuate; leaflets 38–51 per side, arranged regularly, ascending and ± drooping at their tips, linear, with or without ramenta on the abaxial, basal portion of the midrib; basal leaflets single-fold (rarely multi-fold), obliquely praemorse apically; middle leaflets 70–130 × 2.5–5 cm, single-fold, obliquely to truncately praemorse apically; terminal leaflets comprising 2–4 folds, truncately praemorse apically. **Inflorescence** (50–)65–120 cm long including 6–15 cm peduncle, branched to 2(–3) orders, protandrous; rachillae 23–66; triads 7–17 mm apart, opposite and decussate; inflorescences 5–11 present. **Staminate flower** 12–18 × 2–6 mm in bud, cream; stamens 9–13. **Pistillate flower** 7–8 × 4–5 mm in bud, cream, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** ca. 15–15.5 × 10–10.5 mm when ripe, broadly ellipsoid, brown to red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 4 mm in diam.). **Seed** ca. 10 × 8 mm, broadly ellipsoid; endosperm homogeneous.

Distribution:—Recorded from the Huon Peninsula and the central highlands of Papua New Guinea, and the Cyclops Mountains.

Habitat:—Primary or secondary, premontane to montane rainforest, on spurs and ridgetops, 700–1950 m.

Uses:—Leaves used for thatch, the split trunk used for flooring, inflorescences used for brooms, and fruits used as a betel nut substitute.

Vernacular names:—*Aidjaka* (Tari), *Gamu* (Unknown dialect), *Limbom* (Pidgin), *Kawoisch* (Mendi), *Pipi* (Kotte), *Tuwenpeh* (Wapi), *Uwo* (Wagu), *Yauwi* (Kagua)

Conservation status:—Least Concern (LC). This species is widespread (EOO > 170,000 km²) and has been recorded as common at several localities. The relatively low AOO (48 km²) is most likely due to under-collecting with this figure expected to increase.

Specimens examined:—INDONESIA. **Papua Province:** Cyclops Mts., 1100 m, 2°30'S, 140°34'E, 1928, *Mayr 658* (BO!). PAPUA NEW GUINEA. **East Sepik Province:** Eastern ridge of Sumset (Mt. Hunstein), Ambunti Subdistr., 1350 m, 4°31'S, 142°39'E, 11 August 1966, *Hoogland 10934* (BH, BRI, CANB, K!, L!, LAE); Hunstein Mts., 1300 m, 4°31'S, 142°39'E, *Ledermann 11229* (B†); **Eastern Highlands Province:** Mt. Michael, west slopes, 1950 m, 6°25'S, 145°17'E, 28 August 1959, *Brass 31196* (CANB!, K!, L!, LAE); 1 mile N of Okentenu, Kainantu subdistr., 1850 m, 6°13'S, 145°55'E, 13 October 1957, *Pullen 726* (A, CANB!, L!, LAE); **Milne Bay Province:** NE slopes of Mt. Simpson Massif, Mt. Wadimana, 1500 m, 10°2'S, 149°40'E, 19 July 1969, *Kanis 1284* (LAE, CANB!); **Morobe Province:** Near Bulolo, Hidden Valley, near Mt. Kaindi, close to Wau, 1600 m, 7°17'S, 146°37'E, 8 November 2006, *Baker et al. 1316* (AAU, K!, L, LAE); Finschhafen Distr., Sisi village, 15 km NW of Finschhafen, 700 m, 6°29'S, 147°46'E, 4 December 2000, *Banka 2000* (AAU, K!, LAE, NY); Sattelberg, 750 m, 6°29', 147°46', 21 October 1935, *Clemens 526* (L!); Tobou, 900 m, 1 June 1937, *Clemens 6561* (A!); Trig, Bulolo-Watut divide, 7 km SW of Bulolo, 1500 m, 7°15'S, 146°36'E, 13 November 1982, *Kairo 536* (A, BSF, L!, LAE, USF); Hills northeast of airstrip at Wagu, 1050 m, 6°51'S, 146°48'E, 13 March 1964, *Moore 9291* (BH, K!, L!, LAE); **Sandaun Province:** Torricelli

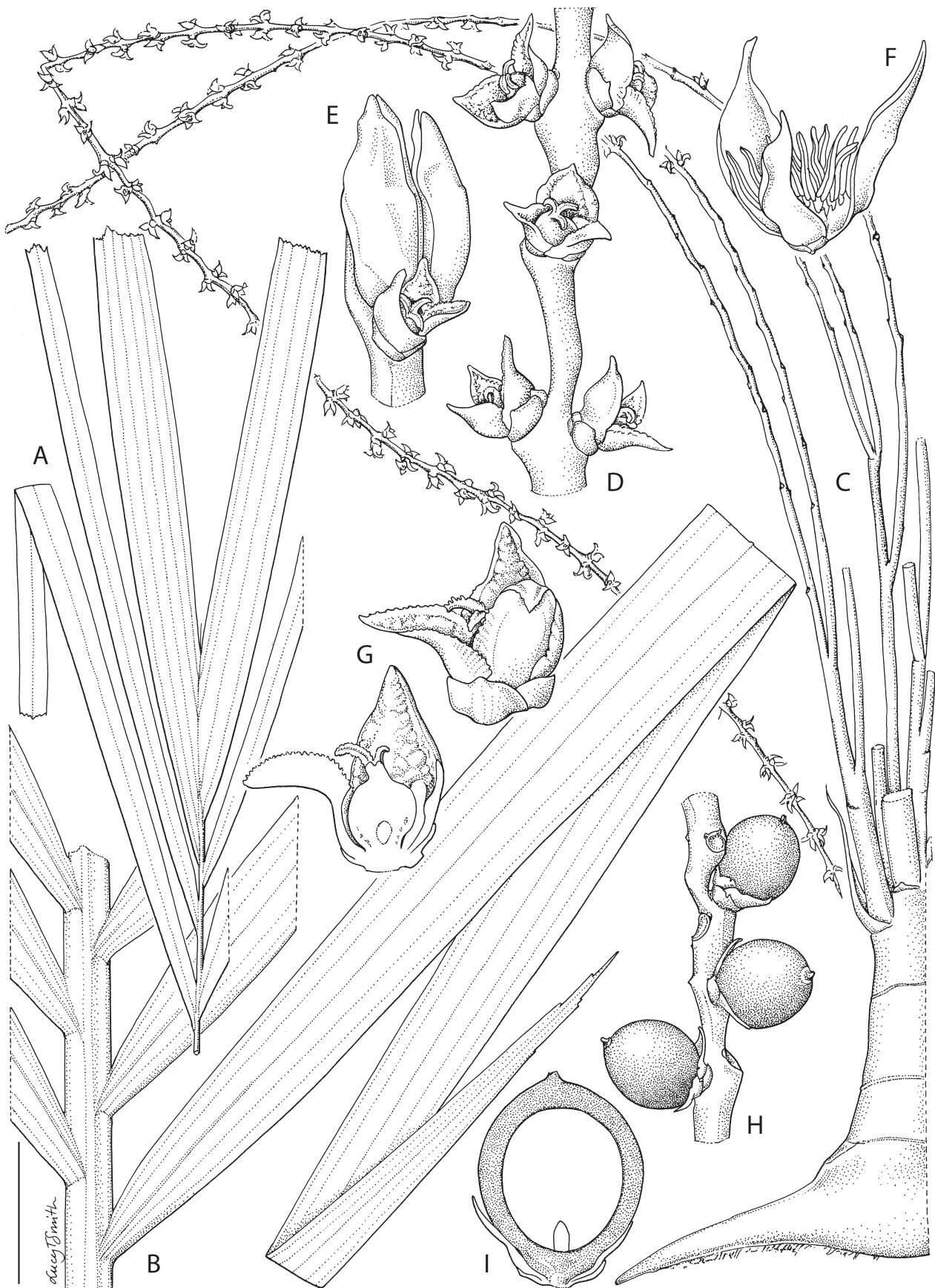


FIGURE 40. *Hydrastele ledermanniana*. A. Leaf apex. B. Mid-leaf portion. C. Inflorescence in part, with pistillate flowers. D. Portion of rachilla with pistillate flowers. E. Triad. F. Staminate flower. G. Pistillate flower whole and in longitudinal section. H. Portion of rachilla with fruit. I. Fruit in longitudinal section. Scale bar: A–B = 8 cm; C = 6 cm; D = 1.5 cm; E–F, I = 1 cm; G = 7 mm; H = 2 cm. All from *Banka* 2000. Drawn by Lucy T. Smith.



FIGURE 41. *Hydiastele ledermanniana*. A. Crown. B. Inflorescence with pistillate flowers. C. Portions of rachillae with triads. D. Portions of rachillae with pistillate flowers. E. Portion of rachilla with fruit. A, C, E from Baker *et al.* 1316; B, D from Banka 2000. All photos: W.J. Baker.

Mts., Peaks ca. 4 miles N of Wigote Village, Lumi Subdistr., 1550 m, 3°23'S, 142°9'E, 19 September 1961, *Darbyshire 464* (A, BRI, CANB, K!, L!, LAE); **Southern Highlands Province:** Angga River gorge, 15 miles E of Mendi, 1700 m, 6°9'S, 143°39'E, 28 June 1961, *Pullen 2646* (CANB!, LAE).

Notes:—*Hydriastele ledermanniana* is a solitary, robust canopy emergent with a non-ventricose stem and a crown consisting of arching leaves. It is distinguished by its protandrous inflorescences with 6–15 cm long peduncles. *Hydriastele ledermanniana* is most similar to *H. gibbsiana* and *H. calcicola* but those species have short peduncles (3–5 cm in length) and in addition the former is ventricose whereas the latter is less robust. Vegetatively, *H. ledermanniana* can be confused with the protogynous palm *H. longispatha*, but it has 57–70 leaflets on each side of the rachis (rarely as few as 48 per side), whereas *H. ledermanniana* has 38–51 leaflets on each side of the rachis.

We failed to locate type material of *H. ledermanniana* and conclude that it was destroyed during the bombing of the Berlin Herbarium in 1943. Therefore, we designate a neotype here. We select *Hoogland 10934* because it matches the description in the protologue of *H. ledermanniana* and was collected from the type locality.

We studied extensive collections, including type specimens, of *H. mayrii*, *H. chaunostachys* and *H. ledermanniana*. Burret (1933) noted that the difference between *H. mayrii* and *H. ledermanniana* is in the presence of strongly, apically sinuous inflorescence branches in the latter. Our neotype of *H. ledermanniana* does in fact display rachillae with some degree of sinuousness, but we render this too trivial a difference to merit the maintenance of *H. mayrii*. As noted by Burret (1936d), the type of *H. chaunostachys* has a much longer inflorescence (120 cm) than the destroyed type of *H. ledermanniana* (80 cm; Beccari 1923), but modern collections bridge the gap between these measurements (e.g. 100 cm in *Banka 2000*) and other differences described by Burret (1936d). Consequently, we place *H. mayrii* and *H. chaunostachys* into synonymy under *H. ledermanniana* here.

19. *Hydriastele longispatha* (Becc.) Baker & Loo (2004: 65). *Gulubia longispatha* Beccari (1914: 25). Type:—PAPUA NEW GUINEA. East Sepik Province: Sepik, *Schultze 323* (holotype B†, isotype FI!)

Gulubia crenata Beccari (1923: 445). Type:—PAPUA NEW GUINEA. East Sepik Province: Hunstein Mts., *Ledermann 8449* (holotype B†).

Gulubia obscura Beccari (1923: 447). Type:—PAPUA NEW GUINEA. East Sepik Province: Ettapenberg, *Ledermann 9133* (holotype B†).

Gulubia brassii Burret (1935: 336). Type:—PAPUA NEW GUINEA. Central Province: Bella Vista, *Brass 5457* (holotype B†, isotypes A!, BRI!, NY!).

Hydriastele valida (Essig) Baker & Loo (2004: 68). *Gulubia valida* Essig (1982: 169). Type:—PAPUA NEW GUINEA. Sandaun Province: Torricelli Mts., *Essig 55099* (holotype BH, isotypes CANB, L!, LAE), *synon. nov.*

Figure 42 (line drawing). Figure 43 (photo plate). Figure 35 (map).

Solitary, robust palm to 35 m tall bearing 15–17 leaves in crown. **Stem** 15–30 cm in diam.; internode 8–10 cm long. **Leaf** 2.5–3.6 m long including petiole; sheath 1–1.5 m long, covered with a thin layer of lanate, buff indumentum, crownshaft ca. 110–200 × 30 cm; petiole 10–40 cm long, flattened or slightly channelled adaxially; rachis usually strongly arcuate; leaflets (48–)57–70 per side, arranged regularly, ascending and sometimes drooping at their tips, linear; normally with ramenta on the abaxial, basal to middle portion of the midrib; basal leaflets single-fold, acuminate or truncately praemorse apically; middle leaflet 90–125 × 2–3 cm, single-fold, somewhat acuminate or truncately praemorse apically; terminal leaflets comprising 2 or 3 folds, truncately praemorse apically. **Inflorescence** 60–90 cm long including 10–15 cm peduncle, branched to 2 or 3 orders, apparently protogynous; rachillae ca. 28 (rarely 8–11); triads 4–10 mm apart, opposite and decussate; inflorescences 7–8 present. **Staminate flower** 13–20 × 3–6 mm in bud (when dry), cream; stamens 8–24. **Pistillate flower** 2–3 × 2–3 mm in bud (when dry), cream to brownish, with free sepals and free, low and ± rounded petals. **Fruit** 7–10 × 6–10 mm when ripe, subglobose to broadly ellipsoid, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3 mm in diam.). **Seed** ca. 6.5 × 5.5 mm, subglobose; endosperm homogeneous.

Distribution:—The central New Guinea highlands, Goodenough Island and the Torricelli Mountains of Papua New Guinea, and Yapen Island in western New Guinea.

Habitat:—Premontane and montane forest on slopes and ridgetops with volcanic soils and limestone, (300–)500–1450 m.

Uses:—Used in house construction, especially for flooring.

Vernacular names:—None recorded.

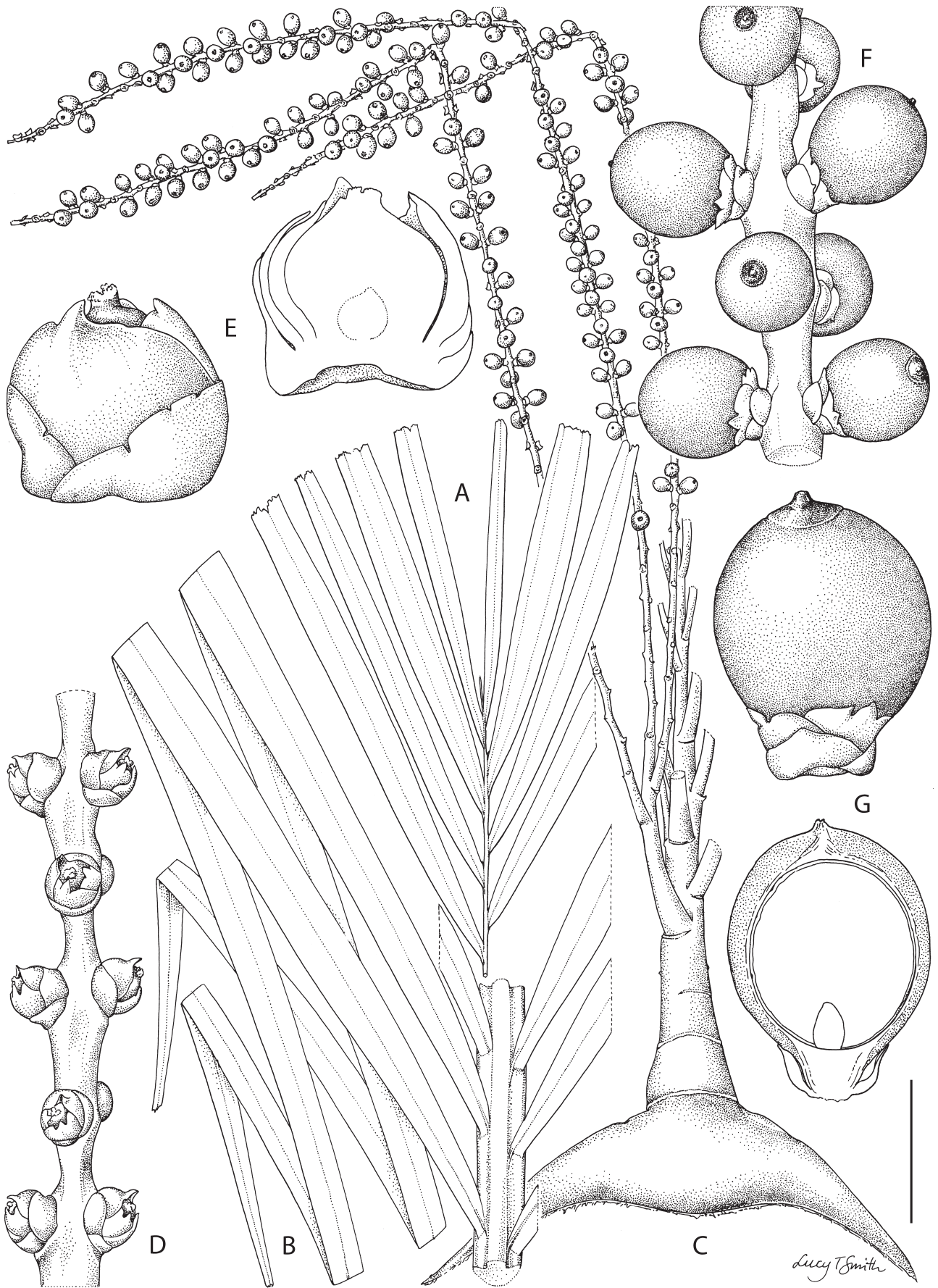


FIGURE 42. *Hydiastele longispatha*. A. Leaf apex. B. Mid-leaf portion. C. Inflorescence in part. D. Portion of rachilla with pistillate flowers. E. Pistillate flower whole and in longitudinal section. F. Portion of rachilla with fruit. G. Fruit whole and in longitudinal section. Scale bar: A–B = 8 cm; C = 6 cm; D, F = 1.5 cm; E = 2.5 mm; G = 7 mm. All from *Baker et al.* 882. Drawn by Lucy T. Smith.



FIGURE 43. *Hydrastele longispatha*. A. Habit. B. Inflorescence with pistillate flowers and infructescence with maturing fruit. All from Baker *et al.* 882. All photos: W.J. Baker.

Conservation status:—Least Concern (LC). *Hydrastele longispatha* is widely distributed (EOO > 395,000 km²) and the relatively low AOO (52 km²) is most likely a low estimate resulting from under-collecting.

Specimens examined:—INDONESIA. **Papua Province:** Mimika, Timika, Mile 50, on road to Tembagapura, forest to west of container depot, Loc 36, 545 m, 4°17'S, 137°1'E, 26 February 1998, Baker *et al.* 882 (AAU, BH, BO, K!, L, MAN); Jalan trans Yapen, Yapen Island, 650 m, 1°45'S, 136°15'E, 26 October 1998, *Maturbongs 614* (BO, FTG, K!, L, MAN, NY); 4 km SW of Bernhard Camp, Idenburg River, 900 m, 3°29'S, 139°6'E, March 1939, *Brass 13099A* (A!, BRI, L!); Same locality as preceding, 3°29'S, 139°6'E, March 1939, *Brass 13099* (A!, L); PAPUA NEW GUINEA. **Central Province:** Bella Vista, 1450 m, 8°33'S, 147°7'E, November 1933, *Brass 5457* (B†, A!, BRI!, NY!); **Milne Bay Province:** Ridge above Mayu River near Mayu I camp (Mt. Suckling Expedition), 500 m, 9°38'S, 149°10'E, 15 July 1972, *Essig LAE 55231* (BH, CANB, K, L!, LAE!); Subprovince Esa'ala, Goodenough Island, northern slopes of North peak, 1100 m, 9°19'S, 150°15'E, 26 December 1977, *Croft LAE 71277* (BH, BRI, CANB!, L!); N of Bubuleta Agricultural Station, 30 km E of Alotau, 300 m, 10°20'S, 150°40'E, 18 December 1976, *Croft et al. LAE 71094* (BH, L!, LAE); **Sandaun Province:** Miwaute, 950 m, 3°25'S, 142°7'E, 20 November 1996, *Barfod 389* (AAU!, K!); Telefomon Subdist., Frieda River, Kokomo Creek, 700 m, 4°42'S, 141°48'E, 28 June 1969, *Henty NGF 42674* (LAE!); Lumi Subdistr., Near Fatima, road from Lumi, 900 m, 3°20'S, 142°10'E, 26 November 1971, *Essig 55099* (BH, CANB, L!, LAE); Telefomin Subdist., Antap Mt., Carpentaria Exploration Co., 1000 m, 4°45'S, 141°50'E, 1 May 1978, *Essig LAE 74081* (LAE!); Same locality as preceding, 4°45'S, 141°50'E, 1 May 1978, *Essig LAE 74083* (LAE!); Sepik: Nov 1910, *Schultze 323* (B†, FI!); **Southern Highlands Province:** Mount Bosavi, Bona Village, WWF Integrated Conservation and Development Project Area, 700 m, 6°26'S, 142°47'E, 3 February 1996, Baker *et al.* 622 (BH, K!, LAE).

Notes:—*Hydrastele longispatha* is a robust, emergent palm with arching leaves and ca. 57–70 ascending leaflets on each side of the rachis. It is distinct from other species treated here due to the combination of the apical leaflet pair with truncately praemorse tips and protogynous inflorescences. Other robust palms in New Guinea and Australia with truncately praemorse apical leaflets have protandrous inflorescences. *Hydrastele longispatha* is further distinguished

by its high variation in stamen number (8–24 stamens) and relatively small (7–10 × 6–10 mm) subglobose to broadly ellipsoid fruits.

Hydriastele longispatha most closely resembles the five robust, protogynous species of *Hydriastele* that occur in east Melanesia. These taxa are described by Essig (1982) and Baker & Loo (2006), but, in brief, *H. macrospadix* and *H. hombronii* from the Solomon Islands have smaller proportions than *H. longispatha* with only 30–46 leaflets on each side of the rachis, while *H. cylindrocarpa* from Vanuatu, and *H. vitiensis* and *H. boumae* from Fiji, are all distinguished by their white to yellowish fruits.

Based on our study of the material cited here, we concur with Essig (1982) in broadening the circumscription of *H. longispatha* due to a continuum in stamen variation and homogeneity across other characters. In addition, due to several new collections, characters that were thought to be distinguishing for *H. valida*, e.g. slightly less arching leaves with stiff and erect leaflets, now fall within the continuum of variation that we accept for *H. longispatha*, resulting in *H. valida* being placed in synonymy.

20. *Hydriastele manusii* (Essig) Baker & Loo (2004: 65). *Gronophyllum manusii* Essig (1995: 100). Type:—PAPUA NEW GUINEA. Manus Province: Manus Island, Mt. Dremsel, 740 m, 2°8'S, 146°57'E, 29 November 1975, *Sands et al.* 2880 (holotype USF, isotypes K!, L!)

Figure 44 (line drawing). Figure 45 (photo plate). Figure 35 (map).

Solitary, moderately robust palm to 20 m tall, bearing 9–13 leaves in crown. **Stem** 10–15 cm in diam.; internode not seen. **Leaf** ca. 1.5–2 m long including petiole; sheath ca. 100 cm long, with white bloom, crownshaft ca. 150 × 15 cm; petiole ca. 10 cm long, channelled adaxially; rachis arcuate; leaflets ca. 40 per side, arranged regularly, ascending and ± drooping at their tips, linear, truncately praemorse apically, lacking ramenta; basal leaflets multi-fold; middle leaflets 60–66 × 2–3 cm, single-fold; terminal leaflets comprising 2–4 folds. **Inflorescence** 60–80 cm long including 20–22 cm peduncle, branched to 2 orders, protandrous; rachillae 12–15; triads on average 3–4 mm apart, opposite and decussate; 1–5 inflorescences present. **Staminate flower** 6–7 × 3–4 mm at anthesis (when dry); stamens 6. **Pistillate flower** 3.5–4 × 2.5–3 mm in bud (when dry), with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** ca. 12 × 4 mm (when dry), elongate and curved (when dry), red, with a rather inconspicuous sclerotic zone encircling apical stigmatic remains (up to ca. 1.5 mm in diam. when dry). **Seed** ca. 8.3 × 3.5 mm (when dry), curved; endosperm homogeneous.

Distribution:—Manus Island in the Bismarck Archipelago.

Habitat:—Premontane rainforest on steep slopes, 600–740 m.

Uses:—None recorded

Vernacular names:—None recorded

Conservation status:—Data deficient (DD). This species is insufficiently known to be assessed, but increased logging in Manus is likely to be a threat (Shearman *et al.* 2008).

Specimens examined:—PAPUA NEW GUINEA. **Manus Province:** Manus Island, Mt. Dremsel, 740 m, 2°8'S, 146°57'E, 29 November 1975, *Sands et al.* 2880 (USF, K!, L!); same locality as preceding, 630 m, 2°9'S, 146°57'E, 26 March 1981, *Kerenga et al.* LAE 77518 (LAE!, USF).

Notes:—*Hydriastele manusii* is a moderately robust canopy palm distinguished by its relatively short (1.5–2 m long), arching leaves with equally short (ca. 10 cm long) petioles. The species is further distinguished by its inflorescences with 20 cm long peduncles and relatively few (12–15) rachillae. Confusion with other species is unlikely.

21. *Hydriastele procera* (Blume) Baker & Loo (2004: 67). *Kentia procera* Blume (1838: 65). *Areca procera* (Blume) Zipp. ex Blume (1843: 95). *Gronophyllum procerum* (Blume) Moore (1963: 265). Type:—INDONESIA. West Papua Province: Triton Bay, 1828, *Zippelius s.n.* (holotype L!)

Figure 46 (line drawing). Figure 47 (photo plate). Figure 35 (map).

Solitary and gregarious, robust palm to 30 m tall, bearing 10–15 leaves in crown, crown spherical. **Stem** 20–30 cm in diam., moderately ventricose; internode 6–25 cm long. **Leaf** (1–)2–4 m long including petiole; sheath ca. 100 cm long, with some white bloom, crownshaft not seen; petiole 15–20 cm long, flattened adaxially; rachis straight or slightly drooping; leaflets 40–61 per side, arranged regularly, single-fold, pendulous, linear; with ramenta attached to the basal portion of the abaxial side of the midrib; middle leaflets 70–90 × 3–4 cm, acuminate to briefly bifid apically; terminal

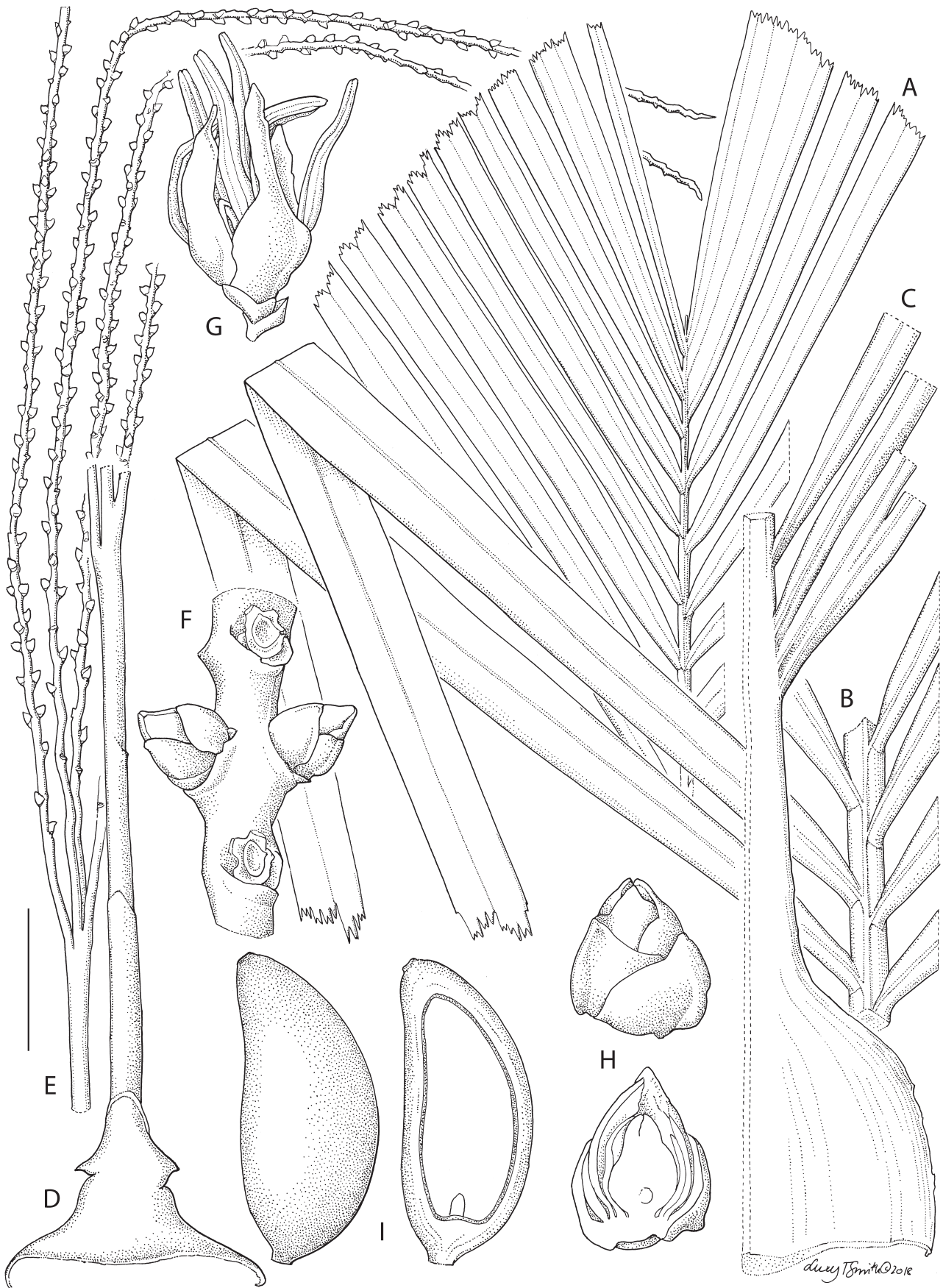


FIGURE 44. *Hydrastele manusii*. A. Leaf apex. B. Leaf mid-portion. C. Leaf base with portion of sheath. D. Peduncle. E. Portion of inflorescence with pistillate flowers. F. Portion of rachilla with pistillate flowers. G. Staminate flower. H. Pistillate flower whole and in longitudinal section. I. Fruit whole and in longitudinal section. Scale bar: A–C = 6 cm; D–E = 4 cm; F, I = 5 mm; G = 4 mm; H = 3.3 mm. All from Sands *et al.* 2880. Drawn by Lucy T. Smith.



FIGURE 45. *Hydriastele manusii*. A. Habit. B. Juvenile habit. All from Manus Island. All photos: Axel Dalberg Poulsen.

leaflets acuminate to briefly bifid apically. **Inflorescence** 55–90 cm long including 7–12 cm peduncle, branched to 2 or 3 orders, protandrous; rachillae 23–40, ca. 2–3 mm in diam.; triads 6–7 mm apart, opposite and decussate; ca. 6 inflorescences present. **Staminate flower** 14–16 × 3–5 mm in bud (when dry); stamens 6. **Pistillate flower** ca. 6–6.5 × 3 mm in bud, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** 10–15 × 6–7 mm when ripe (and dry), ellipsoid, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3.5 mm in diam. when dry). **Seed** ca. 9.5 × 5 (when dry), ellipsoid; endosperm homogeneous.

Distribution:—West Papua Province in western New Guinea.

Habitat:—Limestone cliffs and crags, 0–200 m.

Uses:—Flooring.

Vernacular names:—None recorded.

Conservation status:—Data deficient (DD). More data are needed about the range and abundance of this species.

Specimens examined:—INDONESIA. **West Papua Province:** Triton Bay, 1828, *Zippelius s.n.* (L!); Kaimana Regency, Kaimana Distr., Kroy village, 110 m, 3°37'S, 133°44'E, 7 May 2001, *Mehen SM 21* (MAN, K!); Raja Ampat Regency, Waigeo Island, Rabia strait, 6 m, 0°14'S, 130°50'E, 28 June 1997, *Maturbongs 532* (MAN, K!); Raja Ampat Regency, Gam Island, Durumangkintus, limestone forest behind Yenbeser village, 0°27'58.88"S, 130°40'33.3"E, 5 October 2011, *Heatubun 1133* (MAN, K!).

Notes:—*Hydriastele procera* is a tall and robust palm with a moderately ventricose trunk that often occurs gregariously on limestone. The species is distinguished by its spherical crown of more-or-less straight leaves in combination with protandrous inflorescences (ca. six inflorescences are present at any given time) with relatively slender rachillae (ca. 2–3 mm in diam.), staminate flowers with six stamens, and relatively large fruits (10–15 × 6–7 mm when dry). *Hydriastele procera* is most similar to *H. wosimiensis*, but that species has up to 26 inflorescences, thicker rachillae (ca. 3.5 mm in diam.), staminate flowers with 12 stamens and smaller fruits (7.5–9.5 × 5–5.5 mm when dry).



FIGURE 46. *Hydrastele procera*. A. Leaf apex. B. Mid-leaf portion adaxial side. C. Mid-leaf portion abaxial side. D. Inflorescence in part. E. Portion of rachilla with triads. F. Staminate flower. G–H. Pistillate flower whole and in longitudinal section. I. Fruit whole and in longitudinal section. Scale bar: A–D = 8 cm; E, I = 7.5 mm; F = 5 mm; G–H = 3.3 mm. A–D, I from *Maturbongs 532*; E–H from *Heatubun 1133*. Drawn by Lucy T. Smith.

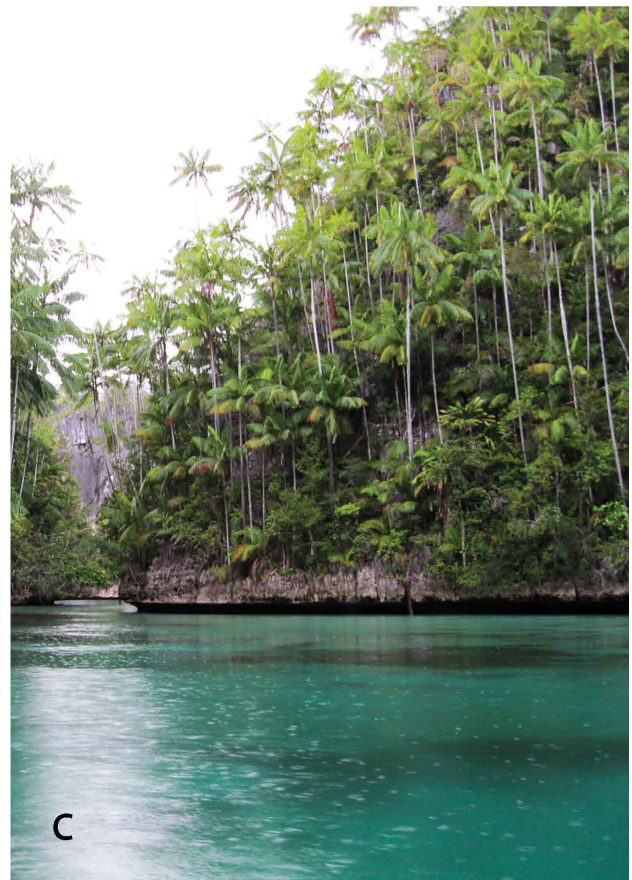


FIGURE 47. *Hydriastele procera*. A–C. Habit. All from Triton Bay, western New Guinea. All photos: Charles Humfrey.



FIGURE 48. *Hydriastele wosimiensis*. A. Portion of stem. B. Leaf apex. C. Mid-leaf portion. D. Inflorescence. E. Portion of rachilla with pistillate flowers. F. Triad. G. Staminate flower in longitudinal section. H. Pistillate flower whole and in longitudinal section. I. Portion of rachilla with fruit. J. Fruit in longitudinal section. Scale bar: A = 3 cm; B–C = 8 cm; D = 6 cm; E = 1 cm; F, J = 7 mm; G = 5 mm; H = 3.3 mm; I = 1.5 cm. All from Baker *et al.* 1068. Drawn by Lucy T. Smith.

22. *Hydriastele wosimiensis* W.J.Baker & Petoe, *sp. nov.* Type:—INDONESIA. West Papua Province: vicinity of Wosimi river, Wasior Distr., Manokwari Regency [Teluk Wondama Regency]; Sikama river, 3 km SE of Senderawoi village, 26km SSE of Wasior, 200 m, 2°57'S, 134°34'E, 27 February 2000, *Baker et al. 1068* (holotype K!, isotypes AAU!, BO, BRI, L, MAN)

Diagnosis:—Distinguished by its slightly drooping leaves with pendulous leaflets in combination with a very large number of protandrous inflorescences (up to 26 at various stages of maturity) with thick rachillae (ca. 3.5 mm in diam.), staminate flowers with 12 stamens, and small ellipsoid fruits (9.5–10 × 6–8 mm).

Figure 48 (line drawing). Figure 35 (map).

Solitary, robust canopy palm to 30 m tall, bearing ca. 20 leaves in crown. **Stem** ca. 25 cm in diam., moderately ventricose; internode 4–25 cm long. **Leaf** 2.5–3 m long including petiole; sheath ca. 100 cm long with copious white indumentum, crownshaft ca. 110 × 25 cm; petiole ca. 40 cm long, flattened adaxially; rachis slightly drooping, extending beyond the terminal leaflets; leaflets ca. 50 per side, arranged regularly, single-fold, pendulous, linear, with scattered ramenta on the abaxial, basal to middle portion of the midrib; middle leaflets ca. 70 × 2.5 cm, obliquely to truncately praemorse apically; terminal leaflets briefly bifid apically. **Inflorescence** ca. 80 cm long including 12 cm peduncle, branched to 2 orders, protandrous; rachillae ca. 25, ca. 3.5 mm in diam.; triads on average 5 mm apart, opposite and decussate; ca. 26 inflorescences present (at various stages). **Staminate flower** ca. 13 × 3–4 mm in bud, cream; stamens 12. **Pistillate flower** 4–5 × 3.5–4 mm in bud, cream, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** 9.5–10 × 6–8 mm when ripe (7.5–9.5 × 5–5.5 mm when dry), ± ellipsoid, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 3.5 mm in diam.). **Seed** 5.6–6.7 × 5–5.5 mm, broadly ellipsoid; endosperm homogeneous.

Distribution:—Known from the type locality in the vicinity of the Wosimi River, south of the Wandammen Peninsula in West Papua Province, western New Guinea.

Habitat:—Lowland rainforest on shallow slopes, 200 m.

Uses:—Stems used for floor boards.

Vernacular names:—*Kaparo* (Wandama).

Conservation status:—Data deficient (DD). More data are needed about the range and abundance of this species.

Specimens examined:—INDONESIA. **West Papua Province:** vicinity of Wosimi river, Wasior Distr., Manokwari Regency [Teluk Wondama Regency], Sikama river, 3 km SE of Senderawoi village, 26km SSE of Wasior, 200 m, 2°57'S, 134°34'E, 27 February 2000, *Baker et al. 1068* (AAU!, BO, BRI, K!, L, MAN).

Notes:—*Hydriastele wosimiensis* is a tall and robust palm with a moderately ventricose trunk. The species is distinguished by its slightly drooping leaves with pendulous leaflets in combination with protandrous inflorescences (up to 26 are present at any given time) with relatively thick rachillae (ca. 3.5 mm in diam.), staminate flowers with 12 stamens, and small fruits (7.5–9.5 × 5–5.5 mm when dry). *Hydriastele wosimiensis* is most similar to *H. procera* although that species has fewer inflorescences (ca. six present) with generally more slender rachillae (ca. 2–3 mm in diam.), larger fruits (10–15 × 6–7 mm when dry), and flowers with six stamens.

MOLUCCANA GROUP

Robust palms, leaves straight to slightly drooping with pendulous leaflets, inflorescences protogynous. The Moluccas, New Guinea, the Bismarck Archipelago and Australia.

23. *Hydriastele costata* Bailey (1898: 129). Type:—AUSTRALIA. Queensland: Cape York Peninsula, Somerset, *Jardine s.n.* (holotype BRI)

Kentia costata Beccari (1877: 36). *Gulubia costata* (Becc.) Beccari (1885: 134). Type:—INDONESIA. Maluku Province: Aru Islands, Wokam, *Beccari s.n.* (holotype FI!, isotype K!).

Gulubia costata var. *minor* Beccari (1885: 135). Type:—INDONESIA. Papua Province: Yapen, Ansum, *Beccari s.n.* (holotype FI!).

Gulubia costata var. *pisiformis* Beccari (1885: 136). Type:—Cultivated in Bogor Botanic Gardens, *Beccari s.n.* (holotype FI!).

Pinanga pisiformis Teijsm. ex Beccari (1885: 136). *nom. illeg.*

Kentia microcarpa Warb. ex Schumann & Lauterbach (1900: 207). Lectotype (designated by Baker & Loo [2004]):—PAPUA NEW GUINEA. Morobe Province: Finschhafen, *Lauterbach 751* (L!, isolectotype FI).

Kentia costata var. *microcarpa* Lauterb. & K.Schum. ex Schumann & Lauterbach (1900: 207). *nom. illeg.*

Gulubia affinis Beccari (1923: 444). Type:—PAPUA NEW GUINEA. East Sepik Province: Hunstein Mts., *Ledermann 8228* (holotype B†).

Gulubia costata var. *gracilior* Burret (1936a: 81). Type:—PAPUA NEW GUINEA. Western Province: Oriomo River, Woroi, *Brass 5887* (holotype B†, isotypes A, BO, BRI!, NY!).

Figure 49 (line drawing). Figure 50 (photo plate). Figure 51 (map).

Solitary, robust to very robust palm, to 35 m tall bearing 12–25 leaves in crown, crown distinctively spherical. **Stem** 15–35 cm in diam. **Leaf** 2.4–5.5 m long including petiole; sheath 50–180 cm long; petiole 10–60 cm long; rachis straight or slightly drooping; leaflets 58–75 per side, arranged regularly, single-fold, pendulous, linear and acuminate to briefly bifid apically; with rammenta attached to the basal portion of the abaxial side of the midrib; middle leaflet 90–130 × 3–5 cm. **Inflorescence** 58–100 cm long including 5–25 cm peduncle, branched to 2 or 3 orders, apparently protogynous; triads 1–5 mm apart, opposite and decussate. **Staminate flower** 6–8 × 2–3 mm in bud, white to brownish; stamens 6, not exposed in bud. **Pistillate flower** ca. 2 × 2.5–3 mm in bud, cream, with free sepals and free, low and ± rounded petals. **Fruit** ca. 8–10 × 6 mm when ripe, ellipsoid, ripening through reddish brown to dark purple or blackish maroon, with conspicuous longitudinal white-greyish stripes, with inconspicuous sclerotic zone encircling apical stigmatic remains (up to ca. 1 mm in diam.). **Seed** ca. 5.5 × 4.5 mm, ellipsoid, costate; endosperm homogeneous.

Distribution:—Widely distributed in the north eastern portion of Cape York Peninsula in Queensland, Australia, and throughout lowland New Guinea and adjacent islands. Also reported from the Bismarck Archipelago (Essig 1982).

Habitat:—Primary or secondary lowland rainforest often on swampy ground, or more infrequently lower montane forest on less waterlogged ridges and slopes, 0–700 m.

Uses:—Stems and leaves used for flooring and house construction, leaf sheaths used as basins for water buckets, carrying baskets, sago containers and plates, indumentum used as firelighter and old inflorescences as brushes. The palm heart is consumed. Commonly planted near villages.

Vernacular names:—*Avos/Afos* (Miyah), *Bay* (Marap), *Kaparo* (Wandamen), *Korr* (Jal), *Mabla* (Orne), *Oratara* (Sumuri), *Poi* (Wapi), *Tab* (Timbunke), *Tabavo Nyi* (Unknown dialect, North Cyclops Mts. area), *Tabuh* (Maprik), *Yawa* (Ambakanja).

Conservation status:—Least Concern (LC). *Hydriastele costata* is widely distributed (EOO > 1,360,000 km²) and common. The AOO (136 km²) is higher than for most other species within the genus yet still likely to be a conservative figure.

Specimens examined:—AUSTRALIA. **Queensland:** Cape York Peninsula, Iron Range, 12°45'S, 143°15'E, 16 June 1948, *Brass 19207* (BRI, K!, L!); Cape York Peninsula, Iron Range, 30 m, 12°45'S, 143°15'E, 17 October 1974, *Irvine 1020* (BRI, CNS, L!); Same locality as preceding, 12°45'S, 143°15'E, 17 September 1974, *Irvine 1011* (BRI, CNS, K!). INDONESIA. **Maluku Province:** Aru Islands: Wokam (Vokan), 5°45'S, 134°30'E, 1873, *Beccari s.n.* (FI!, K!); **Papua Province:** Nabire, Wanggar, Bumi River, 10 m, 3°30'S, 135°27'E, 9 February 2001, *Heatubun 340* (AAU, K!, MAN); Mimika, Timika, Road from Mile 21/Timika to Port, 5 m, 4°41'S, 136°52'E, 12 February 1998, *Baker et al. 836* (AAU, BH, BO, K!, L, MAN); Yapen, Ansum, 1°43'S, 135°49', 1875, *Beccari s.n.* (FI!); Aria, near Uta, 4 m, 4°32'S, 136°0'E, 28 June 1941, *Aet 386* (BO, K!, L!, SING); Northern Biak, Wari village, 10 m, 0°55'S, 135°55'E, 10 September 1998, *Maturbongs 573* (BO, K!, MAN); Jayapura, North Cyclops Mts., 15 m, 2°30'S, 140°32'E, 30 January 2001, *Desianto 21* (AAU, K!, MAN); Manokwari Distr., Bintuni Subdistr., in hill forest inside property line of BP, beside trail between Saengga & Tanah Merah villages, 20 m, 2°27'S, 133°7'E, 19 February 2002, *Maturbongs 733* (BO, K!, LAE, MAN); Arso Distr., Tami River, Yawara, 100 m, 2°51'S, 140°48'E, 15 March 2002, *Gusbager 13* (AAU, K!, LAE, MAN); **West Papua Province:** Sorong distr., Klasaman, Klabainem, 10 m, 0°54'S, 131°20'E, 29 January 2002, *Heatubun 374* (K!, MAN); Manokwari, Nuni, Sungei Asiai, between Mt. Manggombo and Mt. Marwadibau, 15 m, 0°45'S, 133°56'E, 18 August 1995, *Zona 681* (FTG, K!); Tamrau Mountains, furthest end of the Sorong-Manokwari road, 547 m, 0°49'S, 132°31'E, 23 January 2013, *Gardiner 410* (AAU, BO, K!, L, MAN); Wandammen Peninsula, Wasior distr., Manokwari Regency near Dotir village, 11 km N of Wasior, near the confluence of the Mawoi River and the Yoiso River, 20 m, 2°37'S, 134°29'E, 20 February 2000, *Baker et al. 1042* (BO, BRI, K!, L, MAN); Wandammen Peninsula, Wasior distr., Manokwari Regency; Kowi, near Wondiwoi village, ca. 9 km S of Wasior, 570 m, 2°48'S, 134°32'E, 23

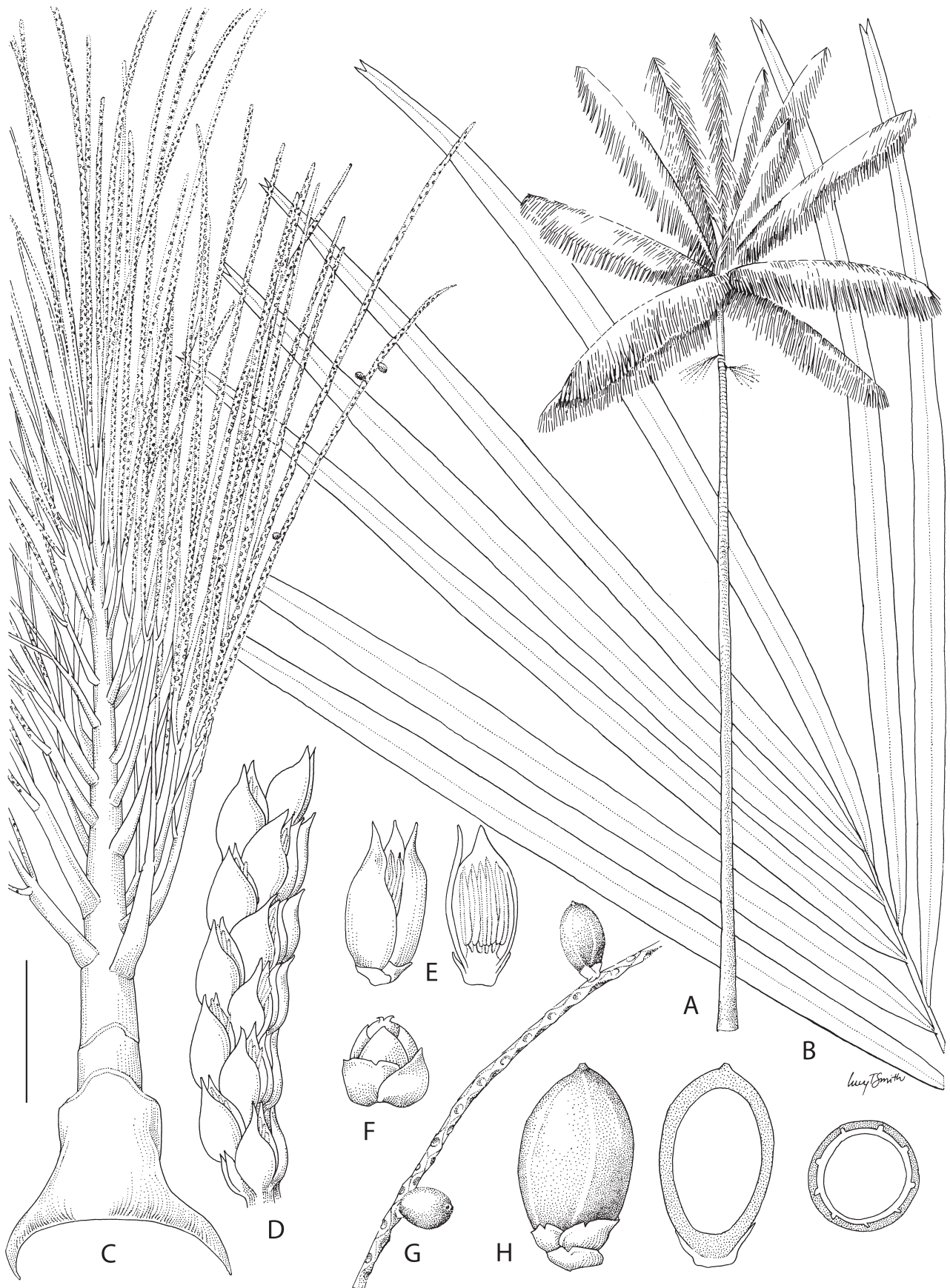


FIGURE 49. *Hydiastele costata*. A. Habit. B. Leaf apex. C. Infructescence. D. Portion of rachilla with triads (pistillate flowers not visible). E. Staminate flower whole and in longitudinal section. F. Pistillate flower. G. Portion of rachilla with fruit. H. Fruit whole, in longitudinal section, and in transverse section. Scale bar: A = 1.8 m; B = 6 cm; C = 9 cm; D = 1 cm; E = 7 mm; F, H = 5 mm; G = 2 cm. A from Prati Valley, August 1995; B–H from *Baker et al.* 836. Drawn by Lucy T. Smith.



FIGURE 50. *Hydrastele costata*. A. Habit. B. Crown. C. Portions of rachillae with triads. D. Portion of inflorescence with pistillate flowers. E. Portion of rachilla with fruit. A from Biak Island; B from Lae Botanic Garden, Papua New Guinea; C–D from *Baker et al. 1042*; E from *Baker et al. 1052*. All photos: W.J. Baker.

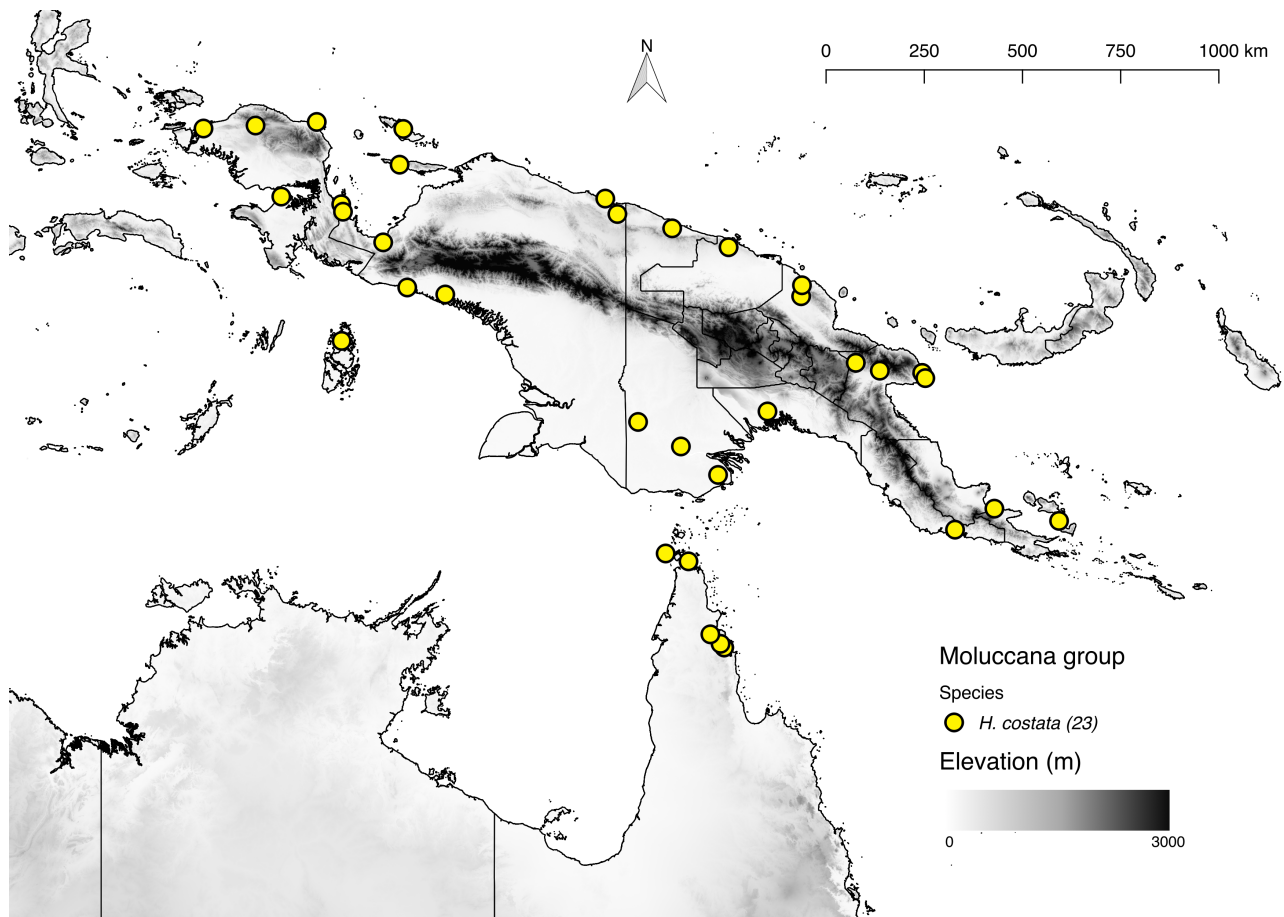


FIGURE 51. Distribution map of the Moluccana group of *Hydriastele* in New Guinea, Australia and adjacent islands.

February 2000, *Baker et al.* 1052 (AAU, BO, BRI, K!, L, MAN). PAPUA NEW GUINEA. **Central Province:** Road from Mori River to Yano Village, 15 km NE of Cape Rodney, 30 m, 10°4'S, 148°32'E, 5 September 1969, *Pullen* 8218 (BH, CANB, L!, LAE); **East Sepik Province:** Pieni River, near Walwali Village, Aitape Subdistr., 30 m, 3°11'S, 142°4'E, 20 June 1961, *Darbyshire* 7971 (A, BRI, L!, LAE); Prince Alexander Range, SE side of Mt. Turu above Ambakanja Village, 700 m, 3°37'S, 143°22'E, 25 August 1959, *Pullen* 1597 (L!, LAE); 5 miles N of Timbunke, 30 m, 4°7'S, 143°30'E, 12 October 1959, *Pullen* 1717 (CANB, L!, LAE); **Gulf Province:** Kikori Distr., Bank of Kikori River near Kopi, 13 km N of Kikori, 40 m, 7°22'S, 144°14'E, 19 November 2000, *Baker et al.* 1095 (AAU, K!, LAE); **Madang Province:** Josephstall FMA area, along footpath towards Morasapa, W of expedition Camp 1 ('Kumamdeber'), and to lower slopes N of the trail, 161.54 m, 4°28'S, 145°1'E, 29 July 1999, *Takeuchi* 13522 (A, K!); Lower Ramu valley, quarter mile N of Josephstall airstrip, 4°44'S, 145°1'E, 2 September 1958, *Pullen* 1082 (A, CANB, L!); **Milne Bay Province:** Peria Creek, Kwagira River, 50 m, 9°35'S, 149°26'E, 25 August 1953, *Brass* 24185 (A, K!, L!, LAE); Inland from Miadeba, Normanby Island, 250 m, 9°52'S, 150°55'E, 24 November 1976, *Croft* 68903 (L!, LAE); **Morobe Province:** Finschhafen, 5 August 1890, *Lauterbach* 751 (FI, L!); Boana, 6°26'S, 146°49'E, 20 September 1940, *Clemens* 41839 (K!); Kajabit Mission Vicinity, 6°15'S, 146°16'E, 7 September 1939, *Clemens* 10674 (MICH, K!); Kajabit Mission Vicinity, 275 m, 6°15'S, 146°16'E, 21 September 1939, *Clemens* 10702 (K!, MICH); Sattelberg, Hillsbach, 2000 m, 6°29'S, 147°47'E, 28 October 1935, *Clemens* 660 (L!); **Unknown Province:** June 1885, *Bauerlen s.n.* (MEL!); British New Guinea [now SE New Guinea], 1890, *Loria s.n.* (K!); **Western Province:** Woroi, Oriomo River, 8°49'S, 143°7'E, January 1934, *Brass* 5887 (A, B†, BO, BRI!, NY!). CULTIVATED. INDONESIA. Bogor Botanic Gardens, *Beccari s.n.* (FI!).

Notes:—*Hydriastele costata* is the commonest lowland tree palm in New Guinea. It is immediately recognisable as a canopy emergent with a distinctive, spherical crown of more-or-less straight leaves with pendulous leaflets. Its highly distinctive longitudinally striped fruits with costate seeds are not seen in any other member of the genus. *Hydriastele costata* has a similar habit to *H. procera* and *H. wosimiensis* from the Longispatha group. *Hydriastele costata* appears to be most similar to *H. moluccana*, a rarely collected species known from North Maluku

Province in Indonesia. *Hydriastele costata* is distinguished from this species primarily by its striped fruits with costate seeds (see Essig 1982).

PALAUENSIS GROUP

Robust palms, leaves strongly arching with ascending leaflets, inflorescences protandrous or protogynous, staminate flowers with 6 stamens that are congenitally exposed in bud, i.e. the margins of the staminate petals do not meet. Palau, the Biak Islands and Australia.

24. *Hydriaste biakensis* Baker & Heatubun (2012: 144–150). Type:—INDONESIA. Papua Province: Biak Island, Oridek distr., Wadibu village, 1°8'32"S, 136°18'11"E, July 2009, *Baker et al. 1342* (holotype K!, isotypes AAU!, BO, MAN)

Figure 52 (line drawing). Figure 53 (photo plate). Figure 54 (map).

Solitary, robust palm to ca. 15 m tall bearing 18–24 leaves in crown. **Stem** ca. 30 cm in diam. **Leaf** ca. 3.3–3.6 m long including petiole; sheath ca. 170 cm long; petiole ca. 47–50 cm long; rachis strongly arcuate; leaflets ca. 65 per side, arranged regularly, single-fold, ascending and sometimes ± drooping at their tips, linear acuminate or sometimes briefly bifid to obliquely praemorse apically, with ramenta attached to the basal portion of the abaxial side of the midrib; middle leaflet 121–126 × 3–4.5 cm. **Inflorescence** 95–100 cm long including 19–21 cm peduncle, branched to 4 orders, apparently protogynous, with pronounced “shoulders” formed by the abrupt constriction of the peduncle right above the prophyll scar; prophyll often ± sigmoid, with pithy keels; rachillae sinuous, especially towards the tip; triads 3–7 mm apart, opposite and decussate. **Staminate flower** 5–6.5 × 2.5–4 mm in bud, white; stamens 6, exposed in bud. **Pistillate flower** ca. 2.5 × 2.5–2.8 mm in bud, with free sepals and free, low and ± rounded petals. **Fruit** 9.5–12 × 5–6 mm when ripe, narrowly ellipsoid, red, with inconspicuous sclerotic zone encircling apical stigmatic remains (up to ca. 1 mm in diam.). **Seed** 7.5–8.2 × 4–4.3 mm, cylindrical; endosperm homogeneous.

Distribution:—Numfoor Island and Biak Island. May also occur on the nearby Auki Island (Baker & Heatubun 2012).

Habitat:—Coastal forest near beach or on cliff edges, on rugged limestone with very thin or no topsoil, near to sea level.

Uses:—Stems and leaf sheaths used for flooring and baskets respectively.

Vernacular names:—*Arwaf* (Biak).

Conservation status:—Endangered (EN; Baker & Heatubun 2012).

Specimens examined:—INDONESIA. **Papua Province:** Biak Island, Oridek distr., Wadibu village, 1°8'32"S, 136°18'11"E, 24 July 2009, *Baker et al. 1342* (AAU!, BO, K!, MAN); Same locality as preceding, 1°8'32"S, 136°18'11"E, 24 July 2009, *Heatubun 970* (BO!, K!, MAN!, NY!); Numfoor Island, 01°03'15.6" S 134°49'17.8"E, 11 November 2012, *Heatubun 1225* (MAN, K!).

Notes:—*Hydriastele biakensis* is endemic to the Biak Islands and is the only canopy species of the genus recorded from this area other than *H. costata*. Unlike *H. costata*, *H. biakensis* has a recurved crown, but differs from similar species in that its terminal leaflets are single-fold and pointed or shallowly notched at their tips (not truncately praemorse). In addition, its staminate flowers are congenitally open in bud and its prophyll is often somewhat distorted, features that are shared with the Australian *H. ramsayi*, but *H. biakensis* is distinguished from this, and all other species in the genus, by its inflorescence branched to 4 orders with markedly sinuous rachillae and a peduncle with prominent “shoulders” resulting from an abrupt constriction by the prophyll scar.

Hydriastele biakensis is strongly supported as sister species to the smaller *H. palauensis* (Loo *et al.* 2006, Baker & Heatubun 2012), which is endemic to the Pacific island nation of Palau and, like *H. biakensis*, has staminate flowers that are congenitally open in bud (see Baker & Heatubun 2012).

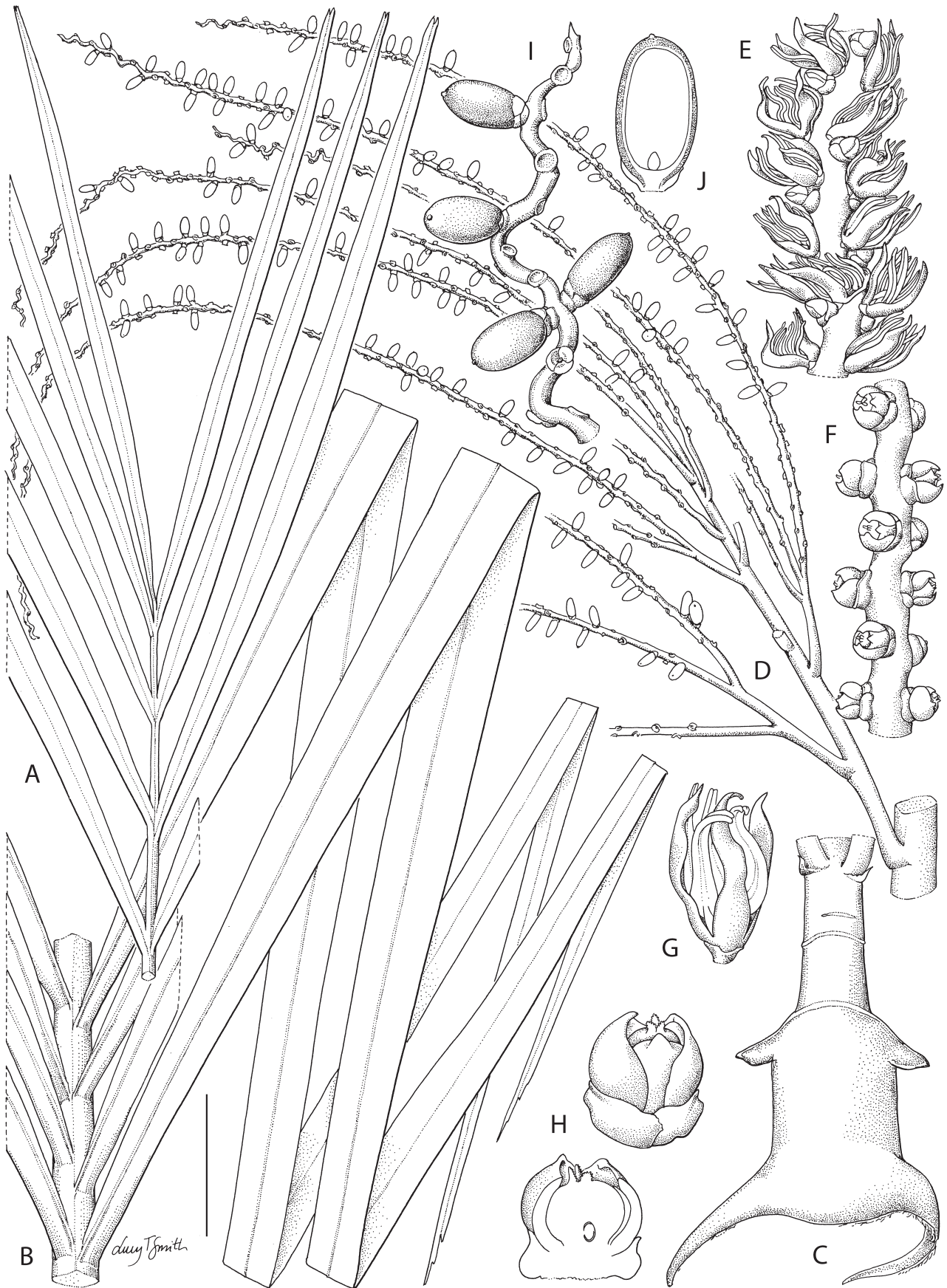


FIGURE 52. *Hydiastele biakensis*. A. Leaf apex. B. Mid-leaf portion. C. Peduncle. D. Inflorescence first order branch. E. Portion of rachilla with triads. F. Portion of rachilla with pistillate flowers. G. Staminate flower. H. Pistillate flower whole and in longitudinal section. I. Apical portion of rachilla with fruit. J. Fruit in longitudinal section. A–B, D = 6 cm; C = 8 cm; E, I = 1.5 cm; F, J = 1 cm; G = 5 mm; H = 3 mm. A–D from Baker *et al.* 1342; E–J from Heatubun *et al.* 970. Drawn by Lucy T. Smith.



FIGURE 53. *Hydriastele biakensis*. A. Habit. B. Crown. C. Inflorescence and peduncular bract contained within prophyll. D. Portion of rachilla with triads. E. Portions of rachillae with fruit. A–B from Biak Island; C–E from *Baker et al.* 1342. All photos W.J. Baker.

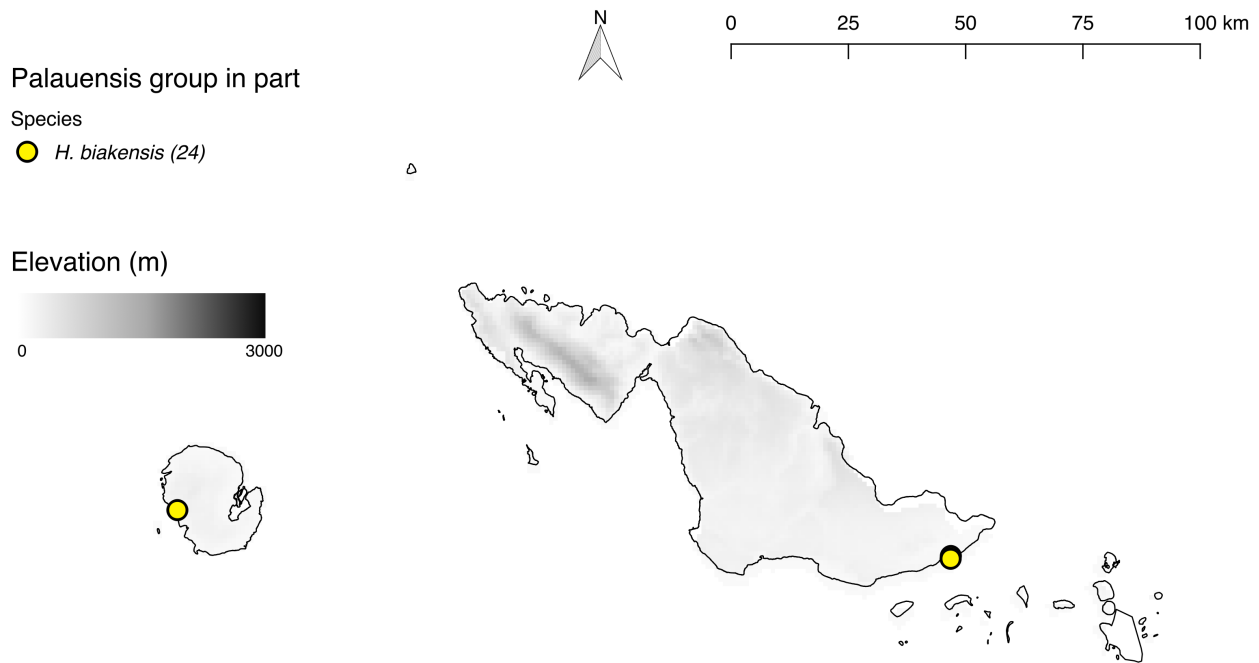


FIGURE 54. Distribution map of the Palauensis group of *Hydriastele* in Biak Island.

25. *Hydriastele ramsayi* (Becc.) Baker & Loo (2004: 67). *Gulubia ramsayi* Beccari (1910: 159). *Kentia ramsayi* (Becc.) Beccari (1913: 148). *Gronophyllum ramsayi* (Becc.) Moore (1963: 265). Type:—AUSTRALIA. Northern Territory: Port Essington, *Ramsay s.n.* (holotype MEL!, isotype FI)

Figure 55 (line drawing). Figure 56 (photo plate). Figure 57 (map).

Solitary, robust palm to 30 m tall, bearing 9–17 leaves in crown. **Stem** 30–35 cm in diam., moderately ventricose. **Leaf** 1.5–3 m long including petiole; sheath ca. 100 cm long; petiole 30–80 cm long; rachis arcuate; leaflets 50–60 per side, arranged regularly, single-fold, ascending, linear acuminate to shallowly notched, ramenta lacking; middle leaflets ca. 80 × 2.5 cm. **Inflorescence** 50–60 cm long including 3.5–4.5 cm peduncle, branched to 2 orders, protandrous; prophyll often ± sigmoid, with pithy keels; rachillae ca. 31–32, not markedly sinuous; triads on average 5–6 mm apart, opposite and decussate. **Staminate flower** ca. 13 × 4 mm in bud (when dry), cream; stamens 5–6, exposed in bud. **Pistillate flower** ca. 5 × 4 mm in bud (when dry), green to cream, with free sepals and free petals with conspicuous, triangular and valvate tips. **Fruit** 12 × 6 mm (when dry), ellipsoid, red, with a distinct, dark, sclerotic zone encircling apical stigmatic remains (up to ca. 2 mm in diam.). **Seed** not seen; endosperm homogeneous.

Distribution:—The central northern portion of Australia’s Northern Territory including the Cobourg Peninsula and Melville Island. Also reported from the north eastern portion of the territory (Dowe 2010).

Habitat:—Open eucalypt woodland dominated by seasonal drought and frequent wildfires, on sandstone slopes or flat ground on sandy soil, lowland.

Uses:—None recorded

Vernacular names:—None recorded

Conservation status:—Least Concern (LC). *Hydriastele ramsayi* has a relatively wide distribution (EOO > 92,000 km²) and the AOO (552 km²) is likely to be a low estimate due to an incomplete occurrence record.

Specimens examined:—AUSTRALIA. Northern Territory: Liverpool R. area, 25 May 1980, *Craven 5918* (MEL, L!); Coburg Peninsula, Smith Point, 11°8’S, 132°9’E, 18 October 1971, *Must 834* (K!, L!); 4 miles SE of Raffles Bay, 11°20’S, 132°26’E, 18 July 1961, *Chippendale 8191* (K!); NW side of Cadwell R., ca. 25 km SE of Maningrida, 12°10’S, 134°25’E, 31 October 1973, *Rodd 2921* (K!); Same locality as preceding, 12°10’S, 134°25’E, 31 October 1973, *Rodd 2922* (K!); Arnhem Land, Oenpeilli, 12°18’S, 133°4’E, 1 October 1948, *Specht 1113* (K!).

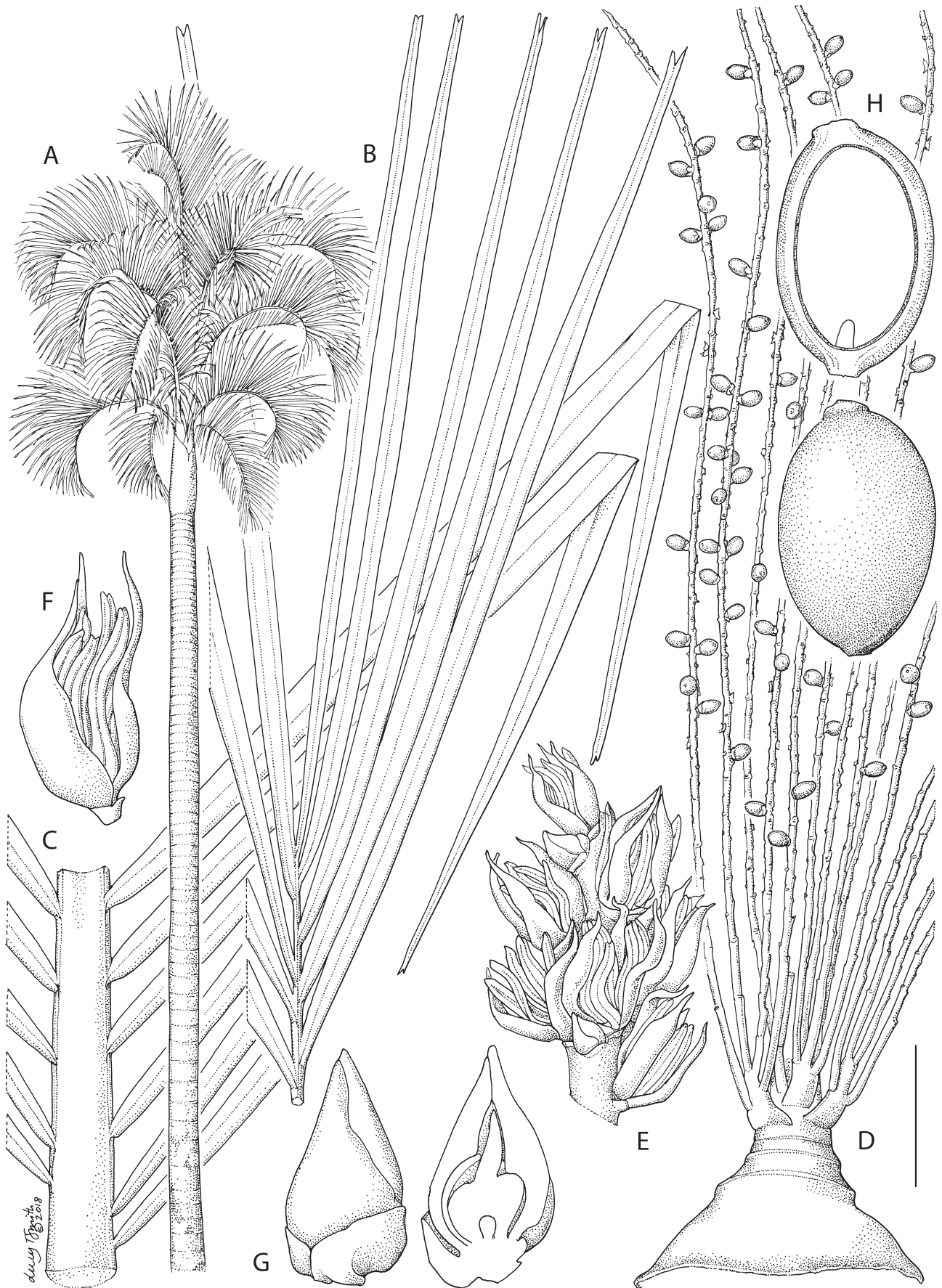


FIGURE 55. *Hydrastele ramsayi*. A. Habit. B. Leaf apex. C. Leaf base. D. Infructescence. E. Portion of rachilla with triads. F. Staminate flower. G. Pistillate flower whole and in section. H. Fruit whole and in section. Scale bar: A = 1.8 m; B–D = 6 cm; E = 1 cm; F = 4 mm; G = 3.3 mm; H = 7 mm. All from *Specht 1113*. Drawn by Lucy T. Smith.



FIGURE 56. *Hydiastele ramsayi*. A–B: Habit. All from Dowe 201 & 202. All photos: J. Dowe.

Notes:—*Hydiastele ramsayi* is the only member of *Hydiastele* endemic to Australia. It is an emergent palm distinguished by its robust, moderately ventricose stem, arching leaves with single-fold terminal leaflets that are shallowly notched at their tips, and protandrous inflorescences branched to 2 orders. In addition, the prophyll is often distorted, and the staminate flowers congenitally open, features that are shared with the Papuan *H. biakensis* although that species is not reported to have a ventricose stem and has protogynous inflorescence branched to 4 orders with markedly sinuous rachillae.

Hydiastele ramsayi is unusual in the genus (and Areceae in general) in occupying a seasonal, rather than everwet habitat. The species is also described in detail by Dowe (2010).

Acknowledgements

We acknowledge the support of the directors and curators of the following herbaria for providing access to specimens: A, AAU, BM, BRI, BO, CANB, FI, L, LAE, MEL, NYBG, S. We thank André Schuiteman, Axel Poulsen and Charles Humphrey for contributing their photos and John Dowe for sharing photos and occurrence data of Australian species. Himmah Rustiami (Herbarium Bogoriense) provided access to valuable information on types at BO. We also thank John Dransfield for his support and general palm taxonomic advice. We would especially like to acknowledge the numerous institutions and counterparts in Indonesia and Papua New Guinea who have made possible our fieldwork for the Palms of New Guinea Project, especially Rudi Maturbongs, Jack Wanggai (Universitas Papua, Indonesia), Himmah Rustiami, Deby Arifiani (Herbarium Bogoriense) and the late Roy Banka (Papua New Guinea Forest Research Institute). Lucy T. Smith prepared the scientific illustrations for this work. This research was funded by a grant to the Palms of New Guinea Project through the BAT Biodiversity Partnership and was further facilitated by grants from the

Bentham Moxon Trust and the International Palm Society Endowment Fund to CDH and WJB, and funding from the Royal Botanic Gardens, Kew.

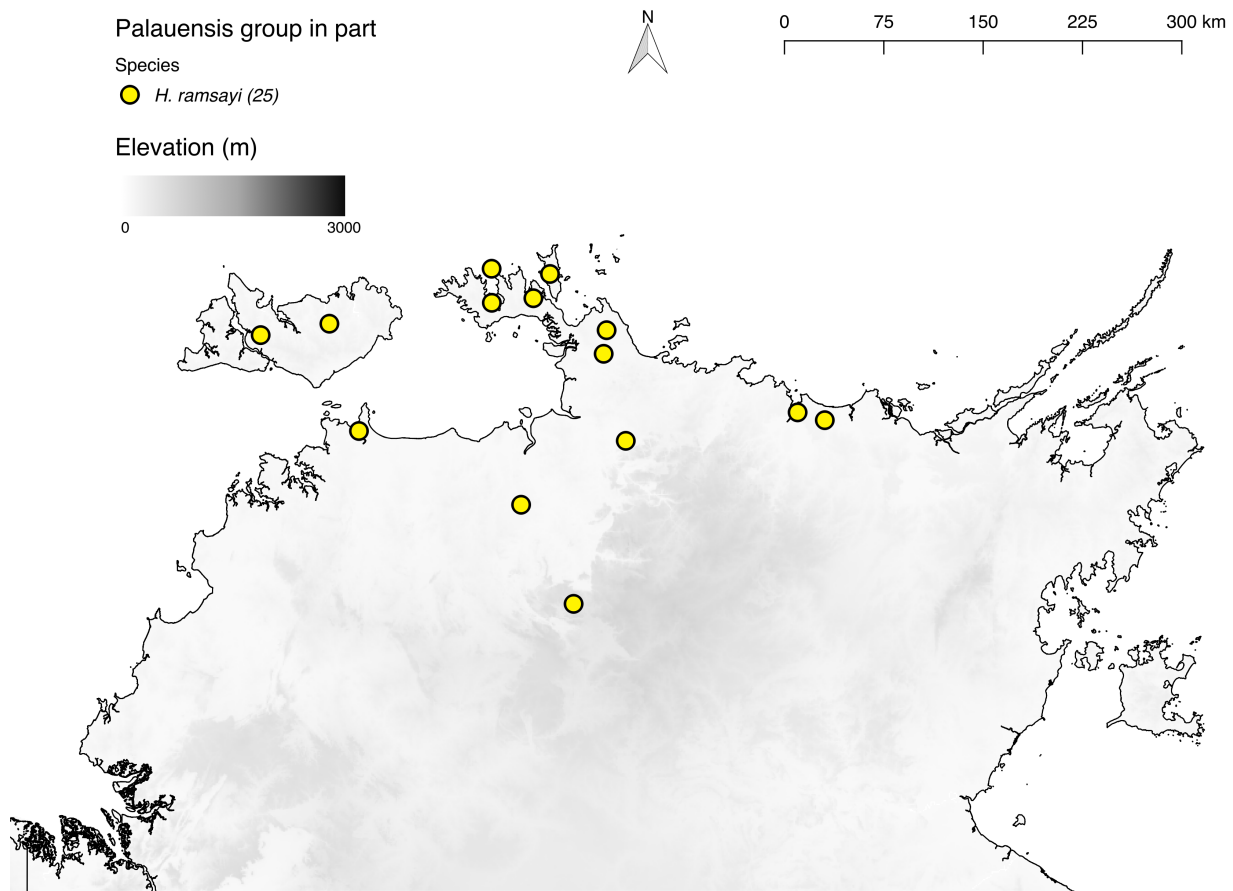


FIGURE 57. Distribution map of the Palauensis group of *Hydriastele* in Northern Territory, Australia.

References

- Adanson, M. (1763) *Familles des Plantes*. Paris, Vincent, 640 pp.
<https://doi.org/10.5962/bhl.title.271>
- Bailey, F.M. (1897) Contributions to the Flora of Queensland. *Queensland Agricultural Journal* 1: 228–235.
- Bailey, F.M. (1898) Contributions to the Queensland Flora. *Queensland Agricultural Journal* 2: 129–131.
- Baker, W.J. (1997) Rattans and Rheophytes—Palms of the Mubi River. *Principes* 41: 148–157.
- Baker, W.J., Maturbongs, R.A., Wanggai, J. & Hambali, G.G. (2000) *Siphokentia*. *Palms* 44: 175–181.
- Baker, W.J. (2002) The Palms of New Guinea Project. *Flora Malesiana Bulletin* 13: 35–37.
- Baker, W.J. & Loo, A.H.B. (2004) A synopsis of the genus *Hydriastele*. *Kew Bulletin* 59: 61–68.
<https://doi.org/10.2307/4111074>
- Baker, W.J., Savolainen, V., Asmussen-Lange, C.B., Chase, M.W., Dransfield, J., Forest, F., Hartley, M.M., Uhl, N.W. & Wilkinson, M. (2009) Complete generic-level phylogenetic analyses of palms (Arecaceae) with comparisons of supertree and supermatrix approaches. *Systematic Biology* 58: 240–256.
<https://doi.org/10.1093/sysbio/syp021>
- Baker, W.J., Norup, M.V., Clarkson, J.J., Couvreur, T., Dowe, J., Lewis, C.E., Pintaud, J., Savolainen, V., Wilmot, T. & Chase, M. (2011) Phylogenetic relationships among arecoid palms (Arecaceae: Arecoideae). *Annals of Botany* 108: 1417–1432.
<https://doi.org/10.1093/aob/mcr020>
- Baker, W.J. & Heatubun, C.D. (2012) New palms from Biak and Supiori, western New Guinea. *Palms* 56: 131–150.
- Baker, W.J. & Dransfield, J. (2016) Beyond Genera Palmarum: progress and prospects in palm systematics. *Botanical Journal of the Linnean Society* 182: 207–233.
<https://doi.org/10.1111/boj.12401>

- Beccari, O. (1877) Palmae della Nuova Guinea. *Malesia* 1: 26–36.
- Beccari, O. (1885) Reliquiae Schefferianae illustrazione di alcune palme viventi nel Giardino Botanico di Buitenzorg. *Annales du Jardin Botanique de Buitenzorg* 2: 82–136.
- Beccari, O. (1905) Palme nuove papuane. *Webbia* 1: 281–313.
<https://doi.org/10.1080/00837792.1905.10669551>
- Beccari, O. (1909) Palmae. *Nova Guinea* 8: 203–220.
- Beccari, O. (1910) Palme Australasiche nuove o poco note. *Webbia* 3: 131–165.
<https://doi.org/10.1080/00837792.1910.10669559>
- Beccari, O. (1913) Contributi alla conoscenza delle palme. *Webbia* 4: 143–240.
<https://doi.org/10.1080/00837792.1913.10669568>
- Beccari, O. (1914) Neue Palmen Papuasiens. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 52: 19–39.
- Beccari, O. (1917) Palmae. In: Gibbs, L.S. (Ed.) *A contribution to the phytogeography and flora of the Arfak mountains*. Taylor and Francis, London, pp. 91–98.
- Beccari, O. (1923) Neue Palmen Papuasiens II. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 58: 442–454.
- Beccari, O. (1924) Neue Palmen Mikronesiens. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 59: 11–16.
- Beccari, O. (1934) Generi, specie e varietà nuove di palme gerontogee della tribù Areceaceae lasciate inedite dal Dr. Od. Beccari ed ordinate a cura di U. Martelli. *Atti della Società Toscana di Scienze Naturali, residente in Pisa. Memorie* 44: 114–176.
- Beccari, O. & Pichi-Sermolli, R.G (1955) Subfamiliae Arecoidearum palmae gerontogee tribuum et generum conspectus. *Webbia* 11: 1–187.
<https://doi.org/10.1080/00837792.1956.10669632>
- Beentje, H. (2016) *The Kew Plant Glossary: an Illustrated Dictionary of Plant Terms*. Kew Publishing, 184 pp.
- Bentham, G. & Hooker, J.D. (1883) Palmae. *Genera Plantarum ad exemplaria imprimis in Herbariis Kewensibus servata definite* 3: 870–948.
- Blume, C.L. (1838) Revue des Palmiers de l'Archipel des Indes Orientales. *Bulletin de Sciences Physiques et Naturelles en Néerlande* 1: 61–67.
- Blume, C.L. (1843) De quibusdam generibus e Tribu Arecinearum. *Rumphia* 2: 63–99.
- Burret, M. (1927) Eine neue Palmengattung von den Molukken. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 10: 198–201.
<https://doi.org/10.2307/3994718>
- Burret, M. (1928) Beiträge zur Kenntnis der Palmen von Malesia, Papua und der Südsee. *Repertorium Specierum Novarum Regni Vegetabilis* 24: 253–296.
<https://doi.org/10.1002/fedr.19280241415>
- Burret, M. (1933) Neue Palmen aus Neuguinea. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 11: 704–713.
<https://doi.org/10.2307/3994682>
- Burret, M. (1934) Palmae neogee VI. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 12: 42–44.
<https://doi.org/10.2307/3994990>
- Burret, M. (1935) Neue Palmen aus Neuguinea II. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 12: 309–348.
<https://doi.org/10.2307/3994894>
- Burret, M. (1936a) Neue Palmen aus Neuguinea III. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 13: 65–101.
<https://doi.org/10.2307/3994917>
- Burret, M. (1936b) Die Palmengattung *Gronophyllum* Scheff. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 13: 200–205.
<https://doi.org/10.2307/3994963>
- Burret, M. (1936c) Die Palmengattungen *Nengella* Becc. und *Leptophoenix* Becc. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 13: 312–317.
<https://doi.org/10.2307/3995003>
- Burret, M. (1936d) Neue Palmen aus Neuguinea IV. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 13: 317–332.
<https://doi.org/10.2307/3995004>
- Burret, M. (1937a) Neue Palmen aus Neuguinea V. *Notizblatt Botanischen Gartens und Museums zu Berlin-Dahlem* 13: 468–475.
<https://doi.org/10.2307/3994832>
- Burret, M. (1937b) Die Palmengattungen *Hydriastele* Wendl. et Drude und *Adelonenga* Becc. *Notizblatt Botanischen Gartens und*

Museums zu Berlin-Dahlem 13: 482–487.

<https://doi.org/10.2307/3994835>

- Burret, M. (1939) Palmae gesammelt in Neu Guinea von L.J. Brass. *Journal of the Arnold Arboretum* 20: 187–212.
- Davis, P.H. & Heywood, V.H. (1963) *Principles of Angiosperm Taxonomy*. Oliver & Boyd, Edinburgh, 558 pp.
- Dowe, J.L. & Ferrero, M.D. (2000a) *Gronophyllum cariosum*, an ornamental new species from Papua New Guinea. *Palms* 44: 161–165.
- Dowe, J.L. & Ferrero, M.D. (2000b) A new species of rheophytic palm from New Guinea. *Palms* 44: 194–197.
- Dowe, J.L. (2010) *Australian Palms: Biogeography, Ecology and Systematics*. CSIRO Publishing, 290 pp.
- Dransfield, J., Baker, W.J., Heatubun, C.D. & Witono, J. (2000) The Palms of Mount Jaya. *Palms* 44: 202–208.
- Dransfield, J., Uhl, N.W., Asmussen, C.B., Baker, W.J., Madeline, M.H. & Lewis, C.E. (2008) *Genera Palmarum: The Evolution and Classification of Palms*. Kew Publishing, 732 pp.
- Essig, F.B. (1973) Pollination in some New Guinea palms. *Principes* 17: 75–83.
- Essig, F.B. (1982) A synopsis of the genus *Gulubia*. *Principes* 26: 159–173.
- Essig, F.B. & Young, B.E. (1985) A reconsideration of *Gronophyllum* and *Nengella* (Arecaceae). *Principes* 29: 129–137.
- Essig, F.B. (1995) A new species of *Gronophyllum* from the Bismarck Archipelago. *Principes* 39: 100–101
- Gibbs, L.S. (1917) *A contribution to the phytogeography and flora of the Arfak mountains*. Taylor and Francis, London, 226 pp.
- Govaerts, R., Dransfield, J., Zona, S., Hodel, D.R. & Henderson, A. (2018) World Checklist of Arecaceae. Facilitated by the Royal Botanic Gardens, Kew. Available from: <http://wmsp.science.kew.org> (Accessed 1 February 2018)
- Heatubun, C.D., Petoe, P. & Baker, W.J. (2018) A monograph of the *Nengella* group of *Hydriastele* (Arecaceae). *Kew Bulletin* 73: 18.
<https://doi.org/10.1007/s12225-018-9743-8>
- IUCN (2001) *IUCN red list categories and criteria*. Version 3.1. Gland & Cambridge: IUCN.
- Labillardière, J.J.H. (1809) Un nouveau genre de palmier. *Mémoires de la Classe des Sciences Mathématiques et Physiques de l'Institut de France* 9: 251–256.
- Lauterbach, C. (1911) Beiträge zur Flora von Neu-Mecklenburg. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 45: 354–365.
- Lewis, G., Schrire, B., Mackinder, B. & Lock, M. (Eds.) (2005) *Legumes of the World*. Royal Botanic Gardens, Kew, 233 pp.
- Linnaeus, C. (1753) *Species Plantarum*. Homiae: Impensis Laurentii Salvii, 1200 pp.
- Loo, A.H.B., Dransfield, J., Chase, M.W. & Baker, W.J. (2006) Low-copy nuclear DNA, phylogeny and the evolution of dichogamy in the betel nut palms and their relatives (Arecinae; Arecaceae). *Molecular Phylogenetics and Evolution* 39: 598–618.
<https://doi.org/10.1016/j.ympev.2005.12.006>
- McDade, L.A. (1995) Species concepts and problems in practice: Insight from botanical monographs. *Systematic Botany* 20: 606–622.
<https://doi.org/10.2307/2419813>
- Moore, H.E. (1963) The types and lectotypes of some palm genera. *Gentes Herbarum* 9: 245–275.
- Moore, H.E. (1966) New palms from the Pacific. *Principes* 10: 85–99.
- Moore, H.E. & Fosberg, F.R. (1956) The palms of Micronesia and the Bonin Islands. *Gentes Herbarum* 8: 423–478.
- Mueller, F. (1870) Palmae. *Fragmenta Phytographiae Australiae (Mueller)* 7: 99–104.
- Mueller, F. (1880) *Select extra-tropical plants readily eligible for industrial culture or naturalisation*. Indian Ed., Calcutta, 394 pp.
- Northern Territory Department of Land Resource Management (2017) *Flora Atlas N.T.* Occurrence Dataset accessed via GBIF.org on 2018-02-12.
<https://doi.org/10.15468/d5o7bf>
- Norup, M.V., Dransfield, J., Chase, M.W., Barfod, A.S., Fernando, E.S. & Baker, W.J. (2006) Homoplasious character combination and generic delimitation: A case study from the Indo-Pacific arecoid palms (Arecaceae: Arecaceae). *American Journal of Botany* 93: 1065–1080.
<https://doi.org/10.3732/ajb.93.7.1065>
- Petoe, P., Cámara-Leret, R. & Baker, W.J. (2018) A monograph of the *Hydriastele wendlandiana* group (Arecaceae: *Hydriastele*). *Kew Bulletin* 73: 17.
<https://doi.org/10.1007/s12225-018-9736-7>
- Quantum GIS Development Team (2018) *Quantum GIS Geographic Information System*. Open Source Geospatial Foundation Project. Available from: <http://qgis.osgeo.org> (accessed 23 September 2018)
- Ridley, H.N. (1916) Report on the botany of the Wollaston Expedition to Dutch New Guinea, 1912–13. *Transactions of the Linnean Society of London. Botany* 9: 1–284.
- Riffle, R.L., Craft, P. & Zona, S. (2012) *The Encyclopedia of Cultivated Palms*. Timber Press, 517 pp.
- Scheffer, R.H.C.C. (1876) Sur quelques palmiers du groupe des Arécinées. *Annales du Jardin Botanique de Buitenzorg* 1: 103–164.
- Schumann, K.M. & Lauterbach, C. (1900) *Die Flora der Deutschen Schutzgebiete in der Südsee*. 613 pp.
- Shearman, C.B., Bryan, J.E., Ash, J., Hunnam, P., Mackey, B. & Lokes, B. (2008) *The state of the forests of Papua New Guinea*. Mapping

the extent and condition of forest cover and measuring the drivers of forest change in the period 1972-2002. University of Papua New Guinea.

- Thiers, B. (2018) *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Available from: <http://sweetgum.nybg.org/science/ih/> (accessed 23 September 2018)
- Uhl, N.W. & Dransfield, J. (1987) *Genera Palmarum, a classification of palms based on the work of Harold E. Moore Jr.* The L. H. Bailey Hortorium and the International Palm Society, 610 pp.
- Utteridge, T.M.A. (2011) A revision of the genus *Medusanthera* (Stemonuraceae, Icacinaceae s.l.). *Kew Bulletin* 66: 49–81.
<https://doi.org/10.1007/s12225-011-9266-z>
- van Steenis, C.G.G.J. (1981) *Rheophytes of the World*. Sijthoff & Noordhoff, The Netherlands, 408 pp.
<https://doi.org/10.1007/978-94-009-8588-9>
- Wendland, H. & Drude, O. (1875) *Palmae Australasiae*. *Linnaea* 39: 153–238.
- Young, B.E. (1985) A new species of *Gronophyllum* (Palmae) from Papua New Guinea. *Principes* 29: 138–141.

Appendix 1: List of Exsiccatae

Aet 386 (23).

Armit s.n. (10); s.n. (6).

Baker, W.J. 566 (1); 573 (1); 607 (1); 611 (10); 616 (6); 622 (19); 632 (1); 643 (10); 665 (6); 667 (1); 819 (6); 820 (8); 823 (13); 836 (23); 876 (9); 879 (10); 882 (19); 884 (4); 1042 (23); 1043 (1); 1052 (23); 1057 (6); 1065 (1); 1068 (22); 1095 (23); 1096 (15); 1103 (4); 1106 (1); 1127 (1); 1135 (17); 1137 (6); 1316 (18); 1331 (14); 1339 (13); 1342 (24); 1365 (7); 1369 (3); 1377 (6); 1379 (16); 1380 (11); 1390 (3); 1436 (5); 1443 (8); 1448 (10).

Banka, R. 2000 (18).

Barfod, A. 350 (1); 389 (19); 413 (10); 458 (1); 499 (10); 501 (1).

Bauerlen, W. s.n. (23).

Beccari, O. 426 (3); 427 (10); 430 (6); 551 (6); s.n. (23); s.n. (23); s.n. (11); s.n. (6); s.n. (1).

Brass, L.J. 3998 (6); 5299 (6); 5457 (19); 5631 (6); 5887 (23); 7083 (10); 7093 (13); 7201 (6); 7245 (23); 7368 (10); 7402 (1); 7591 (23); 7592 (1); 8333 (1); 8701 (1); 8701A (1); 8891 (1); 8963 (1); 8982 (1); 12872 (6); 12952 (6); 12953 (6); 12997 (6); 12998 (6); 13045 (1); 13095 (6); 13099 (19); 13099A (19); 13434 (6); 13608 (5); 13700 (5); 18722 (1); 19250 (1); 23422 (6); 24185 (23); 24255 (1); 28256 (1); 29249 (1); 31196 (18).

Candie s.n. (1).

Carr, C.E. 12657 (1); s.n. (1).

Chapin 80 (6).

Chippendale 8191 (25).

Cizek 18 (1).

Clarkson 4356 (1).

Clemens 135 (6); 298 (6); 526 (18); 660 (23); 1623 (6); 6561 (18); 10465 (1); 10674 (23); 10702 (23); 41839 (23).

Coode, M. 29729 (2).

Craven, L.A. 1424 (6); 5918 (25).

Croft, J. 15567 (2); 61085 (6); 61091 (6); 61279 (6); 65490 (2); 68903 (23); 71094 (19); 71277 (19).

Darbyshire, P.J. 464 (18); 880 (1); 973 (6); 7971 (23).

Davis, A.P. 685 (6); 726 (3).

Desianto, B. 03 (6); 08 (1); 21 (23).

Dransfield, J. 5987 (1); 7605 (6); 7654 (1); 7682 (13).

Essig, F.B. 55001 (1); 55005 (6); 55094 (6); 55099 (19); 55140 (6); 55155 (6); 55166 (19); 55167 (6); 55185 (6); 55187 (6); 55214 (2); 55219 (1); 55231 (19); 74028 (6); 74029 (6); 74049 (12); 74050 (6); 74072 (12); 74081 (19); 74082 (12); 74083 (19); 74092 (6); 74099 (6).

Foreman, D. 48426 (6).

Forestry College Students Bulolo 15413 (6).

Frodin, D. 3154 (1); s.n. (6); s.n. (6).

Furtado, C.X. 31139 (1).

Gardiner, L.M. 410 (23); 424 (3).

Gibbs 5951 (16).

Gideon, O. 20333 (1); 57205 (2).
Gray, E.C. 8135 (6).
Gulliver s.n. (1).
Gusbager, P. 01 (1); 13 (23).
Hambali s.n. (14).
Hartley, T.G. 13082 (1).
Heatubun, C. 87 (6); 152 (1); 269 (1); 281 (1); 285 (6); 290 (6); 329 (10); 333 (1); 340 (23); 343 (1); 358 (6); 367 (6); 373 (6); 374 (23); 375 (3); 406 (10); 416 (1); 422 (13); 426 (10); 765 (13); 777 (6); 969 (14); 970 (24); 1040 (6); 1074 (6); 1133 (21); 1225 (24).
Henty, E.E. 42555 (6); 42674 (19).
Heyligers, P.C. 1537 (1).
Hill 5 (1).
Hoogland, R.D. 9030 (6); 10241 (1); 10934 (18); 11052 (6).
HYN 212 (6).
Isles, R.S. 34405 (2).
Jacobs, M. 9405 (6); 9470 (10); s.n. (6).
Jardine s.n. (1).
Kairo, A. 536 (18).
Kalkman 3399 (1).
Kanehira, R. 12126 (13).
Kanis 1284 (18).
Katik, P. 38000 (6); 74935 (10).
Keim, A. 2 (6); 3 (1).
Kerenga, K. 56427 (6); 56434 (1); 62320 (2); 77518 (20); Klappa, S. 151 (1).
Kloss s.n. (6).
Koster, C. 13879 (6).
Latz 6269 (1).
Lauterbach 751 (23).
Leach 33288 (6).
Ledermann 11229 (18).
Loo 305 (1); 306 (1).
Loria s.n. (23); s.n. (6).
Mackee 1868 (6).
Maconochie 1550 (1).
Marai, P. 444 (6).
Maturbongs, R.A. 292 (3); 506 (6); 532 (21); 551 (14); 553 (14); 555 (14); 556 (14); 557 (14); 561 (14); 562 (14); 563 (14); 564 (14); 566 (14); 573 (23); 574 (cf. 24); 575 (1); 576 (10); 591 (1); 593 (6); 596 (1); 600 (1); 613 (1); 614 (19); 652 (1); 658 (1); 679 (13); 699 (6); 701 (1); 709 (13); 712 (3); 733 (23); 685b (13).
Mayr, E. 24 (6); 253 (6); 658 (18).
Mehen, S. 08 (6); 21 (21).
Millar, A.N. 23072 (1); 35430 (6).
Milliken, W. 1423 (6).
Mogea, J.P. 5529 (1); 6305 (3).
Mohd, S. s.n. (1).
Moore, H.E. 9291 (18).
Morren 3059 (6).
Mueller s.n. (6).
Must 834 (25).
Naoni 6146 (6); s.n. (6).
Peekel 109 (2).
Polak, A.M. 1000 (10).
Pullen, R. 726 (18); 1082 (23); 1100 (1); 1193 (1); 1387 (1); 1504 (6); 1520 (1); 1597 (23); 1601 (1); 1713 (1); 1717 (23); 2646 (18); 3460 (6); 5767 (6); 7302 (1); 7588 (1); 8137 (1); 8218 (23); 8296 (6).
Regalado 1431 (1).

Ridsdale, C. 38004 (2).
Rodd 2908 (1); 2909 (1); 2912 (1); 2921 (25); 2922 (25).
Rustiami, H. 36 (1).
Sambas, E. 17 (3).
Sands, M.J.S. 866 (2); 2880 (20); 6354 (3).
Schlechter 16251 (10); 17466 (10).
Schodde, R. 2284 (1).
Schultze 323 (19).
Smith 12413 (1).
Specht 1113 (25).
Streimann, H. 28658 (6); 28835 (6).
Takeuchi, W. 7284 (10); 7312 (10); 8680 (6); 8691 (6); 8743 (6); 9242 (6); 9902 (2); 9994 (2); 11697 (6); 13213 (1);
13522 (23); 13523 (1); 15142 (1); 18982 (10).
van Balgooy 6588 (1); 6855 (6).
van Leeuwen 11201 (1).
van Royen, P. 3155 (3); 6377 (10).
Versteeg 1388 (13); 1662 (1).
Vink, W. 15285 (6).
Wally, E. 464 (3); 490 (6); 702 (6); 844 (1).
Wanggai, J. 04 (6).
White, K.J. 9553 (1); 10070 (2); 10194 (1); 10460 (1); 10889 (2); 17 (6); 20 (4); 21 (4); 23 (10).
Womersley, J. 37233 (6); s.n. (1).
Young 74011 (6).
Zippelius s.n. (21).
Zona, S. 671 (6); 681 (23); 688 (1); 689 (6); 690 (1); 822 (14); 826 (14); 890 (1); 896 (1).