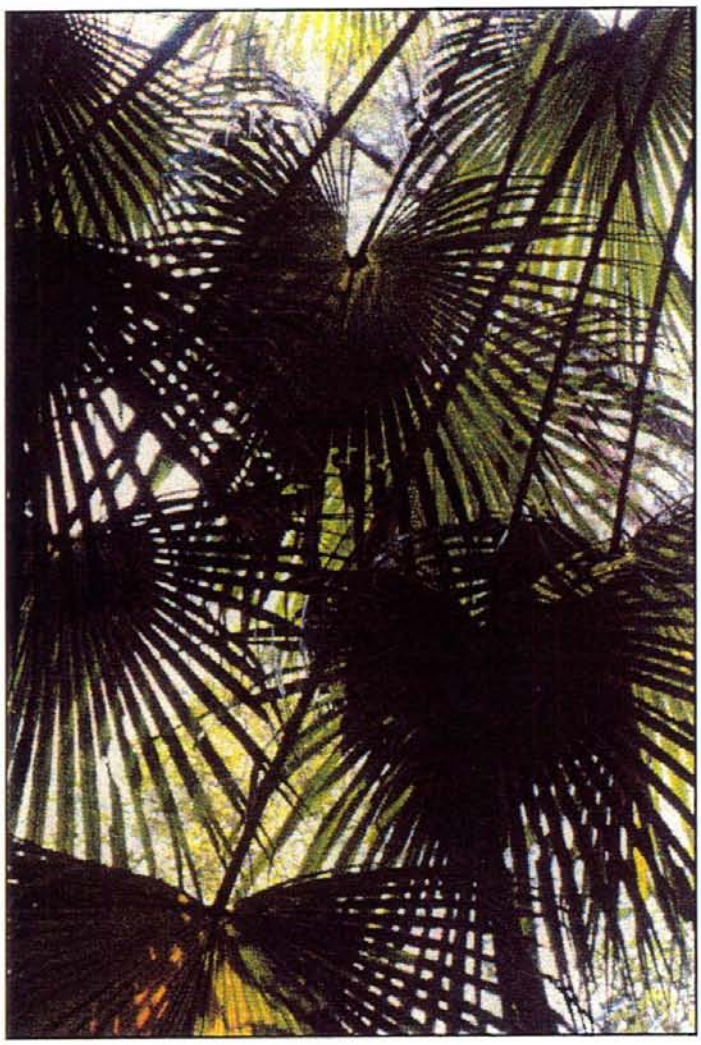
STUDIES IN THE GENUS *LIVISTONA* (CORYPHOIDEAE: ARECACEAE)



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in October 2001

for the degree of Doctor of Philosophy
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within the School of Tropical Biology
James Cook University.

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ABSTRACT

This thesis provides new insights into the genus *Livistona* based on taxonomy, cladistic analyses, molecular investigation, historical biogeography, and gender function. The taxonomic treatment recognises 35 currently accepted taxa. Four new species, *Livistona chocolatina*, *L. concinna*, *L. surru* and *L. tothur*, are described as part of this treatment. They will be formally published elsewhere. Literature research revealed that 92 names have used *Livistona* as part of the binomial. Of these, 68 are typified by extant herbarium specimens. Five names are typified by illustrations. Of the remaining 19 names, types were never designated. It is proposed that eleven names require typification, including *Livistona saribus*, *Chamaerops biroo*, *Corypha decora*, *Corypha minor*, *Livistona altissima*, *Livistona hoogendorpii*, *Livistona jenkinsiana*, *Livistona spectabilis*, *Livistona tonkinensis*, *Saribus olivaeformis* and *Saribus subglobosus*. New names are proposed for *L. decipiens*, which becomes *L. decora*, and *L. mariae* var. *occidentalis*, which becomes *L. nasmophila*.

Phylogenetic relationships were examined using cladistic analyses based on morphological characters. Forty-three characters and 35 taxa were investigated with two character weighting options: unweighted and successive weighting. In the most robust analysis, the following major lineages were evident:

- *exigua* lineage – small understorey palms with irregularly segmented leaves, inflorescence not basally branched
- *saribus* lineage – large canopy palms with irregularly segmented leaves, inflorescence not basally branched
- *chinensis* subclade – inflorescence not basally branched, fruit green, blue or purple, regularly segmented leaves
- *rotundifolia* subclade – inflorescence basally branched, fruit passing through orange/red to mature either orange, red or black, regularly segmented leaves
- *humilis* subclade - inflorescence not basally branched, fruit dark brown or black, regularly segmented leaves with deeply segmented lamina
- *mariae* subclade - inflorescence not basally branched, fruit dark brown or black, regularly segmented leaves with moderately segmented lamina

Although topological resolution was satisfactory, statistical support was low for the analyses and the result cannot be accepted as a reliable estimate of phylogeny.

The internal transcribed spacer (ITS) regions of nrDNA and the intervening 5.8S region of a group of *Livistona* species were investigated to determine if a useful phylogeny could be inferred from that region. DNA was amplified via polymerase chain reaction (PCR) using three primers. Multiple (polymorphic) bands were produced consistently for most species and some sequences had lost the entire ITS2 portion. The results indicate that a *Livistona*-specific primer will need to be designed and that more refined screening of products will be necessary if full length and non-polymorphic sequences are to be obtained.

Hypotheses of historical biogeography were developed utilising three lines of investigation. Firstly, the fossil record suggests a Laurasian origin for the genus. Secondly, an analysis of area endemism, based on the Parsimony Analysis of Endemism (PAE) method, indicates a close relationship of some contiguous areas in which *Livistona* species occur. Thirdly, a cladistic analysis suggests a number of possible scenarios, including an exclusively Laurasian origin, or combinations of both Laurasian and Gondwanan origin. The distribution of species in otherwise floristically unrelated regions suggests that the genus is 'ancient', and that initial radiation may have occurred prior to tectonic events that isolated the landmasses on which ancestral species occurred. Extensive speciation has since occurred in Australia and Malesia, with putatively relictual species occurring in Africa and Australia. The occurrence of *Livistona* in Australia is most plausibly the result of migration from a Laurasian source, rather than being an autochthonous element.

Morphological aspects of a group of representative species were investigated to determine if there were any trends in gender function from hermaphroditism to functional dioecy. Based on predictive morphological criteria, a trend from hermaphroditism to dioecy was indicated in the four species that were studied, and *Livistona chinensis*, *L. muelleri*, *L. decora* and *L. lanuginosa* can be ranked in increasing degrees of dioeciousness respectively. Functional dioecy in *Livistona* may be related to the evolution of species in drier, stressful environments.

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abaxial – the side of an organ that faces away from the axis that bears it, e. g. the under surface of a leaf

adaptation – process of evolutionary modification which results in improved survival and reproduction efficiency; any heritable character, morphological, physiological or developmental, that enhances survival or reproductive success

adaxial – the side of an organ that faces toward the axis that bears it, e. g. the upper side of a leaf

advanced – in regards to evolution, the character state that originates later in evolution than the ancestral state

allopatric species – a species that has evolved in different and disjunct areas from a sister species

anatropous – describing the orientation of an ovule, being bent parallel to its stalk so that the micropyle is adjacent to the hilum

ancestral – with regards to the possession of primitive characters by organisms

anemophily – pollination facilitated by wind or air currents

apomorphy – a derived character or character state

armed – bearing some form of spines

autapomorphy – a character state that is unique to a taxon

autochthonous – being the original inhabitants of an area: having evolved *in situ*

autogamy – fertilisation occurring within the same flower

bootstrapping – a statistical method to estimate confidence in a pattern

bootstrap value – the proportion of times a pattern is repeated in a bootstrapping procedure

bracteole – a small bract borne on a flower stalk

carpel – the single unit of the gynoecium

chartaceous – paper-like, thin and stiff

clade – a branch of an evolutionary tree representing descendants from a common ancestor

cladistic biogeography – examination of the distribution of sister taxa of monophyletic groups, i. e. most recently evolved taxa will be the most recently vicariated

cladogram – graphic image in the form of a 'tree' depicting the phylogenetic arrangement of a group of taxa

collateral – side by side, parallel

connective – the part of a stamen that connects the anthers, usually distinct from the filament

cordate – heart shaped

costapalmate – of a palmate leaf where the petiole is extended as a midrib into the lamina

derived – in regards to evolution, the state that originates later in evolution than the ancestral state

didymous – of anthers where the connective is almost absent

dimorphic – of two forms

distal – situated farthest away from the point of attachment

endemics – species with restricted ranges, often with narrow ecological requirements and sometimes morphologically specialised

endocarp – innermost layer of the fruit wall

endosperm – the nutritive body of the seed

entomophily – pollination facilitated by insects

eophyll – the first leaf with a blade

epicarp – the outer most layer of the fruit wall

epipetalous – borne on the petals

exine – the outer surface of a pollen grain

flexuous – regularly twisted, zig-zag

foveolate – with small round depressions

geitonogamy – fertilisation between different flowers on an individual plant or clonal plants

glabrous – smooth, lacking hairs or scales

glaucous – covered with a bluish gray or greenish bloom

hastula – a flap of tissue borne at the insertion of the blade on the petiole on the upper, lower or both surfaces

homogeneous – of the seed tissue, uniform, the same throughout

homology – character states that share modifications from another condition

homoplasy – convergence, similarity without genetic relationship

hyaline – thin enough to be transparent

illegitimate – in regards to names that are nomenclaturally illegal according to the rules of the ICBN

inaperturate – in pollen, lacking any visible germination openings

interfoliar – among the leaves

internode – part of a stem between the attachment of two leaves

inviable – in regards to pollen or fruit, unable to germinate

isotype – a specimen that is a duplicate of the holotype

lamina – leaf blade

lanceolate – of leaf segments, narrow, tapering to both ends

latrorse – of anthers, opening sideways, lateral to the filament

lectotype – a specimen that serves in place of a lost or unplaced holotype

ligule – a distal projection of the leaf sheath

mesocarp – middle layer of the fruit wall

monocolpate – a pollen grain with a single aperture extending the length of the grain

mononomial – describing pre-Linnaean names that consist of a single word

monophyletic group – a group of organisms that contains the most recent ancestor plus all and only all its descendants

monosulcate – with one sulcus (see sulcus)

neotype – a specimen selected in place of a holotype in the absence of original material

node – the area of stem where the leaf is (was) attached

outgroup – a taxon used in a cladistic analysis for comparative purposes, usually with respect to character polarity determination

paraphyletic – being a group of organisms that includes their most recent common ancestor and some but not all of its descendants

parsimony – the general scientific criterion for choosing among competing hypotheses that explains the data most simply and efficiently

partial inflorescence – with regards to the structure of the inflorescence of Coryphoid palms, a single unit of the iterative branching system that makes up the inflorescence

pedicel – a flower stalk

peduncle – the lower unbranched part of an inflorescence

perforate – pierced with holes

phylogenetic systematics – a method of classification that utilises hypotheses of character transformation to group taxa hierarchically into nested sets and then interprets these relationships as a phylogenetic tree

plesiomorphic – a state that arose earlier in the evolution of a group of taxa than its alternative state

pleonanthic – flowering continuously over most of the life of a plant

plicate – pleated, as in the folds developed in newly emerging spear leaves in palms

polyphilic – a flower that is visited by many species of pollinator

primitive – with regards to the possession of ancestral characters

prophyll – the first bract or leaf produced on a branch

protandrous – stamens shedding pollen before the stigma is receptive

proximal – nearest to the attachment, basal

psilate – covered with small rounded protuberances

puberulous – covered with dense short hairs

rachilla – the ultimate flower-bearing axis of an inflorescence

rachis – the axis of an inflorescence beyond the first branches, i. e. beyond the peduncle

relictual species – species that are persistent examples of floras now mainly vanished

rugose – wrinkled

stigmatic remains – the remnants of flower parts persistent on the fruit epicarp

subclade – portion of a major clade

subtribe – taxonomic level below tribe but above genus

subulate – awl shaped, abruptly tapered to the apex

sulcus – the furrow-like aperture of a pollen grain

suture – a scar indicative of a fold or join in the epicarp

sympatric species – related species that occur in the same geographical range

symplesiomorphy - (1) a synapomorphy of a more inclusive hierarchical level than that being considered. (2) the occurrence in two or more taxa of a monophyletic group of a plesiomorphic character or character state; that is, one that has been inherited from an ancestor more distant than the most recent common ancestor of the group.

sympodial clusters – in regards to the arrangement of flowers, where an individual flower is produced from the axil of the preceding flower's bracteole

synapomorphy – an apomorphy that unites two or more taxa into a monophyletic group

tectate – of pollen grains, two-walled

testa – the outer coat of the seed

tomentum – covering of short hairs, scales, wool or down

type specimen – a specimen upon which the name was established and to which it is forever bound

valvate – meeting exactly without overlapping

versatile – of anthers, freely swinging about the point of attachment to the filament

vicariance – the process whereby an ancestral species splits as a result of the imposition of a barrier(s) within the original population

vicariant species – closely related and ecologically equivalent species that tend to be mutually exclusive occupying disjunct geographical areas

Wallace's Line – the boundary that marks unrelated biological realms east and west of a line drawn approximately through central Malesia; Huxley first coined the term based on the work of Alfred R. Wallace.

xenogamy – fertilisation between pollen and ovules of different plants or genets

ABBREVIATIONS

AFLP – amplified fragment length polymorphism

Apr. – April

auct. non. – *auctorum nonnullorum*; of some authors

Aug. – August

c. – *circa* (about)

cm – centimetres

cp – chloroplast

cult. – *cultus*; cultivated

dbh – diameter at breast height; approximately 1.2 m above ground level

Dec. – December

diam. – *diametro*; diameter

DNA – deoxyribonucleic acid

E – east

EDTA – ethylenediaminetetra-acetate

Feb. – February

hort. – *hortorum*; of gardens

ICBN – International Code of Botanical Nomenclature

ined. – *ineditus*; unpublished

ITS – internal transcribed spacer

Jan. – January

Mar. – March

mm – millimetres

N – north

nom. – *nomen*; name

nom. illeg. – *nomen illegitimum*; illegitimate name

nom. inval. – *nomen invalidum*; invalid name

nom. ined. – *nomem inedit*; proposed name

nom. nud. – *nomen nudum*; name unaccompanied by a description or reference to a published description

nom. provis. – *nomen provisorius*; provisional name

nom. tant. – *nomen tantum*; name only

Nov. – November

NP – National Park

nr – nuclear ribosomal

Oct. – October

ortho. var. – orthographic variation

PAE – parsimony analysis of endemicity

PAUP – phylogenetic analysis using parsimony

PCR – polymerase chain reaction

PO – pollen:ovule ratio

RFLP – restriction fragment length polymorphism

S – south

s. n. – *sine numero*; without a number

Sept. – September

sp. – *species*; species (singular)

spp. – *species*; species (plural)

t. – *tabula*; plate

TAE – tris (hydroxymethyl) methylamine acetate ethylenediaminetetra-acetate

TBR – tree bisection and reconnection

TE – tris ethylenediaminetetra-acetate

W – west

HERBARIUM ACRONYMS

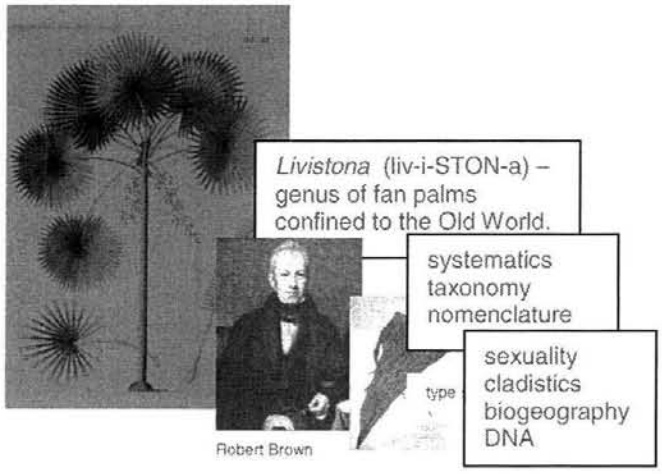
A	Harvard University, Harvard, USA
AAU	Department of Systematic Botany, Aarhus University, Denmark
B	Botanischer Garten und Botanisches Museum, Berlin, Germany
BKF	Royal Forest Department, Bangkok, Thailand
BH	Bailey Hortorium, Cornell University, Ithaca, USA
BM	Natural History Museum, London, United Kingdom
BO	Herbarium Bogoriense, Bogor, Indonesia
BR	Jardin Botanique National de Belgique, Meise, Belgium
BRI	Queensland Herbarium, Mt Coot-tha, Brisbane, Australia
BSIP	Department of Forest Herbarium, Honiara, Solomon Islands
CAHUP	Museum of Natural History, University of the Philippines at Los Baños
CANB	Australian National Herbarium, Canberra, Australia
CANT	South China Agricultural University, Canton, China
DNA	Conservation Commission, Darwin, Australia
FI	University of Florence, Italy
FT	Tropical Herbarium of Florence, Italy
FTG	Fairchild Tropical Garden, Miami, USA
JCT	Tropical Plant Sciences, James Cook University, Townsville, Australia
K	Royal Botanic Gardens, Kew, United Kingdom
KEP	Forest Research Institute of Malaysia, Kepong, Malaysia
L	Rijksherbarium, Leiden, Netherlands
LAE	Forest Research Institute, Lae, Papua New Guinea
LBC	Forestry Herbarium, Museum of Natural History, University of the Philippines at Los Baños
M	Botanische Staatssammulung, Munich, Germany
MAK	Tokyo Metropolitan University, Japan
MAN	Forestry Division, Manokwari, Indonesia
MEL	National Herbarium of Victoria, Melbourne, Australia
NSW	National Herbarium of New South Wales, Sydney, Australia
NY	New York Botanical Garden, New York, USA
P	Muséum National d'Histoire Naturelle, Paris, France
PNH	Philippine National Herbarium, Manila, Philippines

PERTH	Department of Conservation and Land Management, Perth, Australia
QRS	CSIRO, Atherton, Australia
S	Swedish Museum of Natural History, Stockholm, Sweden
SAR	Department of Forestry, Kuching, Sarawak, Malaysia
SING	Singapore Botanic Gardens, Singapore
UC	University of California, Berkeley, California, USA
US	United States National Herbarium, Smithsonian Institution, Washington, USA

Chapter 1

Studies in the genus *Livistona* R. Br. (Coryphoideae: Arecaceae)

GENERAL INTRODUCTION



1.1 Introduction

The palms, family Arecaceae or alternatively Palmae, are one of the most morphologically diverse families in the Monocotyledonae. According to recent studies (Chase *et al.*, 2000; Stevenson *et al.*, 2000), the palms are most closely aligned with either the Poales, the Zingiberales, the Commelinanae or the Lilianae, depending upon which combination of morphological characters and gene sequences is invoked. Morphologically, palms are differentiated from other monocot families by two unique characters: a 'woody' stem and leaves that are plicate in bud and segmented (Uhl and Dransfield, 1987). However, plicate but unsegmented leaves occur in some palms as well as other monocots (Tomlinson, 1990). Geographically, there are two centres of diversity: in the tropical regions of the Old and New Worlds (Dransfield, 1999). Although there are about equal numbers of species in each region, some major evolutionary lines are confined to one or the other. Present classification of the family is based on combinations of morphological features such as leaf structure, orientation of leaf plication, characters of inflorescence, flowers and fruit, flower association and sex distribution (Uhl and Dransfield, 1987; Tomlinson, 1990). Despite a broad understanding of taxonomic relationships within the family, there are some

'conspicuous' and well circumscribed genera, such as *Livistona* R. Br., that have, ecologically and biologically, remained largely unstudied. Uhl and Dransfield (1988, p. 3) noted that the genera in the Coryphoideae are of particular importance: "....primary interest in evolutionary studies because they include the least specialised palm genera....", and "....exhibit many of the evolutionary trends that also occur independently elsewhere in the family." In amenity horticulture, some species of *Livistona* have become prominent, and are of significant economic importance (Jones, 1995). Although ubiquitous in some areas, there is a paucity of biological information about *Livistona*. The primary objective of this thesis is to present a systematic treatment of the genus over its entire distributional range, based on a number of lines of investigation, as outlined in Section 1.7.

1.2 Palm classification

The most recent formal classification of the Arecaceae recognised six subfamilies and about 190 genera (Uhl and Dransfield, 1987, 1999). Although the main groupings of the family were recognised early and have been maintained at various taxonomic levels (Martius, 1824; Drude, 1887; Moore, 1973a), there is evidence that some rearrangement may better reflect phylogenetic relationships (Asmussen and Chase, 2001). The 'traditional' classification system of Uhl and Dransfield (1987) has been only partially supported by recent morphological and molecular analyses (Uhl *et al.*, 1995; Baker *et al.*, 1999; Asmussen *et al.*, 2000; Lewis *et al.*, 2000; Asmussen and Chase, 2001; Lewis and Doyle, 2001). In addition to the debate about higher-level relationships, there are differences among taxonomists with regard to species concepts and species numbers for the family. Uhl and Dransfield (1988) proposed a total of c. 2600 species and considered that this number was possibly too low. Henderson *et al.* (1995), who adopted a broad species concept, suggested that there was considerable 'over-description' of species. Despite taxonomic discrepancies, there is potential for new species to be described in some under-botanised but high diversity areas. A recent treatment of the palms of Madagascar accounted for 171 species of which 70 were newly described (Dransfield and Beentje, 1995). For New Guinea, c. 290 species are recognised (Essig, 1977; Hay 1984; Ferrero, 1997), and the number is expected to increase as a result of current research (J. Dransfield, pers. comm). Other poorly studied but palm-rich areas include Borneo and the Solomon Islands.

1.3 The genus *Livistona* R. Br.

Livistona R. Br. is included in the subtribe Livistoninae, one of 12 subtribes in the tribe Corypheae, which is one of three tribes in the subfamily Coryphoideae (Uhl and Dransfield, 1987). The Coryphoideae is characterised by palmate or pinnate leaves and with flowers solitary or in sympodial clusters (Uhl and Dransfield, 1987). The Livistoninae is characterised by three basally free carpels that are united by their styles. *Livistona*, as circumscribed by Uhl and Dransfield (1987: p. 192), is distinguished by: "....gynoecium of three carpels connate only by their styles, by united sepals, by petals with internal grooves, by the usually small fruits with apical stigmatic remains and basal carpel remains, by seed with homogeneous endosperm, and a large intrusion of seed coat". The closest relatives of *Livistona*, *Pholidocarpus* Blume, *Licuala* Thunb. and *Johannesteijsmannia* H. E. Moore (Uhl and Dransfield, 1987), occur within the overall geographical distribution of the genus, while other close relatives such as *Brahea* Mart. ex Endl. and *Serenoa* Hook. f. occur disjunctly in North America. The closest related genus, *Pholidocarpus*, is distinguished by a thick conspicuous androecial ring that is almost free at the base (the androecial ring in *Livistona* is scalloped apically and epipetalous), a top-shaped gynoecium (widest above the locules in *Livistona*), and large fruit to 6 cm diameter at maturity (usually only to 4 cm in *Livistona*) with usually a corky-warted epicarp (always smooth in *Livistona*). From *Licuala*, *Livistona* is distinguished by lanceolate, apically tapered rather than wedge-shaped apically broad leaf segments, while *Johannesteijsmannia* has unsegmented diamond-shaped leaves, an inflorescence with several inflated peduncular bracts (tightly or loosely tubular in *Livistona*) and a warty epicarp on the fruit (always smooth in *Livistona*). There is general agreement (Tomlinson, 1990; Rodd, 1998) that the generic boundaries of *Livistona* and related genera are well defined, and are currently not open to question. However, relationships of some genera within the Livistoninae and the Thrinacinae subtribes, inferred from molecular data, are not congruent with traditional classification (Asmussen and Chase, 2001).

Livistona has a wide distribution (Fig. 1.1), in the Horn of Africa and southern Arabia (1 sp.), throughout south-eastern and eastern Asia (c. 10 spp.), Malesia (c. 10 spp.) and Australia (c. 18 spp.). Because of this, the genus has received uneven taxonomic attention at the species level. Species in areas such as

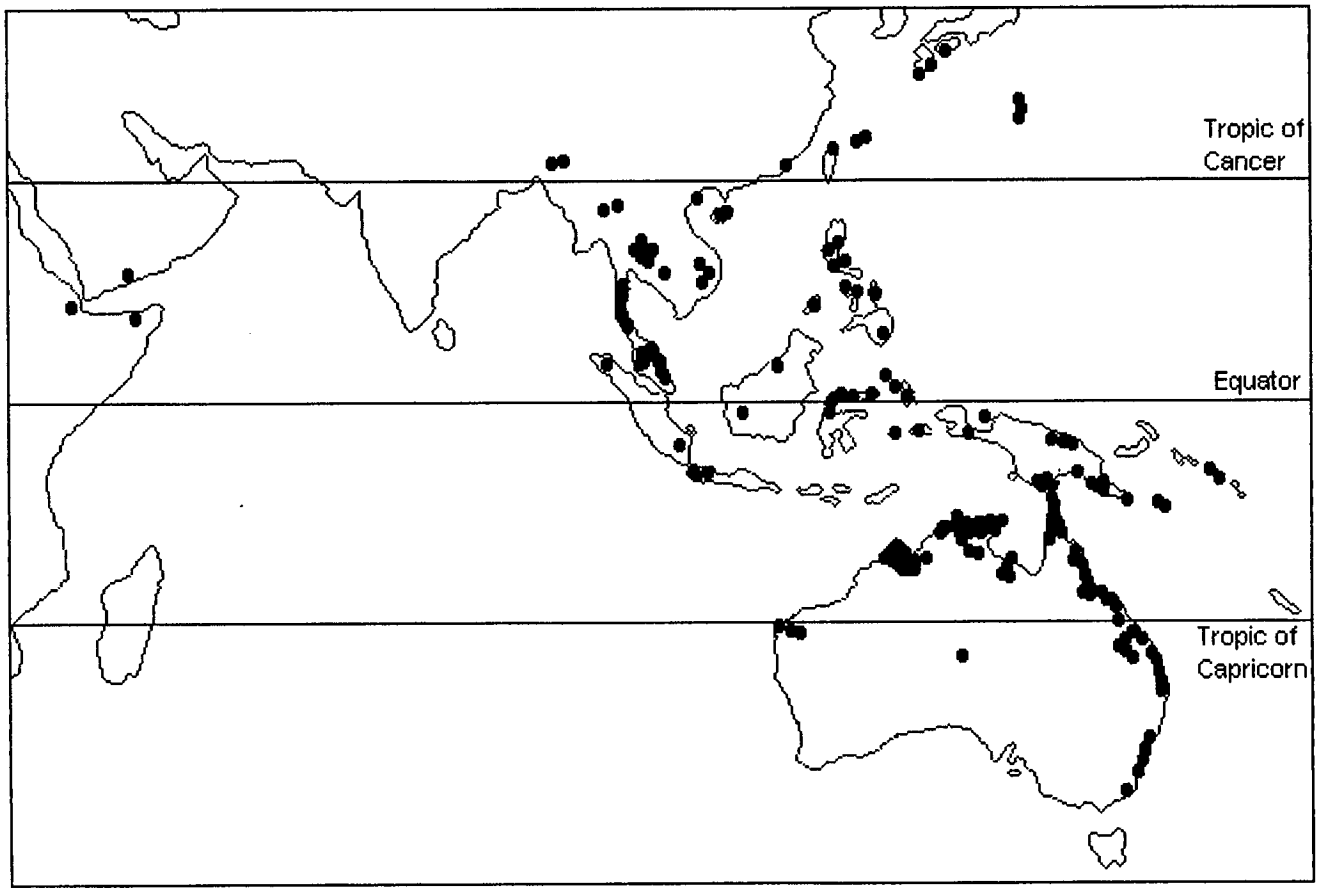


Figure 1.1. Distribution of *Livistona*. The dots represent localities from which one or more specimens were collected. Approximately 400 collections have been recorded. Site data were taken from herbarium sheets.

Australia (Rodd, 1998), China (Pei *et al.*, 1991) and Thailand (Hodel and Vatcharakorn, 1998), have been recently studied. However, these areas account for only about 50% of the species recognised for the genus. In south-eastern and eastern Asia, and Malesia, there appears to be an over-description of species, with a number of taxa based on political boundaries (Dransfield, 1999). Hence it is necessary to examine the genus over its entire range. There are also several undescribed species occurring in northern Australia and New Guinea. These will be introduced in this thesis.

1.4 Taxonomic history

Livistona was established by Robert Brown (1810) (Fig. 1.2), and named for Patrick Murray (died 1671), Baron of Livingston, whose plant collection at Livingston Estate near Edinburgh, helped found the present-day Edinburgh Botanical Garden established in 1670 (Hyam and Pankhurst, 1995). Orthographically, the spelling proposed by Brown was correct, as there is no facility in the Latinisation of the English 'ing', as in Livingston, which transcribes as '*is*' (D. Gallagher, pers. comm.). The genus was first described with two species, *L. humilis* R. Br. and *L. inermis* R. Br., from northern Australia. *Livistona humilis* (Fig. 1.2) was subsequently chosen as the lectotype for the genus (Moore, 1963a) and the specimen collected by Brown from Morgans Island, in the Gulf of Carpentaria, was designated as the type specimen for the species name (Fig. 1.2).

Brown (1810) established the genus on the following characters: flowers hermaphroditic; perianth in two-parts, each part with three segments; stamens six, filaments distinct, basally broad; ovaries three; style connate; stigma undivided; fruit single-seeded; endosperm with a ventral cavity; embryo lateral; leaves palmate, and segment apices bifid (Fig. 1.3). Although Brown's broad circumscription of *Livistona* can be applied to other genera in the Livistoninae, *Livistona* is readily distinguished from related genera by a number of characters, as noted in Section 1.3 for *Pholidocarpus*, *Licuala* and *Johannesteijsmannia*.

Prior to establishment of *Livistona* in 1810, other species that would eventually be included in *Livistona* were named. The first was a pre-Linnaean mononomial *Saribus*, described by Rumphius in 1741, and which was later to be recognised as

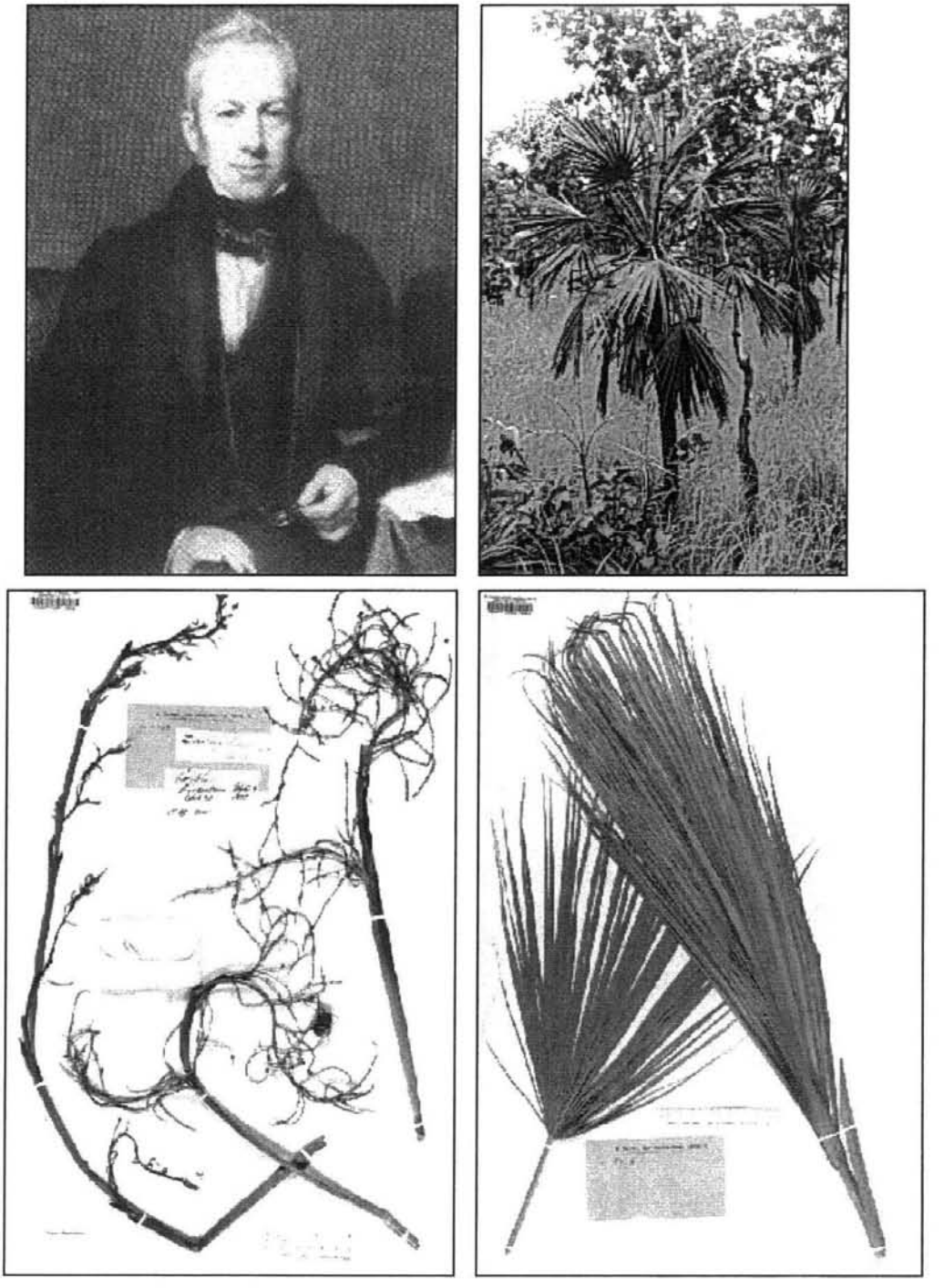


Figure 1.2. Portrait of Robert Brown, *Livistona humilis* in habitat and type specimen of *L. humilis*. *Top left:* Portrait of Robert Brown (1773-1858), author of *Livistona*, engraved by C. Fox from a painting by H. W. Pickergill. Reproduced from Flora of Australia Vol. 1. ***Top right:*** *Livistona humilis* R. Br., lectotype for the genus (Moore, 1963a), near Darwin, Northern Territory. ***Bottom left and right.*** Type specimen of *Livistona humilis*, collected by Robert Brown from Morgans Island, Gulf of Carpentaria, 20 January, 1803, and held in the Natural History Museum Herbarium (BM), London.

Sect. I I. FRONDES PALMATÆ.

CORYPHA. *L. Gært.*

Flores hermaphroditi. *Perianthium* duplex, utrunque tripartitum. *Stamina* sex, filamentis distinctis basi dilatatis. *Ovaria* tria, intus cohærentia. *Styli* connati. *Stigma* indivisum. *Bacca* unica maturescens globosa, monosperma. *Albumen* cavum. *Embryo* basilaris.

OBS. Character e Corypha australi in quá cavitas albuminis ventralis substantia suberosa semirepleta, ideoque forsan Livistonæ atlinior quam Coryphæ umbraculiteræ.

1. C. *australis*, frondibus flabellato-palmatis filis nullis interjectis, petiolis spinulosis, perianthio exteriore trifido acuto. (J.) *v. v.*

LIVISTONA.

Flores hermaphroditi. *Perianthium* duplex, utrunque tripar-

titum. *Stamina* sex, filamentis distinctis infrà dilatatis. *Ovaria* 3, intùs cohætentia. *Styli* connati. *Stigma* indivisum. *Bacca* (unica maturescens) monosperma. *Albumen* cavitate ventrali. *Embryo* dorsalis.
Frondes *pinnato-palmatæ, laciniis apice bifidis.*

OBS. Genus inter Coryphum et Chamærops locandum, ad quod Latania chinensis *Jacq. frag.* p. 16. t. 11. f. 1. pertinere videtur.
Dixi in memoriam viri nobilis PATRICII MURRAY BARONIS DE LIVISTONE : *Balfourii* amici ; qui Hortum Botanicum in Prædio suo suprà mille Plantis instruxerat, Edinensem tunc conditum ditavit : Galiam universam Botanices causa peragravit, ubi febre correptus ccubuit. Plura de viro sui temporis meritissimo vide in Sibbaldi Memor. Balfour. p. 69, et seq.

1. L. *inermis*, frondis laciniis filis interjectis, stipitibus inermibus, caudice 14-30-pedali. (T.) *v. v.*

2. L. *humilis*, frondis laciniis filis interjectis, stipitibus spinosis, caudice 4-6-pedali. (T.) *v. v.*

Figure 1.3. Protologue of *Livistona*. Verbatim extraction from *Prodromus Florae Novae Hollandeae et Insulae Van-Diemen*, pages 267-268, Robert Brown (1810).

Livistona rotundifolia (Lam.) Mart. The first name in the Linnaean system was provided by Lamarck (1786) who described *Corypha rotundifolia* Lam. Martius (1838) transferred it to *Livistona*. *Corypha saribus* Lour., described by Loureiro (1790), was to become *Livistona cochinchinensis* Mart. and ultimately *L. saribus* (Lour.) Merr. ex A. Chev., while *Latania chinensis* Jacq., described by Jacquin (1801), was to become *Livistona chinensis* (Jacq.) R. Br. ex Mart.

Blume (1838) established the genus *Saribus* to include three species, including the lectotype *Saribus rotundifolius* (Lam.) Blume based on *Corypha rotundifolia* Lam. (= *L. rotundifolia* (Lam.) Mart.). Shortly after Blume's work was completed in 1836 [though not published until 1838, Dransfield and Moore (1982)], Martius (1838) provided a treatment of *Livistona* in his *Historia Naturalis Palmarum* (Fig. 1.4). Martius amended the description of *Livistona*, subsumed Brown's *Corypha* species, and Blume's *Saribus* species as well as some *Corypha* species of other authors. In a subsequent edition of *Historia Naturalis Palmarum*, Martius (1849) also included the *Livistona* species described by Griffith (1844) from India and Malaysia. The circumscription provided by Martius firmly established the identity of *Livistona*, and was subsequently accepted by most taxonomists (Miquel, 1855; Wendland and Drude, 1875; Hooker, 1883).

Some of the taxonomy involving *Livistona* has not been accepted. Firstly, Devansaye (1875) provided a synopsis of 'les Coryphinées' in *Revue Horticole*. Although the journal was not usually an arena for taxonomic works, nomenclatural changes were often published and in most cases accepted according to the rules of nomenclature of the time. Devansaye provided a list of names with distribution and descriptive notes for his Coryphinée taxa. He placed most of the *Livistona* species within *Corypha*, *Latania* and *Saribus*, but maintained only five in *Livistona*. Other taxonomists subsequently ignored this work. Kuntze (1891), in his *Revisio Genera Plantarum*, placed most of the then known *Livistona* species under *Saribus*. Kuntze did not justify his proposals but merely applied name changes. Although this work was nomenclaturally valid and effective, Hemsley (1891) disputed this. Many of Kuntze's names are not currently in use. The third event was Drude's (1893) revision of the Australian species of *Livistona*, in which he placed a few species under synonymy and proposed two subgenera. Drude did

Figure 1.4. Portraits of prominent *Livistona* taxonomists. ***Left:*** Portrait of C. F. P. von Martius (1794-1868) from Frontispiece of Volume 1 of *Historia Naturalis Palmarum*, reproduced from Egge (1979). ***Right:*** Portrait of Odoardo Beccari (1843-1920), photograph from Reale Società Geografica Italiana Bolletino, series 5, 12: 190 [1923], reproduced from Moore (1981).

not adopt the nomenclature proposed by either Devansaye or Kuntze, but subsequent taxonomists dismissed his work on the grounds that it lacked descriptions and that some species identities were vague.

Odoardo Beccari (b.1843 - d.1920) (Fig. 1.4) made a significant contribution to *Livistona* taxonomy by describing many species in Australia, south-eastern Asia and Malesia. Beccari was considered the most important palm taxonomist of the 20th Century (Moore, 1981). His contribution to palm taxonomy culminated in a series of monographic studies of palm subfamilies, some of which were published posthumously. Beccari's (1931) most detailed treatment of *Livistona* appeared in *Asiatic Palms - Corypheae*.

A unique chapter in *Livistona* taxonomy was provided in the work of Max Burret (b.1883-d.1964), who described most specimens received by him in Berlin as new species (Henderson, 1999a), and many of which have since been synonymised

(Potztal, 1958). Although never having visited New Guinea, Burret (1935, 1939) described four *Livistona* species from there, three of which were recently synonymised (Rodd, 1998). Burret (1943) also established the genus *Wissmannia*, with the only species *W. carinensis* (Chiov.) Burret, based on *Hyphaene carinensis* Chiov. from Somalia (Chiovenda, 1929). This taxon was subsequently placed under *Livistona* (Dransfield and Uhl, 1983a), thus providing an extension of the genus both in geographical range and morphological diversity based on some unique floral characters that do not otherwise occur in the genus.

Uhl and Dransfield (1987), in *Genera Palmarum*, provided a detailed generic description of *Livistona*, and Rodd (1998), in his revision of the Australian species, described five new species. In Figure 1.5, time-lines of taxonomic activity, the genera in which currently accepted taxa of *Livistona* have been placed, and cumulative numbers of taxa, are presented. Ninety-two names have been, at various times, listed as species or subspecies of *Livistona* (Index Kewensis, 1993; Rodd, 1998; The Plant Names Index, 1999) (Table 1.1).

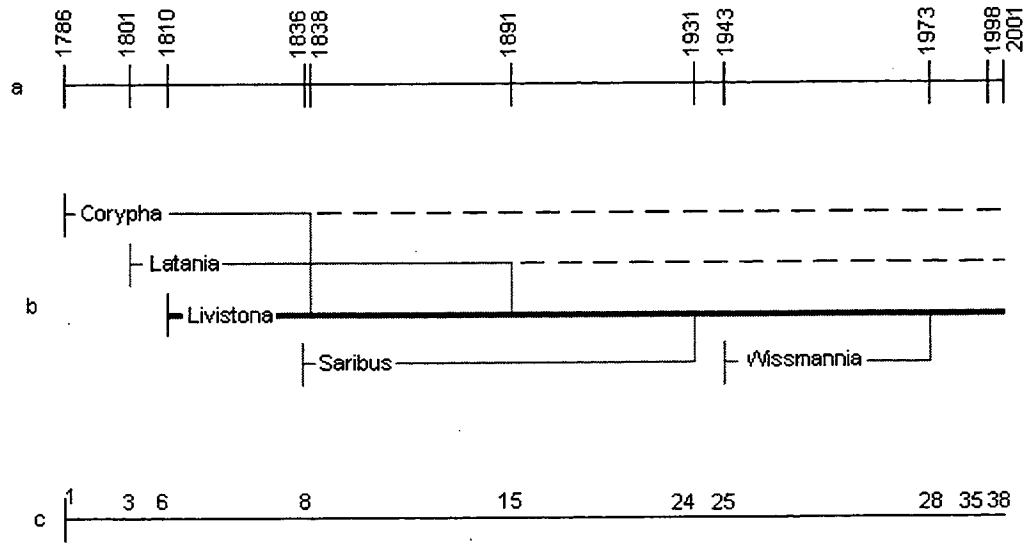


Figure 1.5 Time-lines of the taxonomy of *Livistona*.

a. year in which taxonomic activity occurred.

b. genera in which currently accepted *Livistona* species were originally described.

c. cumulative number of currently accepted species of *Livistona*.

Table 1.1. Names applied to *Livistona*, listed alphabetically, with author and year of origin and/or validation, as at the commencement of this study. Synonyms, and references, are provided where appropriate.

***Livistona* R. Br., 1810**

Livistona sect. *Eulivistona* Drude, 1893

Livistona sect. *Gregorya* Drude, 1893

Livistona subgen. *Livistonella* Becc., 1921 = *Maxburretia* Furt.

1. *L. alfredii* F. Muell., 1892 (as '*Alfredi*')
2. *L. altissima* Zoll., 1857 = *L. rotundifolia* (Lam.) Mart. (*fide* Beccari, 1921)
3. *L. australis* (R. Br.) Mart., 1838
4. *L. beccariana* Burret, 1941
5. *L. benthamii* F. M. Bailey, 1902 (as '*Benthami*')
6. *L. bissula* Mart., 1850
7. *L. blancoi* Merr., 1918 = *L. rotundifolia* (Lam.) Mart (*fide* Rodd, 1998)
8. *L. boninensis* (Becc.) Nakai, (1928 - name only) 1935 = *L. chinensis* var. *boninensis* Becc. Nakai (*fide* Moore and Fosberg, 1956)
9. *L. brassii* Burret, 1935 = *L. muelleri* F. M. Bailey (*fide* Rodd, 1998)
10. *L. carinensis* (Chiov.) J. Dransf. and N. W. Uhl, 1983
11. *L. chinensis* (Jacq.) R. Br. ex Mart., 1838, also as *L. sinensis* Mart. in Griffith, 1844
12. *L. chinensis* var. *subglobosa* (Hassk.) Becc., 1921
13. *L. cochinchinensis* (Blume) Mart. ex Becc. and Hook. f., (1849 - name only) 1892 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Chevalier, 1919)
14. *L. crustacea* Burret, 1939 = *L. muelleri* F. M. Bailey (*fide* Rodd, 1998)
15. *L. decipiens* Becc., 1910
16. *L. decipiens* var. *polyantha* Becc., 1921 = *L. decipiens* Becc. (*fide* Rodd, 1998)
17. *L. diepenhorstii* Hassk., 1858 = *Pholidocarpus diepenhorstii* (Hassk.) Burret (*fide* Burret, 1941)
18. *L. dournowiana* Hort. ex Taylor (1976 - name only) = *L. chinensis* (Jacq) R. Br. ex Mart. (*fide* Taylor, 1976)
19. *L. drudei* F. Muell. ex Drude, (1878 - name only) 1893
20. *L. eastonii* C. A. Gardner, 1923 (as '*eastoni*')
21. *L. endauensis* J. Dransf. and K. M. Wong, 1987
22. *L. enervis* Hort., (1891 - name only)
23. *L. eocenica* Ettingsh. and J. S. Gardner, 1879, a fossil taxon = *Hightea elliptica* Bowerb. (*fide* Reid and Chandler, 1933)
24. *L. erecta* (1963 - name only)
25. *L. exigua* J. Dransf., 1977
26. *L. fengkaiensis* X. W. Wei and M. Y. Xiao, 1982 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Rodd, 1998)
27. *L. filamentosa* Hort. Petrop. ex R. Pfister, (1892 - name only) = *Washingtonia filifera* H. Wendl. ex Watts (*fide* Beccari, 1921)

28. *L. filifera* Hort. ex H. Wendl., (1878 - name only) = *L. inermis* R. Br. (*fide* Kerchove, 1878)
29. *L. fulva* A. N. Rodd, 1998
30. *L. gaudichaudii* Mart., 1849 = *Pritchardia gaudichaudii* (Mart.) H. Wendl. (*fide* Wendland, 1862)
31. *L. halongensis* Nguyen and Kiew, 2000
32. *L. hasseltii* (Hassk.) Miq., 1868 (as '*Hasselti*')
33. *L. holtzei* Becc., 1921 = *L. benthamii* F. M. Bailey (*fide* Rodd, 1998)
34. *L. hoogendorpii* Hort. ex Teysm. and Binn. (as '*Hoogendorpi*') (1866 - name only) 1868 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Burret, 1941)
35. *L. humilis* R. Br., 1810
36. *L. humilis* var. *minutiflora* Becc., (1931 - name only)
37. *L. humilis* var. *novoguineensis* Becc., 1921 = *L. muelleri* F. M. Bailey (*fide* Rodd, 1998)
38. *L. humilis* var. *sclerophylla* (as *sclirophylla* in error) Becc., 1921 = *L. muelleri* F. M. Bailey (*fide* Rodd, 1998)
39. *L. inaequisecta* Becc., 1909 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Beccari, 1921)
40. *L. inermis* R. Br., 1810
41. *L. japonica* Nakai ex Masamune, (1929 - name only) = *L. chinensis var. subglobosa* (Hassk.) Becc. (*fide* Nakai, 1935)
42. *L. jenkinsiana* Griff., 1844, also as *L. jenkinsii* Griff. ex Mart., 1849
43. *L. kimberleyana* A. N. Rodd, 1998
44. *L. kingiana* Becc., 1889 = *Pholidocarpus kingianus* (Becc.) Ridley (*fide* Ridley, 1907)
45. *L. lanuginosa* A. N. Rodd, 1998
46. *L. leichhardtii* F. Muell., (1865 - name only) 1874 = *L. humilis* R. Br. (*fide* Bentham, 1878)
47. *L. lorophylla* Becc. 1921 (as *L. loriphylla*, corrected spelling by Rodd, 1998)
48. *L. macrophylla* Bruder, 1890, a fossil taxon
49. *L. macrophylla* Roster (1904 – name only)
50. *L mariae* F. Muell., (1874 - name only) 1878
51. *L. mariae* subsp. *occidentalis* A. N. Rodd, 1998 = *L. nasmophila* Dowe and D. L. Jones (ined.)
52. *L. mariae* subsp. *rigida* A. N. Rodd, 1998
53. *L. martii* Gaudich., 1842, also known as *L. martiana* Gaudich. ex Mart., 1849 = *Pritchardia martii* (Gaudich.) H. Wendl. (*fide* Wendland, 1862)
54. *L. mauritiana* Wall. ex Mart., 1838 = *L. chinensis* (Jacq.) R. Br. ex Mart. (*fide* Martius, 1838)
55. *L. melanocarpa* Burret, 1939 = *L. benthamii* F. M. Bailey (*fide* Rodd, 1998)
56. *L. merrillii* Becc., 1904
57. *L. microcarpa* Becc., 1907 = *L. rotundifolia* var. *microcarpa* (Becc.) Becc. (*fide* Beccari, 1919a)
58. *L. minima* Reid and Chandler, 1933, a fossil taxon

59. *L. mindorensis* Becc., 1909 = *L. rotundifolia* var. *mindorensis* (Becc.) Becc. (*fide* Beccari, 1919b)
60. *L. moluccana* Hort. ex H. Wendl., (1878 - name only)
61. *L. mulleri* H. Wendl. ex Kerch. (1878 – name only)
62. *L. muelleri* F. M. Bailey, 1902
63. *L. nasmophila* Dowe and D. L. Jones, (ined.)
64. *L. nitida* A. N. Rodd, 1998
65. *L. occidentalis* Hort. ex Hook. f., (1884 - name only) = *Brahea dulcis* (Kunth) Mart. (*fide* Hooker, 1884)
66. *L. okinawensis* Hort. ex L. H. Bailey (1976 – name only) = *L. chinensis* var. *subglobosa* (Hassk.) Becc. (*fide* Bailey, 1976)
67. *L. olivaeformis* (Hassk.) Mart., 1850 = *L. chinensis* (Jacq.) R. Br. ex Mart. (*fide* Beccari, 1921)
68. *L. ovaliformis* Hort. ex R. M. Grey, (1927 - name only)
69. *L. papuana* Becc., 1877
70. *L. ramsayi* F. Muell., 1874 = *Licuala ramsayi* (F. Muell.) Domin (*fide* Domin, 1915)
71. *L. rigida* Becc., 1921
72. *L. robinsoniana* Becc., 1911
73. *L. rotundifolia* (Lam.) Mart., 1838
74. *L. rotundifolia* var. *luzonensis* Becc., 1919
75. *L. rotundifolia* var. *microcarpa* (Becc.) Becc., 1919
76. *L. rotundifolia* var. *mindorensis* (Becc.) Becc., 1919
77. *L. rupicola* Ridley, 1903 = *Maxburretia rupicola* (Ridley) Furt. (*fide* Furtado, 1941)
78. *L. saribus* (Lour.) Merr. ex A. Chev., 1919
79. *L. speciosa* Kurz, 1874
80. *L. spectabilis* Griff., 1844 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Beccari, 1886)
81. *L. subglobosa* (Hassk.) Mart., 1850 = *L. chinensis* var. *subglososa* (Hassk.) Becc. (*fide* Li, 1963)
82. *L. tahanensis* Becc., (1915 - name only) 1921
83. *L. ternatensis* Hort. ex Salomon (1887 – name only)
84. *L. tonkinensis* Magalon, 1930 = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Rodd, 1998)
85. *L. umbraculifera* Hort. ex Vilmorin, (1895 - name only) = *L. rotundifolia* (Lam.) Mart. (*fide* Vilmorin, 1895)
86. *L. victoriae* A. N. Rodd, 1998
87. *L. vidalii* Becc., 1905 = *Corypha utan* Lam. (*fide* Beccari, 1919b)
88. *L. vogamii* H. Sander ex Becc., 1921, also as *L. voganii* H. Sander ex Becc., = *L. saribus* (Lour.) Merr. ex A. Chev. (*fide* Beccari, 1921)
89. *L. whitfordii* Becc., 1905 = *L. merrillii* Becc. (*fide* Beccari, 1919b)
90. *L. woodfordii* Ridley, 1898 (as '*Woodfordi*')
91. *L. zollingeri* Hort. ex Rev. Hort., (1875 - name only)
92. *L. zollingeriana* Blume, (1887 - name only)

1.5 Biology, ecology and other studies of *Livistona*

Despite being a conspicuous element in the natural landscape, and horticulturally common palms in tropical and subtropical regions, the species of *Livistona* are biologically and ecologically largely unstudied. Table 1.2 summarises some of the studies involving *Livistona.*

1.6 *Conservation*

The WCMC (1993) report on palm conservation listed 69 entries for *Livistona*, based on populations of 34 species defined by political boundaries. The difference between the number of entries and the number of species is because some wide-spread species were included in more than one political region. Of the entries, 27 (39%) were of unknown status, 14 (20%) were not threatened, 16 (23%) were rare, and there were four entries (6%) in each of the intermediate, vulnerable and endangered categories. The high percentage of taxa in the unknown category indicated a lack of information regarding the populations of many species. In Australia, all *Livistona* species have been allocated a conservation rating (Rodd, 1998), and *Livistona mariae*, from Palm Valley, Northern Territory, has been the subject of a conservation action plan (Leach, 1992). In south-eastern Asia and Malesia, various species have received conservation ratings and protection plans (Basu, 1991; Kiew, 1991; Madulid, 1991; Mogea, 1991). For Malaysia, Kiew (1989) applied a vulnerable/endangered status to *L. saribus* and rare but not threatened to other *Livistona* species. The endangered status of *L. carinensis* in the Horn of Africa and Yemen has been highlighted by Lucas and Synge (1978), Hedberg (1979), Bazara'a *et al.* (1990) and Welch and Welch (1998, 1999).

1.7 Scope, outline and aims of the thesis

Although 50% of the species in the genus *Livistona* have been recently studied within restricted geographical boundaries (e. g. Australia, China, Thailand), there has been no recent treatment of the genus over its entire distributional range. Beccari (1931) recognised 24 species and Rodd (1998) recognised 38 species, but with recent extensive field-work undertaken in Australia, New Guinea and south-eastern Asia the need for a revision has been identified. Furthermore, field-work combined with herbarium studies undertaken prior to commencement of this

Table 1.2. Summary of some studies involving *Livistona*, arranged by topic and with the relevant reference.

topic	reference	species studied
ecology	Humphreys *et al.*, 1990	*L. alfredii*
	Lothian, 1959a, 1959b	*L. mariae*
	Latz, 1975	*L. mariae*
	Orscheg and Parsons, 1996a, 1996b	*L. australis*
	Monod, 1955	*L. carinensis*
	Bazara'a *et al.*, 1990	*L. carinensis*
	Welch and Welch, 1998, 1999	*L. carinensis*
population studies	Hnatiuk, 1977	*L. eastonii*
	Weiner and Corlett, 1987	*L. endauensis*
	Yoshida *et al.*, 2000	*L. chinensis*
fire ecology	Wuschke, 1999	*L. muelleri*
ethnobotany and resource utilisation	Wallace, 1890	*L. rotundifolia*
	Robinson, 1911a	*L. rotundifolia*
	O'Brien and Kinnaird, 1996	*L. rotundifolia*
	Lane-Poole, 1925	*L.* sp. 'Vailala River'
	Li, 1979	*L. chinensis*
anatomy and morphology	Tomlinson, 1961	*L. australis*
		L. chinensis
		L. rotundifolia
	Mahabale and Kulkarni, 1975	*L. chinensis*
		L. jenkinsiana
karyology	Sharma and Sarkar, 1956	*L. australis*
		L. chinensis
		L. rotundifolia
	Read, 1965	*L. australis*
		L. chinensis
		L. rotundifolia
	Löve, 1978	*L. chinensis*
	Röser, 1993	*L. chinensis*
	Röser, 1994	*L. rotundifolia*
palynology	Sowunmi, 1972	*L. chinensis*
reproductive biology	Henderson, 1986a	*L.* spp.
	Schmid, 1983	*L. humilis*
biogeography	Dransfield, 1981, 1987	*L.* spp.
plant/animal interactions	Kiew and Davison, 1989	*L. endauensis*
		L. tahanensis
		L. chinensis
horticulture	McCurrach, 1960	*L. australis*
		L. chinensis
		L. rotundifolia
	Jones, 1995, 1996	*L.* spp. (27)
	Boyer, 1992	*L.* spp. (8)
	Basu and Chakraverty, 1994	*L. australis*
		L. chinensis
		L. decipiens
		L. jenkinsiana
		L. rotundifolia
		L. saribus

thesis, and work by other palm taxonomists (Dransfield, 1999), indicated that some taxa may be related to political boundaries, especially those species that occur in more than one country in south-eastern Asia. A taxonomic revision of *Livistona* is presented in Chapter 2.

To determine phylogenetic relationships among species of *Livistona*, this thesis provides a cladistic analysis using morphological characters of all species, as established in the taxonomic revision, and presented in Chapter 3. A preliminary investigation to determine molecular relationships, utilising Internal Transcribed Spacer (ITS) sequences of selected representative species, is presented in Chapter 4. Based on the results of the cladistic analysis, and with reference to the fossil record and relationships of areas of endemism, hypotheses of historical biogeography are presented and discussed in Chapter 5. Aspects of distribution and relictualism are also addressed in that chapter.

The reproductive biology and breeding systems of *Livistona* are largely unknown because of the difficulties associated with conducting studies on tall plants. One aspect of reproductive biology was addressed. This study sought to investigate if an index based on morphological features could be developed to predict breeding systems and gender function. This work is presented in Chapter 6.

This work is presented in seven chapters. Due to the specificity of each part, each chapter has a specific introduction, materials and methods, results and discussion sections. However, references and appendices for each part are included jointly in the final pages of the work. The chapter titles are:

Chapter 1. General introduction

Chapter 2. Systematic treatment of *Livistona*

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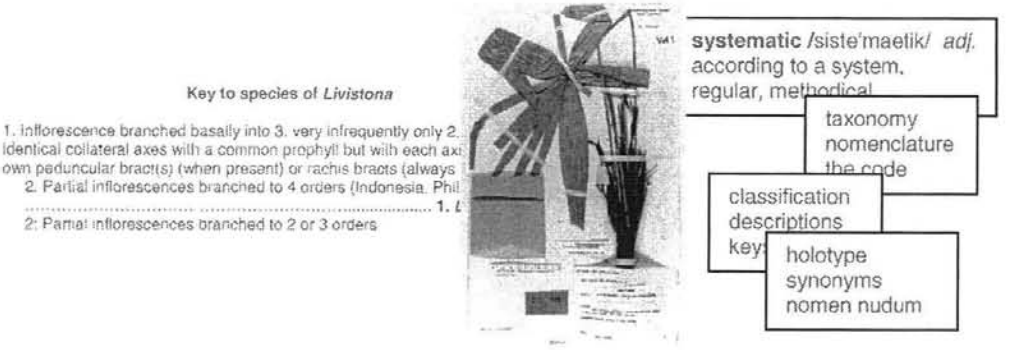
Chapter 2

Studies in the genus *Livistona* R. Br. (Coryphoideae: Arecaceae)

SYSTEMATIC TREATMENT OF *LIVISTONA*



2.1 Introduction

Brown (1810) established the genus *Livistona* R. Br. in his *Prodromus Flora Novae Hollandiae*. Previously, species that would eventually be transferred to *Livistona* were described as species of *Corypha* L. (Lamarck, 1786; Loureiro, 1790) and *Latania* Comm. ex Juss. (Jacquin, 1801), as well as the pre-Linnaean mononomial *Saribus* (Rumphius, 1741). Originally, Brown (1810) described two species, *L. inermis* R. Br. and *L. humilis* R. Br. from islands in the Gulf of Carpentaria, Australia. However, in the same account he also described new species of *Corypha* that would later be transferred to *Livistona*. Brown distinguished *Livistona* and *Corypha* species primarily on minor seed characteristics.

Martius (1838), in his *Historia Naturalis Palmarum*, was the first to provide a detailed treatment of the palm family, and included *Livistona* with a total of eight species. The presently accepted identity of *Livistona*, subsuming *Saribus* and including some former species of *Corypha*, was clearly established in Martius' account.

In Australia, Mueller, as government botanist for Victoria (1856-1896), described four *Livistona* species. Mueller's taxonomic accounts were scattered in a number of journals and it was not until the treatment by Wendland and Drude (1875) in

their *Palmae Australasicae*, that a systematic treatment of the Australian species was provided. Wendland and Drude described five *Livistona* species for Australia. Bentham (1878) included only three *Livistona* species in his treatment of the Australian palms in volume 7 of *Flora Australiensis*. The reduced number was the result of synonymisation and generic transfer of some of Wendland and Drude's taxa. With further exploration and settlement in Australia, Mueller (1892), Bailey (1902, 1910), Beccari (1921) and Gardner (1923) described additional species. More recently, Rodd (1998) described five new species and three new subspecies, and Dowe and Barfod (2001) one species, thus bringing the number of described Australian species to 18.

In south-eastern Asia and Malesia, botanical exploration and taxonomy of *Livistona* were also productive. Following Martius' accounts (1838, 1849), Zollinger (1857), Kurz (1874), Ridley (1898), and Beccari (1877, 1904, 1905, 1907, 1909, 1910, 1911, 1919a, 1919b, 1921) described new species. Beccari (1931), in his series on Asiatic palms, provided the first monograph of *Livistona* covering its entire range, and included 24 species. Subsequently, Burret (1935, 1939, 1941), Dransfield (1977), Wei and Xiao (1982), Dransfield and Wong (1987), Nguyen and Kiew (2000) and Dowe and Barfod (2001) described new species. One new species is proposed in this thesis. It will be formally described in an appropriate journal.

Burret (1943) established a new genus, *Wissmannia*, with a single species *W. carinensis* (Chiov.) Burret, to accommodate a species that was subsequently transferred to *Livistona* by Dransfield and Uhl (1983b). Although based on infertile material, Burret correctly placed the species affinity with Coryphoid genera rather than the Borassoid genera as originally proposed by Chiovenda (1929). Monod (1955) suggested a strong relationship with *Livistona* following examination of collections that included flowers and fruit.

In his revision of *Livistona*, Rodd (1998, p. 52) provided a list of 68 taxa, 31 of which he considered to be currently accepted names. This can be compared with the taxon list provided in Table 1.1 of this thesis, in which 92 names are listed, 42

of which are currently accepted. It is anticipated that the number of accepted species will be reduced because of synonymisation.

2.2 Materials and methods

The morphological species concept was used in this treatment (Stuessy, 1990; Kanis *et al.*, 1999). Although systematists differ as to the precise definition for this concept, it is based on the recognition of basic taxonomic units determined by readily observable morphological discontinuities that ultimately reflect biological limits and genetic divergence.

Abbreviations for publications and journals are based on Lawrence *et al.* (1968) and Stafleu and Cowan (1976-1988). Herbarium acronyms are according to Holmgren *et al.* (1990), and author abbreviations are based on Brummitt and Powell (1992). Nomenclatural rules were followed as in Greuter *et al.* (2000). Pre-Linnaean names, unpublished manuscript names and invalid names of otherwise historical interest are placed in square brackets, where appropriate, in the taxonomic section.

Just over 400 specimens were examined from the following herbaria: A, AAU, B, BM, BO, BR, BRI, CAHUP, CANB, CANT, DNA, FI, FT, FTG, HN, JCT, K, KEP, L, LAE, LBC, M, MA, MAK, MEL, NSW, NY, P, PERTH, PNH, QRS, S, SING, UC, US. Appropriate parts and organs were measured and the data compiled into descriptions and collated in tabular form. These data (Appendices 3-13) form the basis of the cladistic analysis presented in Chapter 3 as well as forming a primary component of the descriptions presented in this chapter. To obtain data that were not available from herbarium specimens, fieldwork was undertaken in Australia, Papua New Guinea, the Philippines and Thailand. A field-trip and excursion time-table is presented in Appendix 1. To further expand the descriptive database, reference was also made to species descriptions in the available literature.

Distribution maps, which are included with each species description, were based on the localities recorded on the labels of the specimens that were examined. Where there were multiple collections from a single location, these are indicated

by a single dot on the distribution map. The number of specimens seen for each species is included under the heading 'Distribution'.

Species, as taxonomic units, were recognised by their morphological characteristics. The four species and four subspecies of *Livistona* in the Philippines presented difficulties because most were very poorly characterised, and there were few verified wild collections from type localities available for examination. To clarify the situation with regard to the Philippine taxa [including *L. rotundifolia* and its four subspecies, *L. merrillii* and *L. robinsoniana*, but excluding *L. saribus* as it is sufficiently distinct to be easily recognised], specimens, descriptions and associated data were scrutinised (Appendices 3-13). Taxonomic decisions were subsequently based upon comparative morphology.

Closely related taxa

In the morphologically based tabulations presented in Appendices 3-13, it was observed that the two pairs of taxa, *L. inermis* and *L. lorophylla*, and *L. beccariana* and *L. woodfordii*, were closely related. This raised questions about the identity of the taxa, and whether taxonomic rearrangement would be appropriate. Comparisons of morphological characters for these pairs of taxa are presented in Tables 2.1 and 2.2.

2.3 Results

2.3.1 *Taxonomic resolution of closely related taxa*

With respect to the comparison of the two pairs of putatively closely related taxa, *L. inermis* and *L. lorophylla* (Table 2.1), and *L. beccariana* and *L. woodfordii* (Table 2.2), it is evident that synonymy may be appropriate for at least the latter pair. For the former pair, there are a number of strongly independent characters that may be used to differentiate the species in the field. For example, *L. lorophylla* is consistently taller with a more robust stem, spine colour is black rather than red, the number of partial inflorescences about double, there is a peduncular bract present, and the fruit are dull pruinose and black as opposed to glossy black. Accordingly, these two species are maintained as distinct.

Table 2.1. Comparison of morphological characteristics of *Livistona inermis* and *L. lorophylla*.

character	*L. inermis*	*L. lorophylla*
maximum stem height	10 m	15 m
average stem diameter	8 cm	15 cm
lamina length	30-70 cm	60-100 cm
# of segments	24-48	34-50
% of segment free	80-97%	85-98%
% of apical cleft	70-84%	55-78%
segment apex	rigid	rigid
adaxial colour	green or grey/green	green or grey/green
abaxial colour	grey	grey
lamina surface	non-waxy	non-waxy
# of parallel veins	17	18
transverse veins	very thin	thin
transverse extension	2	2-3
transverse density	11	10
petiole cross section	adaxially channelled	adaxially flat
armature	single spines	single spines
spine shape	curved	curved
spine colour	reddish	black
leaf-base fibres	very prominent	very prominent
weave	coarse	coarse
partial inflorescences	3	4-8
branching order	3	3
inflorescence length	80-90 cm	80-100 cm
rachilla length	1-7 cm	1-6 cm
# peduncular bracts	0	1
bract indumentum	sparse hairs	sparse tomentum
rachilla indumentum	glabrous	glabrous
flowers per cluster	1-3	1-4
flower length	1.5-2.3 mm	1.2-3 mm
flower colour	yellow/cream	cream
pollen size	44 x 37 μm	23 x 18 μm
fruit shape	obovoid/pyriform	obovoid/pyriform
fruit length	10-13 mm	8-14 mm
fruit diameter	6-7 mm	6-9 mm
fruit colour	glossy black	black
pedicel length	1 mm	0.5 mm
epicarp pores	not present	present
embryo position	lateral	lateral
sexuality (putative)	functional dioecy	functional dioecy

Table 2.2. Comparison of morphological characteristics of *Livistona beccariana* and *L. woodfordii*.

character	*L. beccariana*	*L. woodfordii*
maximum stem height	15 m	15 m
average stem diameter	15 cm	20 cm
lamina outline	circular	circular
lamina length	170 cm	150 cm
# of segments	68-70	65-70
% of segment free	60%	51%
% of apical cleft	23%	11%
segment apex	semi-pendulous	semi-pendulous/rigid
adaxial surface	green	green
lamina surface	non-waxy	non-waxy
# of parallel veins	14	11
transverse veins	thin	thin
transverse extension	2-4	2-5
transverse density	30-35	23
petiole cross section	adaxially ridged	adaxially ridged
armature	single spines	single spines
spine shape	curved	curved
spine colour	black	black
leaf-base fibres	prominent	very prominent
weave	coarse	coarse
partial inflorescences	7-9	5-6
branching order	3	3
inflorescence length	160-200 cm	120-270 cm
rachilla length	4-6 cm	4-6 cm
# peduncular bracts	0	0
bract indumentum	glabrous	glabrous
rachilla indumentum	glabrous	glabrous
flowers in cluster	1-3	2-6
flower length	1-1.5 mm	1.5 mm
flower colour	red	red
fruit shape	globose	globose
fruit length	12-14 mm	6-14 mm
fruit colour	orange-red	orange-red
pedicel length	2 mm	2-3 mm
epicarp pores	present	present
embryo position	lateral	lateral

For the other species, *L. beccariana* and *L. woodfordii*, there are only a few minor differences recorded (Table 2.2), and all within characters where variability at the species level is expected. For example, *L. woodfordii* has a more robust stem, 20 cm as opposed to 15 cm diam., a slightly shorter lamina, the cleft in the segment apex comparatively less deep, fewer partial inflorescences, and a greater number of flowers in the floral clusters. Accordingly, synonymisation is proposed in the following treatment with *L. beccariana* placed under *L. woodfordii*.

2.3.2 *Typification summary*

Of the 92 names that historically have been listed under *Livistona* (Table 1.1) since the genus was first established, 68 are typified by specimens deposited in various herbaria. Of these specimens, 57 were examined, eight were not examined as they were unavailable for loan or examination but otherwise are known to exist, and three could not be located and are assumed to be lost or destroyed. Five names are typified by illustrations. Three names are of fossil taxa. Of the remaining 19 names, types were not designated by the original authors. Some of these names are currently in synonymy either under other *Livistona* species or other genera, or are otherwise 'names of no standing'. A summary of typification is presented in Table 2.3, and the typification for all names associated with *Livistona* is presented in Appendix 2. The 35 currently accepted species described in this account are presented in Table 2.4. Proposed typifications are presented in Table 2.5. These will be published in an appropriate journal as part of the taxonomic revision.

Table 2.3. Summary of typification for names in *Livistona*.

typification	number of taxa
typified by extant herbarium specimens	**68** (includes 1 fossil taxon)
examined	57
not examined but known to exist	8
not located: presumed lost or destroyed	3 (includes 1 fossil taxon)
typified by illustrations	**5**
types not designated	**19** (includes 1 fossil taxon)
Total:	**92**

Table 2.4. List of currently accepted taxa recognised in this account, arranged in systematic order, with the date of publication of the name.

Livistona R. Br., 1810

1. *L. rotundifolia* (Lam.) Mart., 1838
2. *L. robinsoniana* Becc., 1911
3. *L. merrillii* Becc., 1904
4. *L. papuana* Becc., 1877
5. *L. woodfordii* Ridley, 1898
6. *L. chocolatina* Dowe, 2002 (ined.)
7. *L. tothur* Dowe and A. S. Barfod, 2001
8. *L. surru* Dowe and A. S. Barfod, 2001
9. *L. jenkinsiana* Griff., 1844
10. *L. endauensis* J. Dransf. and K. M. Wong, 1987
11. *L. tahanensis* Becc., (1915 - name only) 1921
12. *L. halongensis* Nguyen and Kiew, 2000
13. *L. boninensis* (Becc.) Nakai, (1928 - name only) 1935
14. *L. chinensis* (Jacq.) R. Br. ex Mart., 1838
15. *L. saribus* (Lour.) Merr. ex A. Chev., 1919
16. *L. exigua* J. Dransf., 1977
17. *L. muelleri* F. M. Bailey, 1902
18. *L. nasmophila* Dowe and D. L. Jones, 2002 (ined.)
19. *L. decora* (Bull) Dowe, 2002 (ined.)
20. *L. inermis* R. Br., 1810
21. *L. benthamii* F. M. Bailey, 1902
22. *L. concinna* Dowe and A. S. Barfod, 2001
23. *L. nitida* A. N. Rodd, 1998
24. *L. australis* (R. Br.) Mart., 1838
25. *L. carinensis* (Chiov.) J. Dransf. and N. W. Uhl, 1983
26. *L. alfredii* F. Muell., 1892
27. *L. humilis* R. Br., 1810
28. *L. fulva* A. N. Rodd, 1998
29. *L. eastonii* C. A. Gardner, 1923
30. *L. victoriae* A. N. Rodd, 1998
31. *L. drudei* F. Muell. ex Drude, (1878 - name only) 1893
32. *L. lorophylla* Becc., 1921
33. *L. lanuginosa* A. N. Rodd, 1998
34. *L. mariae* F. Muell., (1874 - name only) 1878
35. *L. rigida* Becc., 1921

Table 2.5. Taxa for which neotypes and lectotypes need to be chosen.

Livistona saribus (Lour.) Merr. ex A. Chev. Vietnam. (neotype to be chosen)

Chamaerops biroo Sieb. (= ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.). Japan. undated, *Siebold s. n.* (lectotype L).

Corypha decora Bull (= ***Livistona decora*** (Bull) Dowe). Australia. (neotype to be chosen)

Corypha minor Blanco (= ***Livistona merrillii*** Becc.). Philippines. undated, *Llanos 221* (lectotype MA).

Livistona altissima Zoll. (= ***Livistona rotundifolia*** (Lam.) Mart.). Indonesia. Cultivation. Bogor Botanic Gardens, undated, *H. Zollinger 2684* (lectotype BM).

Livistona hoogendorpii Hort. ex Teysm. and Binn. ex Miq. (= ***Livistona saribus*** (Lour.) Merr. ex A. Chev.). Indonesia. Cultivation. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (lectotype FI) [Beccari Herbarium, sheets 11330 and 11330-B].

Livistona jenkinsiana Griff. Illustration (lectotype) in Griffith, Palms Brit. E. Ind. t. 226 A, B (1850).

Livistona spectabilis Griff. (= ***Livistona saribus*** (Lour.) Merr. ex A. Chev.). Illustration (lectotype) in Griffith, Palms Brit. E. Ind. t. 226 C (1850).

Livistona tonkinensis Magalon (= ***Livistona saribus*** (Lour.) Merr. ex A. Chev.). Vietnam. Riviere Noire and the middle region of the Tonkin River, 25 Jan 1930, *M. Magalon s. n.* (lectotype P).

Saribus olivaeformis Hassk. (= ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.). Indonesia. Cultivation. Bogor Botanic Gardens, 'nel viale presso la chieta', *Beccari s. n.* (lectotype FI) [Beccari Herbarium, sheets 1131, 113-B and 113-C].

Saribus subglobosus Hassk. (= ***Livistona chinensis*** (Jacq.) R. Br. ex Mart.). Indonesia. Cultivation. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (lectotype FI) [Beccari Herbarium, sheets 11333 and 11333-B].

2.4 Taxonomy

Livistona R. Br., *Prodr.* 267 (1810); Martius, Hist. nat. palm. 238 (1838); Miquel, Fl. Ned. Ind. 3: 57 (1855); Hooker, Gen. Pl. 3: 880 (1883); Drude, Natur. pflan. 2(3): 35 (1887); Beccari, Ann. Roy. Bot. Gard. (Calcutta) 13: 43 (1931); Hay, Palmae, Guide monocots. Papua New Guinea 3: 207 (1984); Uhl & Dransfield, Gen. Palmarum 190 (1987); Rodd, Telopea 8: 51 (1998). Type: *L. humilis* R. Br. (*fide* Moore, 1963a).

Saribus Blume, Rumphia 2: 48 (1838). Type: *S. rotundifolius* (Lam.) Blume (*fide* Moore, 1963a).

[*Saribus* Rumph., Herb. Amboin. 1: 42 (1741)].

[*Corypha* L., Jussieu, Gen. pl. 39 (1789) *pro. parte*].

Livistona sect. *Eulivistona* Drude, Bot. Jahr. 39: 12 (1893). Type: *L. leichhardtii* F. Muell. (= *L. humilis* R. Br.).

Livistona sect. *Gregorya* Drude, Bot. Jahr. 39: 12 (1893). Type: *L. alfredii* F. Muell.

Wissmannia Burret, Bot. Jahr. 73: 184 (1943). Type: *Wissmannia carinensis* (Chiovenda) Burret (= *L. carinensis* (Chiov.) J. Dransf. and N. W. Uhl).

Solitary, short to tall, erect, pleonanthic hermaphrodite or functionally dioecious palms. **Trunk** slender to robust, smooth or with nodes conspicuous; internodes compressed or long. **Leaves** palmate or costapalmate, when senescent sometimes forming a persistent skirt; leaf-bases fibrous, ligulate; petioles long, adaxially grooved, flat or ridged, abaxially rounded or angled, margins smooth or spiny; hastula present; lamina regularly or irregularly segmented; segments narrow, lanceolate, single-fold, fused or separate at the base, tapered to the apex, apices shallowly or deeply cleft, rigid or pendulous. **Inflorescences** interfoliar, not

branched at the base, or trifurcate or occasionally bifurcate with ± identical collateral axes; partial inflorescences 1 (*L. humilis* only) or 3-14 per axis, branched to 2 to 5 orders when primary inflorescence axis is regarded at branch number '0' and the first branch of the partial inflorescence as branch '1'; prophyll 2-keeled; peduncular bracts lacking or if present then tubular; rachis bracts tubular, subtending each partial inflorescence, secondary rachis bracts lacking or present; rachillae straight or flexuose. **Flowers** bisexual, solitary or in sympodial clusters, spirally arranged, variously coloured; sepals triangular, fused at the base with apices lobed, glabrous or hairy; petals free, triangular, valvate, glabrous or hairy; stamens 6, epipetalous, shorter than the petals; filaments subulate; anthers didymous, medi-fixed, versatile, latrorse; carpels wedged-shaped, basally separated; styles united, slender, shorter than the stamens; stigma 3-lobed. **Fruit** globose, pyriform or ellipsoid, variously coloured, 1-seeded; stigmatic remains apical to subapical; epicarp thin or thick, smooth or with scattered pores or mildly rugose; suture line extending longitudinally from stigmatic remains toward the base or not readily visible; mesocarp dry or fleshy, with or without fibres. **Seed** globose, ellipsoid or reniform; endosperm homogeneous, intruded by the testa from one side with spongy or crystalline tissue in a ± reniform shape to displace most of the endosperm; embryo small, supra- to sub-lateral. Eophyll simple. $n = 18$ (Sharma and Sarkar, 1956).

A genus of 35 species distributed in Djibouti, Somalia, Yemen, NE India, SE and E Asia, Ryukyu Islands, southern Japan, Bonin Islands, the Philippines, Malesia and Australia; grows in rainforest, montane forest, swamp forest, monsoon forest, coastal forest, semi-closed to open woodlands and savanna, on various soils, including limestone and peat, in permanently or seasonally wet situations, or in semi-arid to arid situations where usually associated with permanent ground water or at the base of cliffs. *Livistona* was named for Patrick Murray, Baron of Livingston [died 1671], whose plant collection formed the basis of the Edinburgh Botanic Gardens.

2.5 Key to species of *Livistona*

1a. Inflorescences basally trifurcate, very infrequently bifurcate, with the axes more or less similar and with a common prophyll but with each axis bearing its own peduncular bract(s) (when present) or rachis bracts (always present) **2**

1b. Inflorescences not branched at the base, with or lacking peduncular bracts **9**

2a. Partial inflorescences branched to 4 orders **3**

2b. Partial inflorescences branched to 2 or 3 orders **4**

3a. Trunk nodes obscure to moderately prominent, internodes grey to light green; leaf base fibres moderately coarse (Indonesia, Philippines) ..... 1. *L. rotundifolia*

3b. Trunk nodes very prominent, internodes dark green aging grey; leaf base fibres very coarse (Philippines) ..... 2. *L. robinsoniana*

4a. Fruit < 35 mm long **5**

4b. Fruit > 35 mm long **8**

5a. Sepals and petals yellow **6**

5b. Sepals and petals red **7**

6a. Rachis bracts of inflorescences loosely tubular; rachillae glabrous; flowers 3-4.5 mm long (Philippines) ..... 3. *L merrillii*

6b. Rachis bracts of inflorescences tightly tubular; rachillae finely puberulous; flowers c. 1.2 mm long (Indonesia) ..... 4. *L. papuana*

7a. Segment apices semi-pendulous, hanging c. 45° or more to the vertical; lamina deeply folded, angles of folds 90° or less, surfaces of proximal parts of partial inflorescences and rachillae glabrous (Papua New Guinea, Solomon Islands) ..... 5. *L. woodfordii*

7b. Segment apices rigid, lying at ± the same plane as the orientation of the leaf; lamina moderately folded, angles of folds 91° or more but usually much greater, surfaces of proximal parts of partial inflorescences and rachillae with chocolate-coloured tomentum (Papua New Guinea) ... 6. *L. chocolatina*

8a. Lamina with abaxial surface silvery glaucous; segment apices rigid; rachillae 6-12 cm long, glabrous; fruit 35-43 mm diam. (Papua New Guinea) .... 7. *L. tothur*

8b. Lamina with abaxial surface green; segment apices pendulous, hanging ± parallel to the vertical; rachillae 14-24 cm long, densely pubescent; fruit 50-65 mm diam. (Papua New Guinea) ..... 8. *L. surru*

9a. Fruit green, purple-green, blue or purple at maturity **10**

9b. Fruit black, purple-black or dark brown at maturity **17**

10a. Lamina regularly segmented, leaf segments not grouped **11**

10b. Lamina irregularly segmented, leaf segments grouped with divisions between each group split almost to the hastula **16**

11a. Leaf segments with rigid apices lying in ± the same plane as the orientation of the leaf **12**

11b. Leaf segments with pendulous apices, hanging ± parallel to the vertical .. **14**

12a. Fruit leaden blue to dark purple, ellipsoid, obpyriform to reniform, 19-35 mm long (India, Sikkim, Bangladesh, Myanmar, Thailand, China, Malaysia) ..... 9. *L. jenkinsiana*

12b. Fruit green, globose to obovoid to 14 mm long **13**

13a. Leaf with 60-70 segments, abaxial surface green; inflorescences to 150 cm long, partial inflorescences c. 8; fruit obovoid to pyriform (Malaysia) .... 10. *L. endauensis*

13b. Leaf with 49-50 segments, abaxial surface grey-green; inflorescences to 80-91 cm long, partial inflorescences 4; fruit globose to oblong (Malaysia) ..... 11. *L. tahanensis*

14a. Inflorescence longer than the leaves, extended above the crown to c. 340 cm long (Vietnam) ..... 12. *L. halongensis*

14b. Inflorescence shorter than the leaves, in the crown to c. 220 cm long **15**

15a. Rachis bracts glabrous; one peduncular bract present; inflorescence to 220 cm long (Japan) ..... 13. *L. boninensis*

15b. Rachis bracts glabrous to moderately tomentose; peduncular bract lacking; inflorescence to 120 cm long (China, Taiwan, Japan) ..... 14. *L. chinensis*

16a. Large canopy palms to 40 m tall; lamina to 200 cm long; partial inflorescences 4-9; fruit blue to purple (Laos, Kampuchea, Vietnam, Thailand, Malaysia, Indonesia, Philippines) ..... 15. *L. saribus*

16b. Small understorey palms to 5 m tall; lamina to 50 cm long; partial inflorescences 3-4; fruit purple-green (Brunei) ..... 16. *L. exigua*

17a. Inflorescence lacking peduncular bract(s) **18**

17b. Inflorescence with peduncular bract(s) **25**

18a. Leaf segments with rigid apices **19**

18b. Leaf segments with pendulous apices **20**

19a. Lamina 60-90 cm long, flat; dark olive to grey-green; sepals maroon and carpels pink to maroon; fruit ellipsoid (Australia, New Guinea) ..... 17. *L. muelleri*

19b. Lamina 130-175 cm long, folded, grey-green; sepals and carpels cream to yellow; fruit globose (Australia) ..... 18. *L. nasmophila*

20a. Mid leaf segment free for > 80% of its length **21**

20b. Mid leaf segment free for < 80% of its length **22**

21a. Partial inflorescences > 8; fruit globose; petiole strongly armed with spines to 20 mm long (Australia)..... 19. *L. decora*

21b. Partial inflorescences 3-8; fruit obovoid/pyriform; petiole weakly armed with spines to 5 mm long (Australia) ..... 20. *L. inermis*

22a. Petiole stubs habitually retained on trunk (Australia, New Guinea) ....
..... 21. *L. benthamii*

22b. Petioles stubs not habitually retained on trunk **23**

23a. Rachis bracts glabrous, tightly tubular, not disintegrating into open fibres (Australia) ..... 22. *L. concinna*

23b. Rachis bracts densely tomentose or scaly, loosely tubular, disintegrating into open fibres **24**

24a. Fruit shiny, black (Australia) ..... 23. *L. nitida*

24b. Fruit reddish brown to dull black, occasionally glaucous (Australia) ..... 24. *L. australis*

25a. Fruit > 36 mm diam. **26**

25b. Fruit < 36 mm diam. **27**

26a. Inflorescence longer than leaves; rachillae glabrous, sepals and petals (abaxial surfaces) with long hairs; rachis bracts glabrous (Djibouti, Somalia, Yemen) ..... 25. *L. carinensis*

26b. Inflorescence shorter than the leaves; rachillae, sepals and petals lacking hairs; rachis bracts sparsely to moderately scaly (Australia) ..... 26. *L. alfredii*

27a. Small palms to 7 m tall; inflorescences sexually dimorphic; fruit bearing inflorescences with a single partial inflorescence at the apex, non-fruit bearing inflorescences with 4-7 partial inflorescences (Australia) .....
.....27. *L. humilis*

27b. Large palms > 7 m tall; inflorescences not obviously sexually dimorphic **28**

28a. Segment apices very shallowly cleft, 3-5% of the length of the free portion of the segment; abaxial surface of lamina with coppery coloured tomentum (Australia) ..... 28. *L. fulva*

28b. Segment apices deeply cleft, 24-79% of the length of the free portion of the segment; abaxial surface of lamina glabrous **29**

29a. Leaf segment apices always rigid **30**

29b. Leaf segment apices pendulous, semi-pendulous or infrequently rigid..... **31**

30a. Leaves 10-20 in crown; fruit glossy, purple-black (Australia)...29. *L. eastonii*

30b. Leaves 25-40 in crown; fruit dull, dark reddish-brown to black (Australia) ..... 30. *L. victoriae*

31a. Free portion of mid leaf segment >60% of the length of the segment **32**

31b. Free portion of mid leaf segment <55% of the length of the segment **33**

32a. Rachis bracts glabrous; petiole base purple; segment apices pendulous hanging ± parallel to the vertical; fruit globose to pyriform (Australia) ..... 31. *L. drudei*

32b. Rachis bracts sparsely tomentose; petiole base green; segment apices semi-pendulous, hanging at c. 45° to the vertical; fruit obovoid/pyriform (Australia) ..... 32. *L. lorophylla*

33a. Fruit 25-35 mm diam.; segment apices semi-pendulous hanging at c. 45° to the vertical; peduncular bracts and rachis bracts very densely tomentose, flowers solitary or in pairs (Australia) ..... 33. *L. lanuginosa*

33b. Fruit < 20 mm diam.; peduncular bracts and rachis bracts densely, moderately or sparsely tomentose; flowers in clusters of 3-8 ..... **34**

34a. Lamina to 220 cm long, moderately folded with folds > 91°; segment apices pendulous hanging ± parallel to the vertical; rachis bracts moderately to densely scaled; fruit 12-18 mm diam. (Australia) ..... 34. *L. mariae*

34b. Lamina to 170 cm long, strongly folded with folds < 90°; segment apices rigid or semi-pendulous; rachis bracts sparsely scaled; fruit 12-14 mm diam. (Australia) ..... 35. *L. rigida*

2.6 Descriptions of species

1. ***Livistona rotundifolia*** (Lam.) Mart., Hist. nat. palm. 3: 241 (1838); Miquel, Fl. Ned. Ind. 3: 58 (1855); Miquel, Palm. archip. ind. 12 (1868); Beccari, Ann. Roy. Bot. gard. (Calcutta) 13: 74 (1931).

Corypha rotundifolia Lam., Encycl. 2: 131 (1786); Willdenow, Sp. pl. 2: 201 (1797); Hayne, Term. bot. tab. 11, fig. 1 (1807); Sprengel, Syst. veg. 2: 138 (1825); Schultes, Syst. veg. 7(2): 1309 (1830). *Saribus rotundifolius* (Lam.) Blume, Rumphia 2: 49 (1838). Type: Lectotype (*fide* Merrill, 1917). Illustration in Rumphius, Herb. Amboin. 1: t. 8. (1741).

[*Saribus* Rumph., Herb. Amboin. 1: 42 (1741)].

[*Corypha umbraculifera auct. non.* L., Sp. pl. 1187 (1753) (*fide* Merrill, 1917)].

Livistona umbraculifera Hort. ex Vilmorin, Vilm. Blumengärtn. ed. 3, 1: 1149 (1895), *in syn.*

Livistona altissima Zoll., Nat. Tijdschr. Ned. Indië 14: 150 (1857). *Saribus* sp. n. ? 'Sadjeng', Zollinger, Syst. Verz. 78 (1854); Miquel, '*Saribus spec. Zolling. Cat p. 78*', Fl. Ned. Ind. 3: 58 (1855); Miquel, Palm. archip. ind. 14 (1868). *Livistona zollingeri* Hort. ex Devansaye, Rev. hort. 47: 34 (1875). *Livistona zollingeriana* Blume, Salomon, Palmen 142 (1887). *Saribus zollingerianus* Hassk., Salomon, Palmen 142 (1887). Type: Lectotype here chosen. Indonesia. Cultivation. Bogor Botanic Gardens, undated, *H. Zollinger 2684* (lectotype BM).

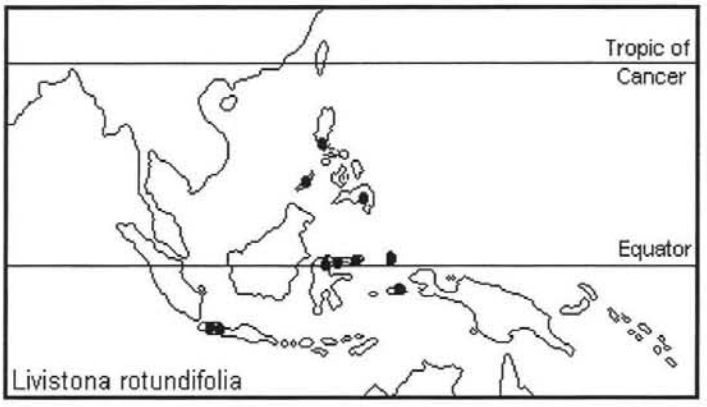
Livistona rotundifolia (Lam.) Mart. var. *microcarpa* (Becc.) Becc., Philipp. J. Sci. 14: 341 (1919); Beccari, Leafl. Philipp. Bot. 8 (Aug. 25): 3024 (1919) ***syn. nov.*** *Livistona microcarpa* Becc., Philipp. J. Sci. 2: 231 (1907). Type: Philippines. Palawan, Carañugan River, 28 Feb. 1906, *H. M. Curran 3784* (holotype FI; isotypes BM, NY, P).

Livistona rotundifolia (Lam.) Mart. var. *mindorensis* (Becc.) Becc., Philipp. J. Sci. 14: 341 (1919) ***syn. nov.*** *Livistona mindorensis* Becc., Philipp. J. Sci. 4: 615

(1909). Type: Philippines. Mindoro, Bongabong River, May 1906, *M. L. Merritt 4108* (holotype FI).

Hermaphroditic palm. **Trunk** to 45 m tall, 15-25 cm dbh, erect to slightly leaning, cylindrical, slightly broader at the base, nodes obscure to moderately prominent, internodes grey to light green, petiole stubs not persistent. **Leaves** 20-50 in a globose crown; petiole slightly arching, 90-210 cm long, 15 cm wide proximally, c. 2 cm wide distally, triangular in cross section, adaxially flat or moderately ridged, abaxially rounded, margins with single black spines 1-20 mm long throughout or proximally only, with largest proximally, distally becoming smaller and more widely spaced, or with spines completely lacking; leaf-base fibres moderately prominent, moderately coarse, brown, persistent, ligule triangular; lamina circular to sub-circular, 75-150 cm long, adaxially semi-glossy dark green, abaxially lighter sub-glaucescent green; segments regular, 60-90, free for 38-62% of their length, apical cleft 4-25% of length of free segment, apical lobes usually erect, pendulous in segments with deeper clefts; mid-leaf segments c. 5 cm wide at the disjunction; parallel veins 6-9 each side of midrib, equal to or less prominent than transverse veins which are thin, extending across 2-7 parallel veins, density of 15-32 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical collateral axes, 90-150 cm long, sharing a common base and a common prophyll, arching; partial inflorescences c. 10, longest to c. 30 cm, branched to 4 orders; prophyll to 30 cm long, glabrous, straw coloured, bicarinate; peduncular bracts lacking or 1; rachis bracts tightly sheathing throughout, tubular, reddish brown, glabrous, apically truncate, remaining intact with age; rachillae 3-20 cm long, 1-1.5 mm thick, rigid, glabrous, yellowish. **Flowers** solitary or in clusters of 2-4, to 2-3 mm long, yellowish, sessile on small pulvini; sepals broadly ovate, very obtuse, dorsally carinate; petals longer than the sepals, less obtuse, yellowish; anthers roundish, minute; ovary glabrous; style subulate, acute, very short. **Fruit** globose to subglobose, 11-25 mm diam., at first yellow, ripening to red or to dark violet or bluish-black; stigmatic remains inconspicuous; epicarp thin, smooth or with scattered lenticellular pores; suture line for full length of fruit; mesocarp c. 1.5 mm thick, slightly fibrous to gritty; endocarp very thin; pedicel 2-3 mm long. **Seed** globose, 10-13 mm diam., endosperm intruded for two-thirds to almost full width of endosperm; hilum broad, orbicular; embryo

lateral c. 2 mm long. Eophyll 5-ribbed. *Footstool palm, Balla (Mindanao), Luzon Livistona, Anahao (Tagalog), Bulus (Albay Province), Mindoro Livistona, Panobao (Tagalog), Pilig (Tagalog).* Fig. 2.1.



DISTRIBUTION. Indonesia and the Philippines [7°S-15°N]. In Indonesia on Java, Sulawesi and Maluku, and in the Philippines on Mindanao, Cebu, Palawan, Panay and Mindoro. The dots on the map represent 23 collections.

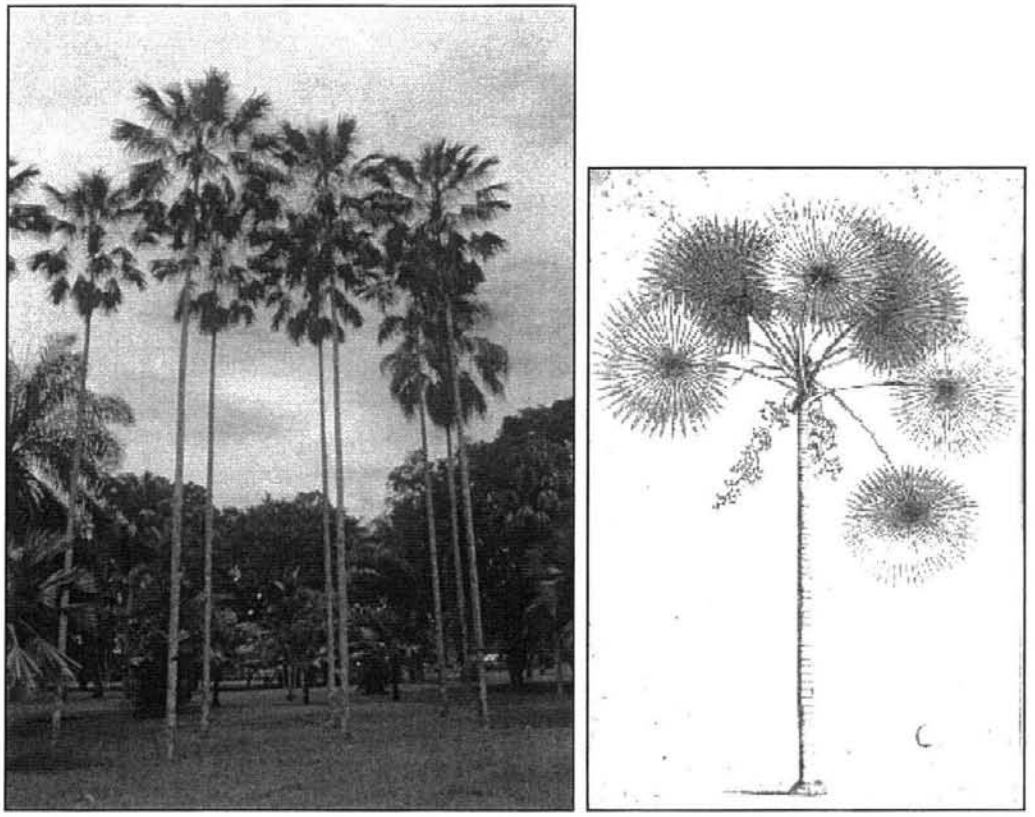


Figure. 2.1. ***Livistona rotundifolia.*** ***Left:*** Habit, cultivated, Lae Botanic Gardens, Papua New Guinea. ***Right:*** Type, illustration in Rumphius (1741), *Herbarium Amboinense*, pl. 8.

HABITAT AND ECOLOGY. In seasonally dry swamp forest, swamps, mangrove margins, along rivers and secondary forest, and on karst limestone (Podzorski 1986) at 0-300 m alt. Locally abundant. Flowers all year; fruits all year.

SPECIMENS SEEN. INDONESIA: Java, Puger, 15 Oct. 1889, *S. H. Koorders 6128* (BO); Java, Koeli, 15 Oct. 1889, *S. H. Koorders 6129* (BO); N Sumatra, 2 Oct. 1927, *J. A. Lörzing 12131* (BO); N Celebes, 31 Jan. 1890, *S. H. Koorders 18424, 18425* (BO); N Celebes, near Manado, 1956, *L. L. Forman 409* (A, BO, LAE); Ternate and Celebes (Woka), and Java (Saligi), 1817, *Reinwardt 60* (L); N Celebes, Bolaang, Mongondow, Pindool, Lelak, 21 Oct. 1973, *J. Dransfield & J. Mogea JD 3831* (BO); Moluccas, Halmahera, Ekor, Bukit Dowora Ina, 30 Sept. 1974, *de Vogel 3236* (BO, L); Moluccas, Halmahera, Akelamo Oba, 00°34'N, 127°36'E, c. 50 m alt., 6 Dec. 1974, *E. F. de Vogel 4436* (K, LAE); North Moluccas, Halmahera Island, Jailol District, Kampung Pasir Putih, 1 Aug. 1981, *P. M. Taylor 605* (US); Ceram, undated, *de Vriese & Teysmann s. n.* (L). PHILIPPINES: Mindoro. Mt Yagaw, 400 m alt., 30 Sept 1953, *H. C. Conklin 535* (PNH); Samar. Llorente, Mt Apoy, May-June 1969, *H. G. Guiterrez et al. 367* (PNH); Babuyanes Prov., Calayan Island, 150 m alt., May 1961, *E. Quisumbing and R. del Rosario 61-369* (PNH); Mindanao. District of Davao, Todayo (Mt Apo), May 1909, *A. D. E. Elmer 11967* (A, BM, BO, K, L, NY, UC); Palawan. Tagburos Mt, vicinity of Puerto Princesa, 18-22 Mar. 1940, *L. E. Ebalao 648* (K); No locality: 1904, carpological collections 1712, *Burck s. n.* (L). CULTIVATION: Indonesia: Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI); Singapore Botanic Gardens, near main gate, B area, introduced as species from Negros, Manila, July 5 1935, Singapore Field 29393, undated, *C. X. Furtado s. n.* (A, SING); Singapore Botanic Gardens, 6 July 1935, *C. X. Furtado 29394* (A); Singapore Botanic Gardens, near main gate, B area, Singapore Field 40542, 11 Mar 1955, *C. X. Furtado s.n.* (SING). Malaysia. Penang Hill, Viaduct Road, Methodist Centre, 6 May 1966, *T. C. Whitmore FRI0291* (L). PAPUA NEW GUINEA: Lae Botanic Gardens, 5 Mar. 1977, *J. R. Croft 71100* (LAE).

NOTES. *Livistona rotundifolia* was the first species in the genus to be taxonomically recognised, and named by Rumphius (1741) in the pre-Linnaean publication *Herbarium Amboinense*, as the mononomial *Saribus*. Linnaeus (1753) included Rumphius' *Saribus* as part of his broadly circumscribed *Corypha umbraculifera*, however Lamarck (1786) extracted *Saribus* from that taxon and used it as the basis for his *Corypha rotundifolia*, which is the first use of the specific epithet, and named for the round leaves: "....*Coryphe à feuilles rondes*....". Merrill (1917) noted that "*Saribus* Rumph. is the whole basis of *Corypha rotundifolia* Lam., which in turn typifies *Livistona rotundifolia* Mart.", and therefore established the illustration in *Herbarium Amboinense*, tab. 8,

(Rumphius, 1741) as the lectotype (Fig. 2.1). Moore (1963a) established *S. rotundifolius* as the lectotype for the genus *Saribus*.

The entity of *Saribus* Rumph. was implicated in other taxa, with Loureiro (1790) partly basing his *Corypha saribus* on it. To clarify the perceived confusion over the identity of the species, Blume (1838) established the genus *Saribus*, utilising the name of Rumphius' mononomial as his genus name, to include *C. rotundifolia* and other taxa, and thus made the combination *Saribus rotundifolius*. Soon after, Martius (1838) provided the first synopsis of *Livistona*, subsuming Blume's *Saribus* and some *Corypha* species by various authors, resulting in the currently accepted combination *Livistona rotundifolia*. Martius' account clearly established the relationship of *L. rotundifolia* to other taxa, including Linnaeus' *C. umbraculifera*, Blume's *Saribus*, and the versions of *C. rotundifolia* provided in the works of Willdenow (1799), Sprengel (1825) and Schultes and Schultes (1829). In the latter two references, Loureiro's *C. saribus* was placed as a synonym of *C. rotundifolia*. Martius, however, excluded *C. saribus* from his *L. rotundifolia* but included it as a synonym of *L. cochinchinensis*, thus aligning *C. saribus* and *L. cochinchinensis* for the first time and thus establishing the disassociation of *C. saribus* from *L. rotundifolia*. See Notes under *L. saribus* for further discussion.

Livistona altissima was described by Zollinger (1857) for palms cultivated at Bogor Botanic Gardens (Miquel, 1868) with a "....*trunco altissimo gracili*..." but otherwise resembled *L. rotundifolia* but lacked petiolar spines, "...*frondibus habitu et conglomeratione L. rotundifolia Mart. petiolis subrecurvis inermibus*....". The undated collection *Zollinger 2684* [BM] from Java, is here chosen as the lectotype. Zollinger (1857), in the protologue of *L. altissima*, stated that the name 'Zollingerianis' had been used on the herbarium label. Previously the taxon had been designated as *Saribus* sp. by Zollinger (1854) and Miquel (1855), and subsequently as *Livistona zollingeri* (Devansaye, 1875) and the orthographic variation *Livistona zollingeriana* Salomon (1887). Beccari (1931) synonymised *L. altissima* under *L. rotundifolia*.

Beccari (1919a, 1919b) ultimately recognised three subspecies of *L. rotundifolia* in the Philippines, two of which, *L. rotundifolia* var. *microcarpa* [basionym *L. microcarpa* (1907)] and *L. rotundifolia* var. *mindorensis* [basionym *L. mindorensis* (1909)], cannot be separated from *L. rotundifolia sensu strictu.* The third, *L. rotundifolia* var. *luzonensis*, is otherwise placed under *L. robinsoniana* (See Notes for that species). The characters that Beccari used to delimit the Philippine subspecies were narrow and can be accounted for in the overall variation that would be expected to occur in a widespread species. Beccari (1931) wrote of *L. rotundifolia*: ".... a palm of wide geographical distribution and subject, for that reason, to vary more or less, but easily grouped around one well characterised type...".

Livistona rotundifolia is one of a group of closely related species that has its distribution in Malesia and the Philippines. The complex is characterised by a trifurcate, or very infrequently bifurcate inflorescence, and fruit maturing through an orange-red phase to be fully mature at orange, red, crimson, dark red or black. The complex consists of *L. rotundifolia* (Indonesia, Philippines), *L. robinsoniana* (Philippines), *L. merrillii* (Philippines), *L. chocolatina*, *L. papuana*, *L. surru*, *L. tothur* (New Guinea), and *L. woodfordii* (New Guinea and Solomon Islands).

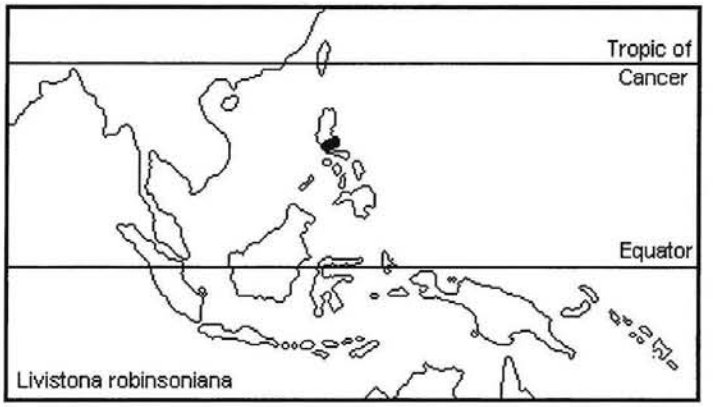
2. *Livistona robinsoniana* Becc., Philipp. J. Sci. 6C: 230 (1911). Type: Philippines. Polillo Island, Aug. 1909, *C. B. Robinson 9265* (holotype FI; isotypes, K, US).

Livistona rotundifolia var. *luzonensis* Becc., Leafl. Philipp. Bot. 8 (Aug. 25): 3025 (1919); Beccari, Philipp. J. Sci. 14: 340 (1919) ***syn. nov.***; as *Livistona rotundifolia* Mart., in Beccari, Leafl. Philipp. Bot. 2: 647 (1909); Merrill, Fl. Manila 122 (1912). Type: Philippines. Luzon, Tayabas Prov., Lucban, Mt Banahao, May 1907, *A. D. E. Elmer 9293* (holotype FI; isotypes BM, BO, L, NY, US).

Hermaphroditic palm. **Trunk** to 20 m tall, 15-25 cm dbh, erect to slightly leaning, cylindrical, slightly broader at the base, nodes very prominent, light green to white, internodes dark green aging to grey, petiole stubs not persistent, with

longitudinal fissures. **Leaves** 20-50 in a globose crown; petiole slightly arching, 90-210 cm long, to 15 cm wide proximally, c. 2 cm wide distally, triangular in cross section, adaxially flat or moderately ridged, abaxially rounded, margins with single, kris-like, black spines 1-20 mm long throughout or proximally only, with largest proximally, distally becoming smaller and more widely spaced; leaf-base fibres prominent, very coarse in a criss-crossed pattern, brown, persistent, ligule triangular; lamina circular to sub-circular, 75-150 cm long, adaxially semi-glossy dark green, abaxially lighter sub-glaucescent green; segments regular, 60-90, free for 38-62% of their length, apical cleft 15-25% of the length of the free segment, apical lobes usually erect, pendulous in segments with deeper clefts; mid-leaf segments c. 5 cm wide at the disjunction; parallel veins 6-9 each side of midrib, equal to or less prominent than transverse veins which are thin, extending across 2-7 parallel veins, density of 15-32 per unit area of 15x10 mm. **Inflorescences** trifurcate, or infrequently bifurcate, with ± identical collateral axes, 90-150 cm long, sharing a common base and a common prophyll, arching; partial inflorescences c. 10, longest to c. 30 cm, branched to 4 orders; prophyll to 30 cm long, glabrous, straw coloured, bicarinate; peduncular bracts lacking or 1; rachis bracts tightly sheathing throughout, tubular, reddish brown, glabrous, apically truncate, remaining intact with age; rachillae 3-20 cm long, 1-1.5 mm thick, rigid, glabrous, yellowish. **Flowers** solitary or in clusters of 2-4, to c. 2 mm long, yellowish, sessile on small pulvini; sepals broadly ovate, very obtuse, dorsally carinate; petals longer than the sepals, less obtuse, yellowish; anthers roundish, minute; ovary glabrous; style subulate, acute, very short. **Fruit** globose, 11-15 mm diam., at first yellow, ripening to brick red; stigmatic remains inconspicuous; epicarp thin, smooth or with scattered lenticellular pores; suture line for full length of fruit; mesocarp c. 1.5 mm thick, slightly fibrous to gritty; endocarp very thin; pedicel 2-3 mm long. **Seed** globose, 10-12 mm diam., endosperm intruded to almost full width of endosperm; hilum broad, orbicular; embryo lateral, c. 2 mm long. Eophyll 5-ribbed. *Luzon Livistona, Anahao (Tagalog).* Fig. 2.2.

HABITAT AND ECOLOGY. In rainforest at 100-300 m alt.



DISTRIBUTION. Philippines. Luzon and Polillo. [13°-14°N]. The dots on the map represent 16 collections.

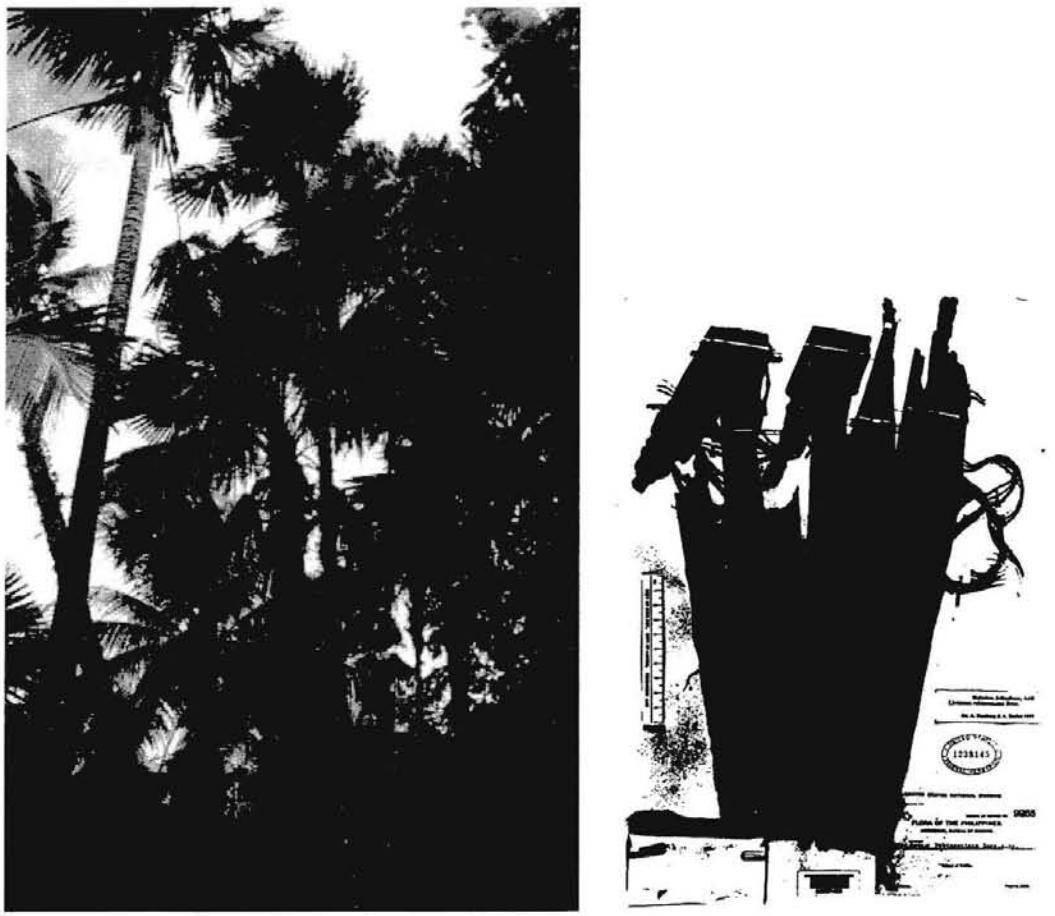


Figure. 2.2. ***Livistona robinsoniana.*** ***Left:*** Habit, Polillo Island, Philippines. ***Right:*** Type, *Robinson 9265* (US), Polillo Island, 1909.

SPECIMENS SEEN. PHILIPPINES: Quezon Prov. Polillo Island, Barangay Sibulan, Sitio San Francisco, c. 50 m alt., 9 Dec. 2001, *J. L. Dowe 700 with E. Romero* (BRI, K, PNH); Polillo Island, Nov.-Dec. 1948, *R. B. Fox 8996* (A); Polillo Island, Karlangan, sea-level, 25 Nov. 1948, *R. B. Fox 6b* (PNH); Polillo Island, Lukutaw, sea-level, 4 Jan. 1949, *R. B. Fox 223* (PNH); Luzon. Panitian, c. 50 m alt., 24 May 1984, *J. Dransfield JD6208* (K); Zambales Prov. Mt Pinatubo, 350 m alt., Nov. 1947, *R. B. Fox 26* (PNH); Camarines Prov., June 1908, *H. M. Curran 10631* (BM, L, US); Luguna Prov. Los Banos (Mt Makiling), June-July 1917, *A. D. E. Elmer 18054* (BM, L, K); Mt Makiling, 13 Oct. 1916, *C. Mabesa 26228* (US); Mt Makiling, 100 m alt., 25 June 1985, *E. S. Fernando 7115* (LBC); Mt Makiling, 100 m alt., 26 May 1988, *E. S. Fernando 7451* (LBC); Mt Makiling, 25 Jan. 1913, *F. C. Gates 5700* (CAHUP); Mt Makiling, 450 m alt., 24 Jan 1914, *F. C. Gates Q93* (CAHUP); Mt Makiling, Mar. 1958, *J. V. Pancho 3488* (CAHUP); Batangas Prov. San Juan, Laiya, 10 May 1980, *B. F. Hernaez 3625* (CAHUP); Camarines Sur Prov. Albay, Tabacco, 18 Aug 1984, *B. F. Hernaez 3870* (CAHUP).

NOTES. *Livistona robinsoniana* was described by Beccari (1911) based on *Robinson 9265* [FI] (Fig. 2.2) collected from Polillo Island (Robinson, 1911b), and named for the collector, Canadian botanist C. B. Robinson [1871-1913], who was murdered on the island of Ambon. Beccari related *L. robinsoniana* to *L. rotundifolia*, but distinguished it on fruit colour, being orange-reddish rather than bluish-black, and in the depth to which the testa intruded into the endosperm, it being much deeper than in *L. rotundifolia*. However, fruit colour in *L. rotundifolia* as interpreted here, is variable, with fruit maturing when orange, red, crimson or nearly black. The degree of intrusion of the testa into the endosperm is also variable even within a species, and cannot be regarded as a reliable taxonomic character. Regarding fruit colour in *L. rotundifolia*: it appears that mature fruit colour in individual plants is uniform, but that variation can occur between individuals. Some of the original designations of fruit colour for *L. rotundifolia* included Lamarck (1786), 'orange , then red'; Blume (1838), 'yellowish to atro-coerulescentes'; and Beccari (1907) for *L. microcarpa* 'shining vermilion red, ultimately wine red or nearly black'. The mechanisms that control fruit colour in *L. rotundifolia* require further study.

Livistona rotundifolia var. *luzonensis* was named by Beccari (1919a) for its occurrence on the Philippines island of Luzon. An examination of the type specimen showed that there was a close association between it and *L. robinsoniana* which has been supported by field work in the Philippines.

Examination of the protologues for the two taxa also confirmed this. Beccari (1919a) based the description of this subspecies on *Elmer 9293*, collected from Mt Banahao, on Luzon, and distinguished it from *L. rotundifolia forma typica* by the greater degree of intrusion of the seedcoat into the endosperm. Earlier, Beccari (1909) referred this specimen to *L. rotundifolia*, and questioned the species indigenousness: "....grows in a wild condition even if originally of foreign origin". The leaves on *Elmer 9293* display comparatively deep clefts, 30-40 cm, in the segment apices, a character not associated with *L. rotundifolia* which has very shallow clefts, only 3-25 cm deep. Deep clefts of 30-40 cm were also described for *L. merrillii* (Beccari, 1931). The degree of intrusion of the seedcoat is variable even between fruit on a single tree, so its use as a distinguishing character is questionable.

Further to this, there are plants widely cultivated under the name *L. rotundifolia* var. *luzonensis*. These plants are characterised by very coarse leaf-base fibres that form a distinctive cross-weave pattern, and a prominently ringed stem with dark green internodes contrasting with grey nodes. These distinctive characters were not included in Beccari's (1919a) protologue, where he wrote: "bark smooth, hard, grayish white, with shallow or obscure rings", and the leaf-base fibres as "shredded into a soft matrix of brown fibres which persist even after the leaves with their petioles have fallen, and frequently a mass of this nest material can be noticed at different heights along the stem still encircled and intact". Field observations support this.

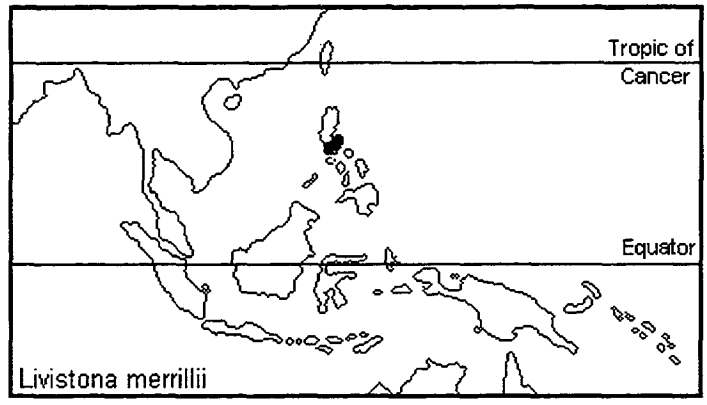
3. ***Livistona merrillii*** Becc., in Perkins, Fragm. Fl. Philipp. 1: 45 (1904). *Corypha minor* Blanco *non* Jacq., Fl. Filip. 229 (1837), ed. 2, 161 (1845), ed. 3, 1: 290 (1877). Type: Lectotype here chosen: Philippines. Undated, *Llanos 221* (lectotype MA).

Livistona whitfordii Becc. Webbia 1: 341 (1905); Beccari, Philipp. J. Sci. 4: 615 (1909). Type: Philippines. Atimonan, 23 Aug. 1904, *H. N. Whitford 731* (holotype FI).

Livistona blancoi Merr., Sp. blancoan. 84 (1918), *nom. superfl.* Type: Philippines. Tayabas Prov., Luzon Island, Unisan, 11 May 1916, *Merrill 919* (isotypes A, BM, BO, K, L, NY).

Hermaphroditic(?) palm. **Trunk** to 20 m tall, 15-30 cm dbh, erect, cylindrical, slightly broader at the base, nodes prominent, lighter green to grey in the upper portions, aging to grey throughout, internodes dark green to purple-green in the upper portion, aging to grey, petiole stubs not persistent. **Leaves** 40-50 in an oblong or globose crown; petiole 90-200 cm long, slightly arching, proximally c. 15 cm wide, distally c. 2.5 cm wide, triangular in cross section, adaxially flat, abaxially rounded, with deciduous tomentum, margins frequently unarmed in leaves from mature plants or armed throughout, with single curved black spines 6-20 mm long in the basal one-third, reducing to scattered rudimentary tubercules toward the apex; leaf-base fibres prominent, coarse, in a woven pattern, persistent after leaf fall and as intermittent encircling masses in the upper portions of the stem; ligule long; lamina circular, costapalmate, 100-150 cm long, green adaxially, slightly lighter green abaxially; segments regular, c. 70, free for c. 34% of their length, apical clefts 30-40% of the length of free segment, 4-6 cm wide at the disjunction, apices acuminate, rigid when apical cleft is shallow, pendulous when apical cleft is long; hastula prominent, irregularly curved, lobed; parallel veins most prominent, 5-6 each side of midrib; transverse veins very thin, extending across 2-3 parallel veins, density c. 13 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical collateral axes, 100-150 cm long; each axis with 5-10 partial inflorescences, branched to 3 orders, longest to 40 cm; prophyll to 45 cm long, 7 cm wide, ancipitous, bicarinate, glabrous, thinly coriaceous, apices acuminate, caudate; peduncle c. 2.5 cm wide near the base; peduncular bract 1, elongate-tubular, to 50 cm long, closely longitudinally striate, bicarinate, glabrous, apices acuminate caudate; rachis bracts tubular, brown, broadening slightly toward the apex, apices acute, glabrous; rachillae 4-10 cm long, yellowish, glabrous. **Flowers** solitary, sessile, 3-4.5 mm long, ovate-acute in bud, on raised large pulvini; sepals fused basally, fleshy, lobes broadly sub-triangular, thick, yellow; petals elongate-triangular, thick, acute, slightly spreading at anthesis, yellow; stamens with basally fused filaments, thick and short, contracted into short subulate apices, connective very short, narrow; anthers

didymous, sub-orbicular; carpels cuneate, deeply sculptured, apically contracted into a very short style. **Fruit** globose or slightly obloid, tapered to the base, 16-23 mm diam., dark red, shiny; epicarp smooth; mesocarp 2-3 mm thick, grainy; endocarp thin, crustaceous; pedicel 2-5 mm long. **Seed** globose, 11-15 mm diam.; intruded by the testa to about halfway to almost fully across the seed; embryo lateral. *Ballang (Cagayan Prov., Luzon), Telsis (Zambales Prov.).* Fig. 2.3.



DISTRIBUTION. Philippines. Luzon, Cagayan, Tayabas and Zambales Provinces [13-16°N]. The dots on the map represent seven collections.

HABITAT AND ECOLOGY. Forming groves in *Shorea* forest and on rocky limestone hills near the seashore at 60-200 m alt.

ETHNOBOTANY. Leaves used for thatching and for raincoats, stems for bows and flooring.

SPECIMENS SEEN. PHILIPPINES: Luzon. Camarines Prov. Paracale, Nov.-Dec. 1918, *M. Ramos & G. Edano 33759* (K, US); Camarines Prov. May 1908, *H. M. Curran 10409* (A, UC, US); Payabas Prov. Mar. 1908, *H. M. Curran 10189* (US); Laguna Prov. Covinti, 9 Mar. 1904, *A. Loher 7056* (K); Zambales Prov. Jan 1907, *H. M. Curran 5834* (US); Quezon Prov. Polillo Island, Panukulan, Sitio Kitiwan, 7 May 1989, *E. S. Fernando 8019* (LBC); Polillo Island, 12 April 1980, *B. F. Hernaez 3622* (CAHUP).

NOTES. *Livistona merrillii* was first described by Beccari (1904) based on a specimen from Guinayangan, Luzon, *Merrill 2071* [FI] (Fig. 2.3), with unarmed petioles, and cherry-like fruit, although only seen in the immature state, and named for the American botanist E. D. Merrill [1876-1956] who worked in the Philippines. *Corypha minor*, a name used by Blanco (1837) and based on *Llanos*

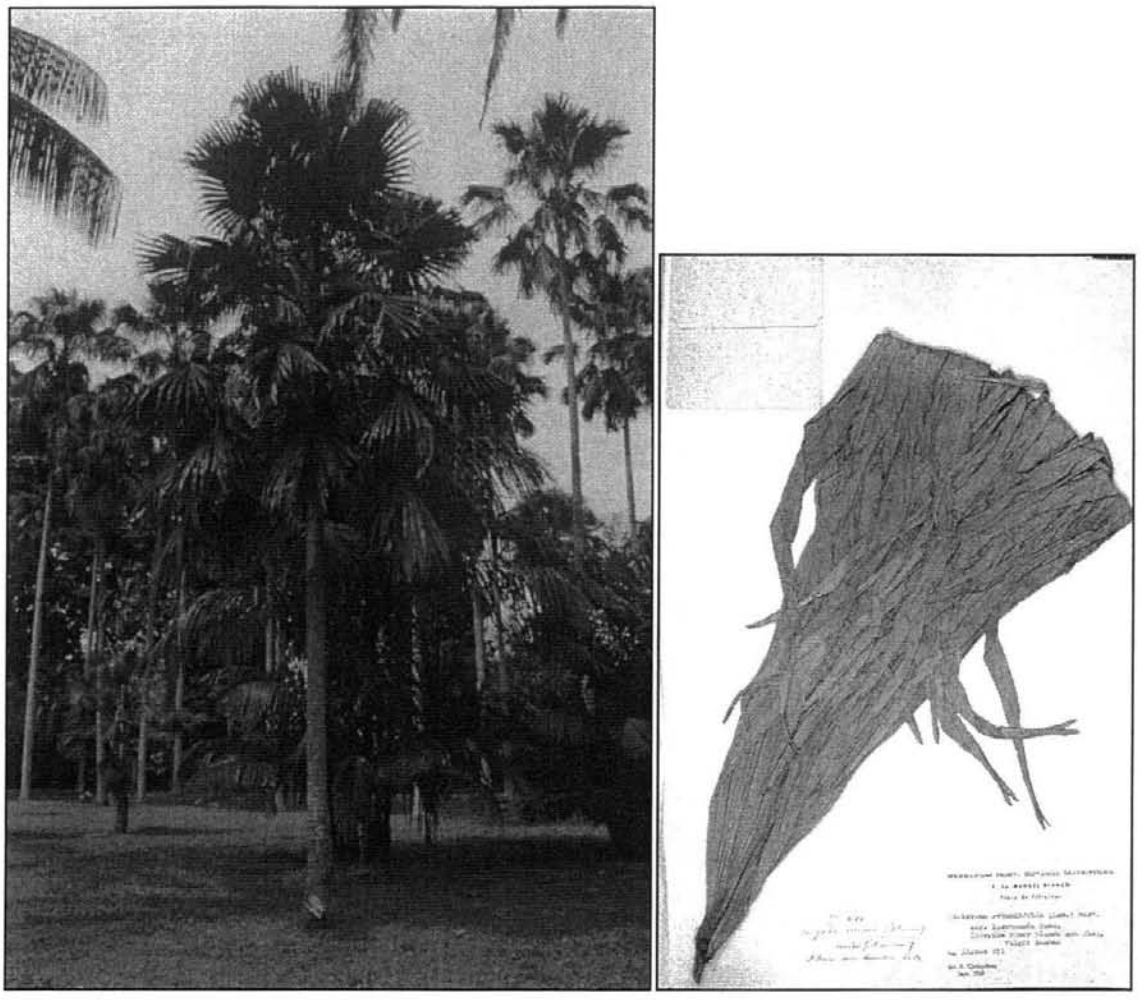


Figure 2.3. ***Livistona merrillii.*** ***Left:*** Habit, cultivated plant, Bogor Botanic Gardens, Indonesia. ***Right:*** Type of *Corypha minor* Blanco (= *L. merrillii*), *Llanos 221* [MA], Philippines, undated.

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211 [MA] which is here chosen as the lectotype for that name, was included as a synonym of *L. merrillii* by Beccari, as were *L. rotundifolia* (*cf.* Naves and Villar, 1882) and *Livintona* (sic.) sp. (*cf.* Vidal, 1886). Beccari therefore interpreted *Livistona merrillii* as a new name for the misplaced name *C. minor* Jacq., which is the basionym for *Sabal minor* (Jacq.) Persoon, a palm species from SE United States. The rejection of *Merrill 2071* as the type for *L. merrillii* is appropriate according to the ICBN, as the type of a name for which a new name is substituted adopts the type of the older name. Unfortunately, the specimens mentioned by Naves and Villar, and Vidal have not been located. Fire destroyed the herbaria operated by Vidal in 1897 and that of Naves in 1899 (van Steenis-Kruseman, 1950) and duplicates appear not to have been sent to other herbaria.

In a subsequent description of *L. merrillii* also based on *Merrill 2071*, Beccari (1905) suggested that *C. minor* was related to *L. whitfordii*, a species that he newly described following his treatment of *L. merrillii*, but was distinguished from it by the shallower apical clefts. In subsequent descriptions of *L. whitfordii*, a species named for American botanical collector H. N. Whitford [1872-1941], Beccari (1909) concluded that the petiole margins were basally armed with spines in contrast to the protologue which described them as unarmed. Beccari (1919b) placed *L. whitfordii* as a synonym of *L. merrillii*.

Merrill (1918), in reviewing the species established by Blanco, proposed a new name *L. blancoi* for *C. minor*. It is not clear if Merrill considered *L. blancoi* to be a new species or whether it was simply a matter of providing a more appropriate epithet. He appended *L. blancoi* with '*nom. nov.*' but went on to say that "differs remarkably" from both *L. merrillii* and *L. whitfordii*. *Livistona blancoi* was named for the Spanish Augustinian friar, F. M. Blanco [1780-1845] who provided the first major account of the Philippine flora. However, Merrill distinguished *L. blancoi* from *L. merrillii* by "shorter leaf-segments and in its much more slender petioles" thus implying that he considered that they were two distinct species. In addition, Merrill maintained that *L. merrillii*, *L. whitfordii* and his *L. blancoi*, had unarmed petioles. The type for *L. blancoi* is *Merrill 919*.

Subsequently, Beccari (1919b, 1931) reiterated the synonym of *C. minor* under *L. merrillii*, but did not make any reference to Merrill's *L. blancoi*. Merrill (1925), however, reappraised his former placement of *C. minor* and *L. blancoi* and included them as synonyms of *L. rotundifolia* var. *luzonensis* but still retained *L. merrillii* as a separate taxon. Considering the inappropriate application of a new name for an established taxon, *L. blancoi* must be considered a superfluous name.

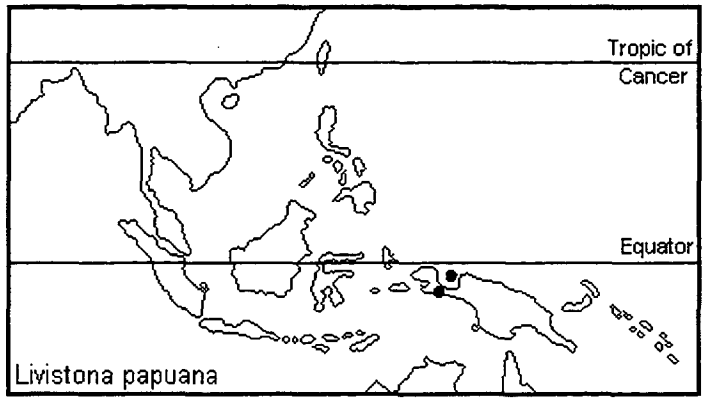
With consideration of the above taxonomy, and invoking a number of Articles in the ICBN, the correct name for the species presently known as *L. merrillii* was investigated. Could it be interpreted as '*Livistona minor*'? The name *C. minor* was first used by Jacquin (1776) and is the basionym of *Sabal minor* (Jacq.) Persoon. Blanco's (1837) use of the same name for the Filipino palm, even though he may or may not have interpreted it as the Jacquin species, would have constituted a

simple misplacement, and Beccari's creation of a new name, *L. merrillii*, was the correct procedure, according to Article 58.1 (Tokyo Code). For the taxon to be called *L. minor*, Blanco would have had to make it clear that he was not interpreting his species as the Jacquin taxa. However, Blanco's protologue did not make this distinction, and it must be assumed that he was interpreting the Philippines species to be the same as that described by Jacquin. Nonetheless, Blanco provided a description that adequately distinguished the two species, describing his *C. minor* as *"eleva tanto como los cocos y las Arecas"* [as tall as the coconut and Arecas], which contrasts with *Sabal minor*, i. e. Jacquin's *C. minor*, which is trunkless. Therefore, it was nomenclaturally correct for Beccari to have established a new name for the species, and for the author of *C. minor* to be cited as Blanco non Jacq. when in synonymy. However, the correct type for *L. merrillii* should be *Llanos 221* [MA], as the specimen hereby chosen as lectotype for *C. minor*, as supported by Article 7.3 (Tokyo Code).

4. *Livistona papuana* Becc., Malesia 1: 84 (1877). *Saribus papuanus* (Becc.) Kuntze, Revis. gen. pl. 736 (1891). Type: Indonesia. Papua. Miosnom Island, Apr. 1875, *Beccari s. n.* (holotype FI).

Hermaphroditic(?) palm. **Trunk** to 30 m (50) tall, 12-30 cm dbh, erect, leaning, grey, nodes raised, internodes elongate. **Leaves** 17-40 in a compact globose crown; petiole 111-200 cm long, c. 15 mm wide at the apex, whitish with a thin, deciduous waxy coating, adaxially flat to slightly convex, abaxially convex, margins unarmed or with spines throughout, margins sharp when unarmed; spines kris-like, to 20 mm long; leaf-base fibres soft, reddish, disintegrating; lamina sub-circular, costapalmate, 90-180 cm long, 100-150 cm wide, adaxially shiny or greyish green, abaxially lighter green, rigid, waxy glaucous; segments regular, 45-90, rigid, thick, free for 23-69% of their length, apical cleft 2-11% of length of free segment, 4-5 cm wide at the disjunction; apices acuminate, rigid; parallel veins prominent, 7-8 each side of midrib, thin; transverse veins inconspicuous, thin, extending across 2-4 parallel veins, density c. 26 per unit area of 15x10 mm. **Inflorescences** trifurcate with 3 ± identical collateral axes, 100-225 cm long, arching, the mid axis slightly longer than the laterals; partial inflorescences 5-10,

branched to 3 orders; prophyll to 25 cm long, to 8 cm wide, glabrous, basally brown, distally yellowish, disintegrating fibrous; peduncular bracts 1-4, 30-50 cm long, tightly tubular, deeply bifid and lacerate at the apex, glabrous; rachis bracts tubular-elongate, closely sheathing; tertiary bracts tubular, subterete, mouths truncate, entire or lacerate-fibrous, and extended on one side into 2-toothed tips; rachillae 3-12 cm long, straight, c. 1 mm thick, finely reddish-brown puberulous, most dense underneath and immediately outside of enclosing bracts, whitish-green on exposed parts. **Flowers** solitary or in clusters of 2-4, c. 1.2 mm long, sessile on superficial pulvinuli, with an inconspicuous bracteole; sepals fused, lobes long, triangular, c. 1 mm long, apically acute, longitudinally nerved, yellow; petals triangular, obtuse, apically acute, c. 1 mm long, c. 1.2 mm wide at the base, yellow, adaxial surface with the impressions of the stamens; stamens fused ½ way up the petal, shoulders flat, filament very thin c. 0.5 mm high; anthers ovate, c. 0.1 mm long; carpels c. 0.8 mm long; stigma pointed. **Fruit** globose to obovate-obpyriform, 10-25 mm long, 5-25 mm diam., orange-red, apex rounded, tapered to a narrow base, stigmatic remains slightly subapical; epicarp smooth with longitudinally arranged yellow dots or short lines; mesocarp fibrous, with fibres embedded in the endocarp; endocarp bony to woody, 1.5-2 mm thick; pedicel 1-5 mm long. Seed globose, 20-25 mm diam.; embryo sub-lateral. *Woka (Papuan name), wanna (Poparo language).* Fig. 2.4.



DISTRIBUTION. Indonesia. In Papua on Miosnom, Biak and Yapen islands, and the Timika area [1-5°S]. The dots on the map represent three collections.

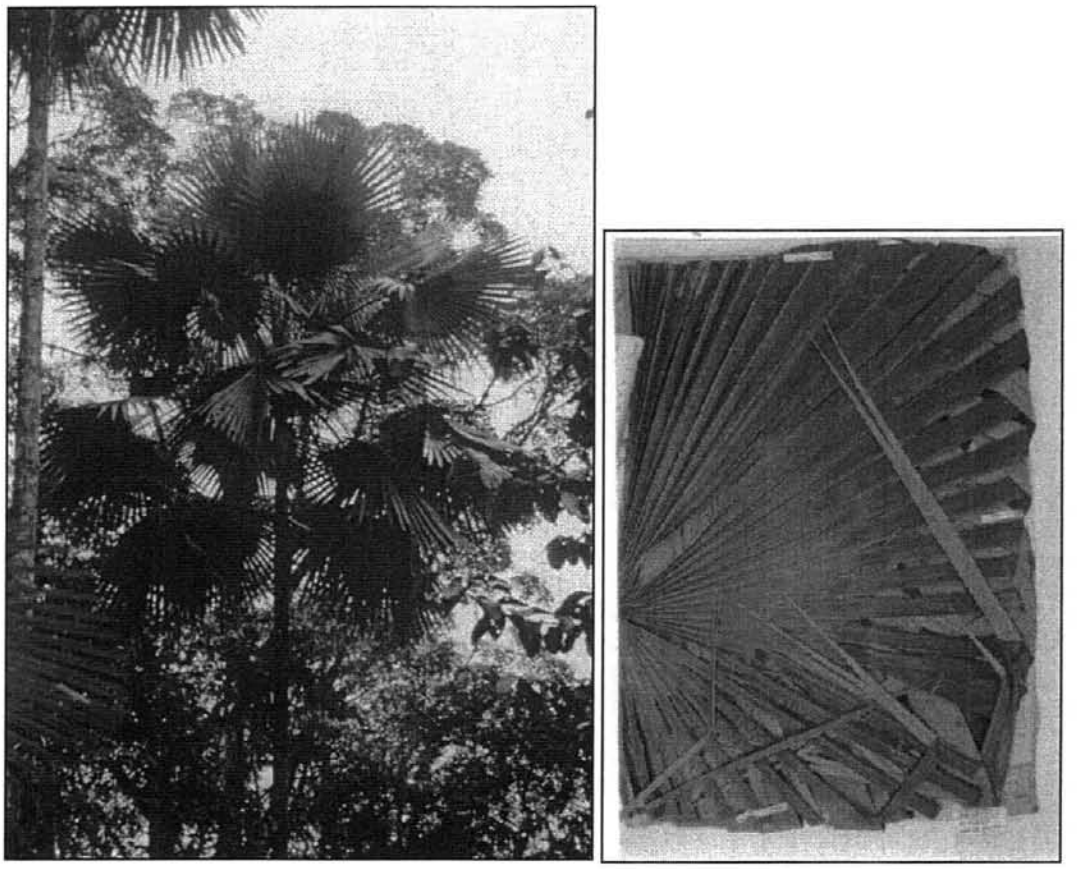


Figure 2.4. ***Livistona papuana***. ***Left:*** Habit, Timika, Papua, Indonesia. ***Right:*** Type specimen, *Beccari s. n.* [FI], Miosnom Island, Indonesia, 1877.

HABITAT AND ECOLOGY. In rainforest at 200-540 m alt.

SPECIMENS SEEN. INDONESIA: Papua. Yapen Island, N side, Sewenui village, 31 July 1999, *H. Arisoi HA1* (MAN); Yapen Island, N side, Sewenui village, 31 July 1999, *H. Arisoi HA2* (MAN). Fakfak. Timika, path E at 50 mile on road to Tembagapura, 04°17.18'S, 137°1.3'E, 540 m alt., 17 Feb. 1998, *W. J. Baker WJB851* (AAU, BH, BO, BRI, K, MAN).

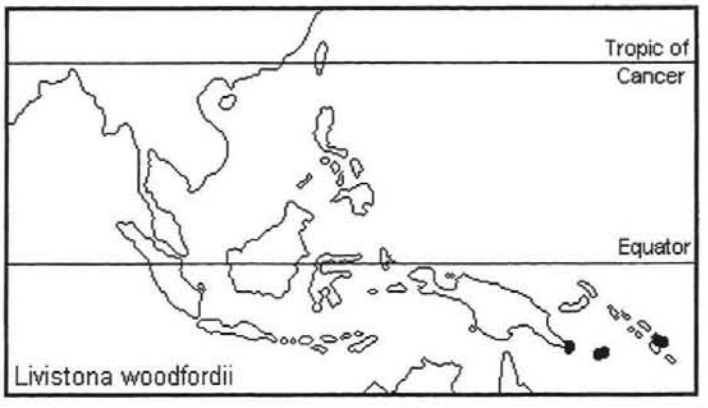
NOTES. *Livistona papuana* was described by Beccari (1877) from his own collection from Miosnom Island in Cenderawasih Bay, Papua (Fig. 2.4). He suggested some resemblance to *L. rotundifolia*, but from which it could be distinguished by the lack of armature and fruit being obovate/obpyriform rather than globose. Beccari did not describe flowers or mature fruits. Recent collections from Yapen Island, such as *Arisoi HA1* [MAN], have yellow flowers and orange red fruits. Taxonomy for the species appears straightforward, although Kuntze (1891) created the name *Saribus papuanus*, a nomenclaturally rejected name.

5. *Livistona woodfordii* Ridley, Gard. Chron. ser. 3, 1, 23: 177 (1898) [as *L. Woodfordi*]. Type: Solomon Islands. San Cristobal Island, 1898, *Micholitz s. n.* (holotype B, destroyed; isotypes BM, FI, SING).

Livistona beccariana Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 326 (1941). Type: Papua New Guinea. Milne Bay Prov. Louisiade Archipelago, *W. MacGregor s. n.,* 1888? (holotype B, destroyed; isotypes BM, FI).

Hermaphroditic(?) palm. **Trunk** to 16 m tall, 12-20 cm dbh, erect, slightly broader as the base, nodes slightly raised, irregular in width, light grey, internodes irregular in width, greyish-brown to grey with age, petiole stubs not persistent. **Leaves** 30-60 in a globose to broadly conical crown; petiole to c. 110 cm long, 13 mm wide in the distal portion, slightly arching, triangular in cross section, adaxially slightly ridged, flat or slightly channelled, abaxially rounded, covered with a deciduous white powder, margins unarmed or with single, small, curved, green spines, confined to the proximal half; leaf-base fibres moderately prominent, coarse, persistent, reddish-brown; lamina deeply folded, sub-circular to circular, 60-170 cm long, 45-90 cm wide, rigid, adaxially shiny mid-green, glaucous, abaxially lighter green with fine powdery wax; segments regular, 60-70, free for 51-75% of their length, apical cleft 5-23% of length of free segment, 1-4 cm wide at the disjunction, apices acuminate, erect to semi-pendulous; hastula raised c. 10 mm; parallel veins 5-7 each side of midrib, slightly more prominent or similar to the transverse veins; transverse veins thin, extend across 2-5 parallel veins, density 23-33 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical collateral axes, 120-270 cm long, slightly curving; partial inflorescences 5-10, longest to 45 cm long, branched to 3 orders; prophyll to 14 cm long; peduncular bracts lacking; rachis bracts chartaceous, tubular, glabrous, apex acute; tertiary rachis bracts subtend all minor branches, tubular, glabrous, chartaceous, apex acute; rachillae 4-6 cm long, 1 mm thick, basally with fine brown-purple tomentum, otherwise glabrous. **Flowers** in clusters of 2-6, sessile, subglobose in bud, 1-1.5 mm long; sepals obtuse, 0.2-0.3 mm long, imbricate, red; petals deltoid, 0.8-1 mm long, 0.7-0.8 mm wide, red; filaments apically subulate with a very narrow connective; anthers subglobose; pollen asymmetrically elliptical/ellipsoid; aperture symmetrical/asymmetrical monosulcate; apices of

sulcus acute, as long as the long axis; long axis (23-) 23.5 (-24) μm; wall thickness 1.25 – 1.5 μm; tectum tectate; ornamentation same all over grain; tectum surface psilate; ornamentation punctate, very sparse distribution (M. Harley, pers. comm.); style sharply tapered, about the same height as the anthers. **Fruit** globose, 7-12 mm diam., reddish orange to reddish brown; epicarp smooth, shiny, with scattered lenticellular pores; suture line extends for about ½ the length of the fruit, marked with lip-like structures; mesocarp 0.7-1.7 mm thick, fleshy, fibrous; endocarp cartilaginous, shiny, yellowish; pedicel 2-3 mm long. **Seed** globose, 6-9.5 mm diam, dull, dark coloured; hilum orbicular; raphe thin; endosperm intruded by the testa for about ¾ of the way through to form a central cavity filled with compacted brownish tissue; embryo lateral. *Boda (Wedau language), filu (Kakabai language).* Fig. 2.5.



DISTRIBUTION. Papua New Guinea and Solomon Islands [9-11°S]. In the Solomon Islands on Tulagi (Nggela) and San Cristobal Islands. In Papua New Guinea in Milne Bay Prov., on Rossel and Sudest Islands and the mainland near Cape Vogel and East Cape. The dots on the map represent 15 collections.

HABITAT AND ECOLOGY. Coastal forest on limestone or lateritic soils at 0-70 m alt., in high rainfall areas. Flowers Jan.-Apr.; fruits May-July.

SPECIMENS SEEN. SOLOMON ISLANDS: San Cristobal, 1897-98, *Micholitz s. n.* (SING, BM); Tulagi Island, 3 July 1967, abundant in wet laterite soils, 90-110 m alt., *G. F. C. Dennis BSIP7944* (K, L, LAE, SING); Tulagi Island, 30 Sept. 1964, *Whitmore's collectors 4427* (K, L, SING, US); Tulagi, 10 Mar. 1970, *T. C. Whitmore 18101 & collectors* (LAE); Tulagi, W end of

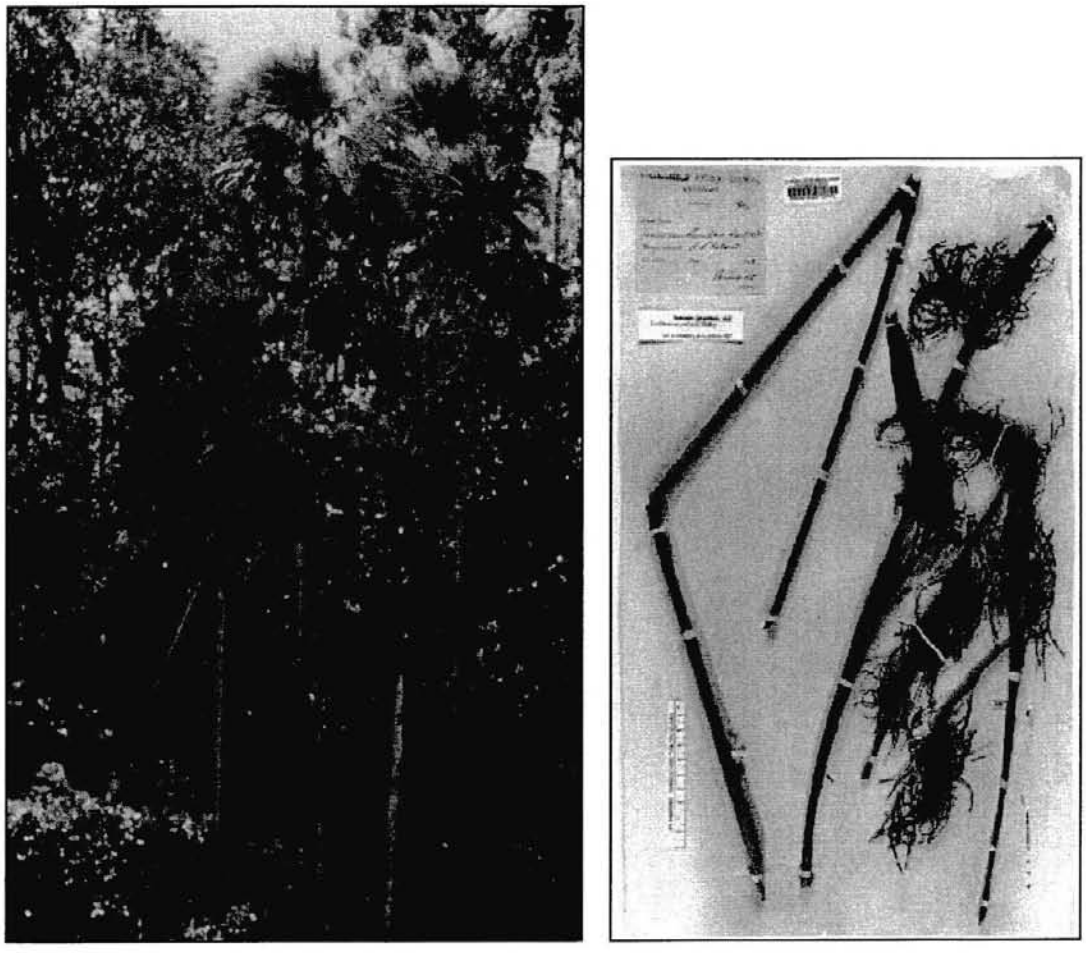


Figure 2.5. ***Livistona woodfordii.*** ***Left:*** Habit, Tulagi Island, Solomon Islands. ***Right:*** Type specimen, *Micholitz s. n.* [BM], 'S. S. Islands', 1897.

island, 0-50 m alt., 28 June 1995, *S. Zona 661* (K); Tulagi, (N'gela), c. 50 m alt., 25 Jan. 1933, *L. J. Brass 3517* (A, L; photo BRI); [Solomon Islands], 23 Mar. 1914, *C. M. Woodford s. n.* (K). PAPUA NEW GUINEA: Milne Bay Prov. Rossel Island, Abeleti, 50 m alt., 1 Oct. 1956, *L. J. Brass 28281* (K, L, LAE, PNH, US); Rossel Island, Abeleti, 11°20'S, 154°10'E, 50 ft alt., 6 Nov. 1965, *E. E. Henty 27041* (L, LAE); Rossel Island, Pambwa area, Yeleamba, 50 m alt., 24 May 2001, *R. Banka 2015 with J.L. Dowe* (BRI, K, LAE); Sudest Island, c. 5 km NW of East Point, 60-70 m alt., 26 May 2001, *R. Banka 2019 with J.L.Dowe* (BRI, K, LAE); Milne Bay Prov. Cape Vogel Peninsula, Menapi, 120 m alt., 2 Apr. 1953, *L. J. Brass 21809* (LAE, US); Cape Vogel Peninsula, near Tapio village, 9°38'S, 149°53'E, alt. 10 m, 14 July 1954, *R. D. Hoogland 4284* (A, CANB, L, LAE). CULTIVATION: Singapore Botanic Gardens, O towards M & Q, probably progeny of the type collection, 28 Mar. 1935, *C. X. Furtado 29223* (SING); Singapore Botanic Gardens, undated, *anon. 21175* (SING).

NOTES. *Livistona woodfordii* was described by Ridley (1898) from the collection *Micholitz s.n.* [BM] from "*In insula Polynesiae*" and annotated as "*S. S. Islands*' on the specimen labels (Fig. 2.5). It was named for the English naturalist Charles Morris Woodford [b. 1852, d. 1927] who collected natural history specimens in the Solomon Islands [1886-1914] and was the colony's first Acting High Commissioner (1896-1915) (Woodford, 1890; Golden, 1993). There are minor discrepancies regarding the collection date of the type specimen. On the type it is written as 1898, but the itinerary of Micholitz placed him in the Solomon Islands in October 1897, and in the Louisiade Archipelago, Papua New Guinea, in Apr./May 1898 (van Steenis-Kruseman, 1950). The date on the type could relate to the time that Ridley received the specimen. An expanded description was provided by Beccari (1931), and was in part based on an inflorescence and fruit collection, *Macgregor s. n.* [BM], from the Louisiade Archipelago, most probably in 1888 (Thomson, 1889; van Steenis-Kruseman, 1950). Beccari (1931) related that Mueller sent the MacGregor specimen to him prior to 1889 [in 1888, via Hermann Wendland, according to Burret (1941)]. Burret (1941), providing taxonomic and descriptive notes on some species of *Livistona*, concluded that the Louisiade collection was a different species and so named it *L. beccariana*. As Burret's description was based on the Macgregor collection, it is the type of *L. beccariana*. Burret provided a detailed description of the inflorescence and fruit fragments, but nothing of the palm's habit or leaves. *Livistona beccariana* is hereby placed as a synonym of *L. woodfordii*.

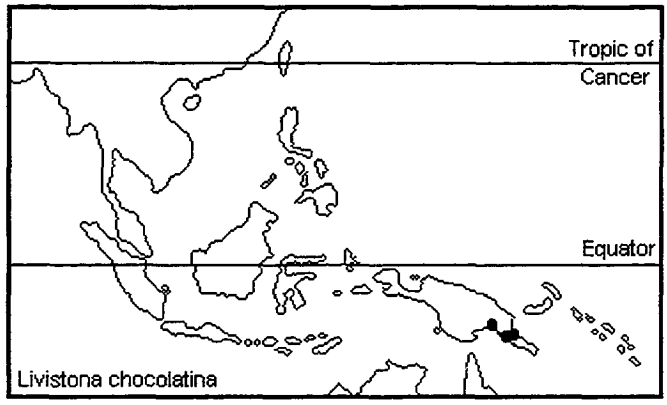
6. '*Livistona chocolatina* Dowe', ined.

(NB. This species will be formally described elsewhere and is included here only as a preliminary taxon.) Proposed type: Papua New Guinea. Central Prov. Kuriva Mission area, 4 km north of Haritano Hwy along forestry road, 9°00.821'S, 147°07.815'E, 300 m alt., 4 March 2000, *A. S. Barfod 466 with R. Banka, J. L. Dowe and A. Kjaer* (holotype AAU; isotypes BRI, CANB, K, LAE).

Hermaphroditic(?) palm. **Trunk** to 23 m tall, 16-18 cm dbh, erect, slightly broader at the base, light grey, nodes slightly raised, internodes narrow, petiole stubs not retained. **Leaves** 30-40 in a spherical crown; petiole 110-155 cm long,

slightly arching, green, proximally c. 3 cm wide, distally c. 2 cm wide, triangular in cross section, adaxially flat, abaxially rounded, glabrous with a cover of deciduous white waxy powder, margins usually spineless, or with small single spines to 5 mm long only in the very basal portion; leaf-base fibres course, brown, persistent until leaf fall then readily deciduous; ligule short; hastula c. 1 cm tall, 5 cm across with a central division; lamina moderately folded, sub-circular, flat, rigid, 100-120 cm long and wide, adaxially mid grey green, abaxially light grey green, glaucous waxy; segments regular, 45-60, rigid, free for c. 44% their length, apical cleft c. 4% of length of free segment, apices rigid; mid-lamina segments 4-5 cm wide at the disjunction; parallel veins 7-8 each side of midrib; transverse veins more prominent, extend across 2-4 parallel veins, density 22-30 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical axes, 195-225 cm long, but with central axis more robust than the lateral axes; each axis with 6-10 partial inflorescences, branched to 3 orders; prophyll 22-37 cm long, 8-15 cm wide, glabrous, chartaceous, lacerate-fibrous at the apex, basally brown, distally yellow; peduncle of central axis subterete, to 2.8 cm diam.; peduncle of lateral axes terete, to 1.6 cm diam.; each axis with 2-4 peduncular bracts; peduncular bracts glabrous, tubular, lacerate at the apex; rachis bracts 40-45 cm long, tightly tubular, fibrous, disintegrating at the apex with maturity, pubescent throughout but more densely so toward the apex, light reddish brown; bases of partial inflorescences with dense chocolate brown tomentum; rachillae 8-12 cm long, subterete to angular, 2-3 mm thick, basally with chocolate brown tomentum. **Flowers** solitary or in clusters of 2-4, tightly aggregated in bud and during anthesis, c. 1.2 mm high; sepals red, fused, lobes long, triangular, c. 1 mm long, apically acute, longitudinally nerved; petals red, triangular, obtuse, apically acute, occasionally shark-tooth like, c. 1 mm long, c. 1.2 mm wide at the base, adaxial surface with the impressions of the stamens; connective very thin, c. 0.5 mm long; anthers ovoid, c. 0.1 mm long; carpels c. 0.8 mm high, stigmas pointed. **Fruit** globose, c. 25 mm diam., orange-red, shiny; epicarp with scattered lenticellular dots and light 3 mm long lines pointing in longitudinal direction toward the apex; stigmatic remains apical to slightly sub-apical; mesocarp fleshy, fibres thick, distributed throughout but more densely aggregated toward the endocarp and shallowly embedded in the surface of the endocarp; endocarp to 1 mm thick, bony; pedicel 4-5 mm long, 2 mm thick, jointed, green, with prominent scars of

fallen flowers. **Seed** globose; endosperm intruded by the seedcoat to about two-thirds across, intrusion broadly kidney-shaped, crystalline/spongy; embryo lateral. Eophyll 5-ribbed. *Livistona 'Kuriva', Manganau (Lababia language).* Fig. 2.6.



DISTRIBUTION. Papua New Guinea. In Central Prov., Kuriva area, in Gulf Prov. on hills near the Vailala River, and in Morobe Prov. near Lababia on Bulili Ridge [8-9°S]. The dots on the map represent three collections.

HABITAT AND ECOLOGY. Grows in isolated colonies, sometimes locally common, on slopes with calcareous or clayey soils, at 300-400 m alt. Flowers Jan.-Feb.; fruits Mar.-May.

SPECIMENS SEEN. PAPUA NEW GUINEA: Gulf Prov. Vailala River, hills inland, Dec. 1922, *Lane-Poole 332* (BRI). Morobe Prov. Lababia, Bulili Ridge, 400 m alt., 6 Apr. 2000, *A. Barfod 514 with A. Kjaer and T. Magun* (AAU, LAE). Central Prov. Kuriva Mission, 22 Mar. 1998, *M.D.Ferrero 980080, 980081, 980083* (LAE).

NOTES. *Livistona chocolatina* was first collected by Lane-Poole in 1922 as '*Livistona* sp. No. 332' (Lane-Poole, 1925) from "hills inland from Vailala River". It was next collected in 1998 by M. D. Ferrero, and again in 2000 by Barfod *et al.*, and from whose collections the type *Barfod 466* [AAU] was chosen. The species is distinguished from *L. tothur* and *L. surru* by the usually spineless or only mildly spined petiole that initially has a thick coating of white waxy powder, smallish rigid leaves, a trifurcate inflorescence with each axis having multiple peduncular bracts, distinctive chocolate brown tomentum on the basal surfaces of the partial inflorescences and rachillae, and globose fruit to 25 mm diameter that mature orange-red.

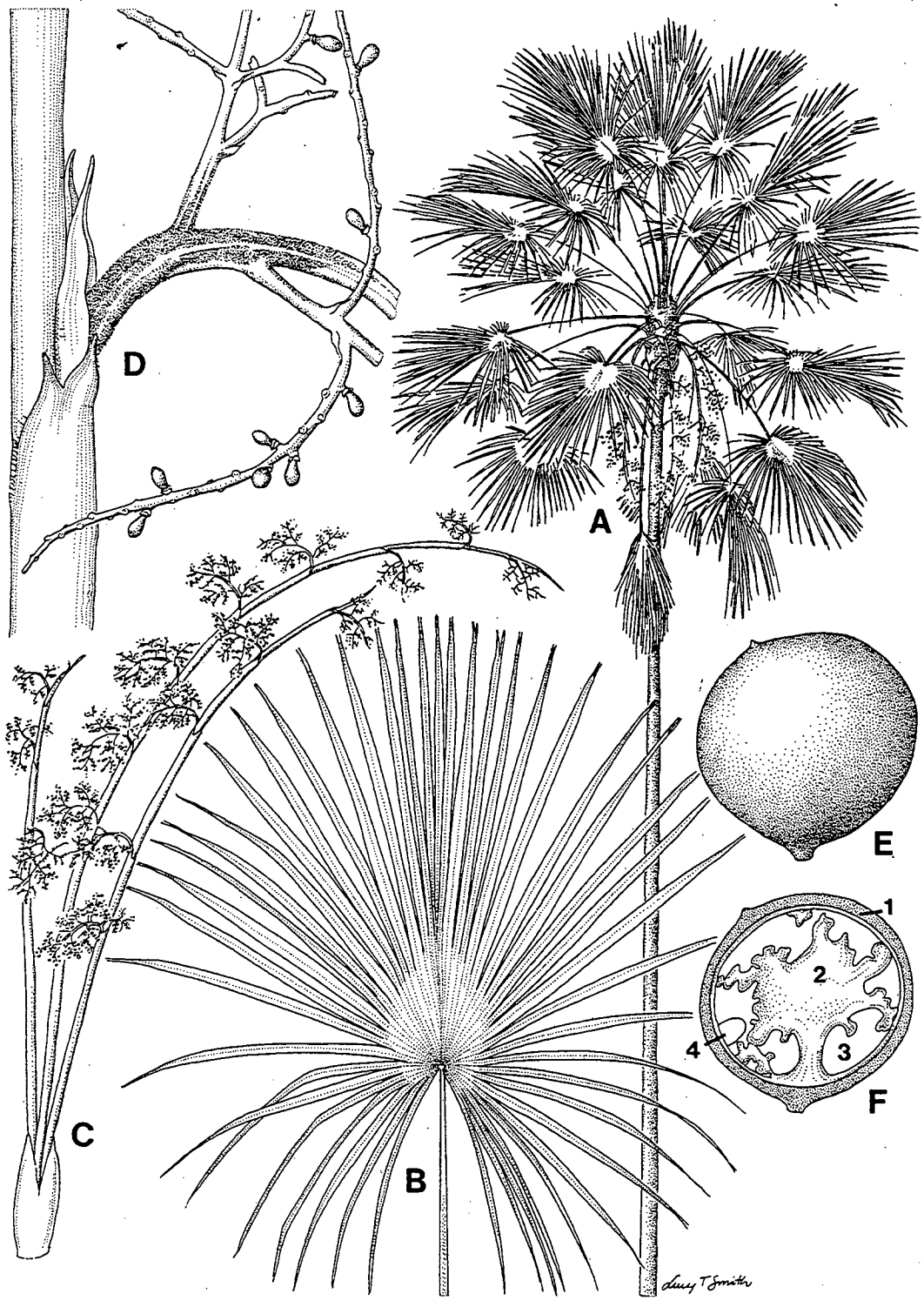
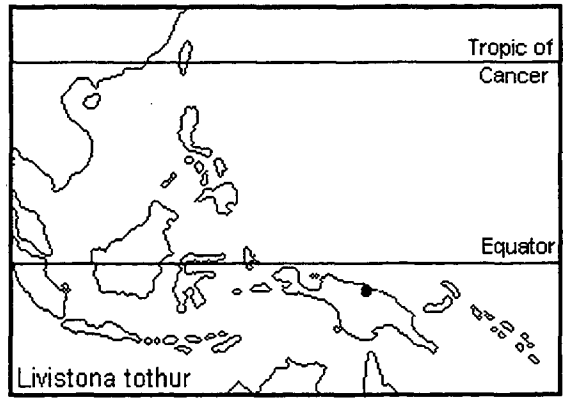


Figure 2.6. ***Livistona chocolatina.*** A. Habit. B. Leaf, adaxial view x 0.06. C. Inflorescence x 0.08. D. Basal portion of partial infructescence showing tomentum and immature fruit x 0.4. E. Fruit, side view x 1.2. F. Fruit in LS, showing mesocarp [1], seedcoat intrusion [2], homogeneous endosperm [3] and embryo [4] x 1.2. A, E, F, *A. Kjaer 514*; B, C, D, *A. Barfod 466*. Illustration by Lucy T. Smith.

7. *Livistona tothur* Dowe & A. S. Barfod, Austrobaileya 6: 171 (2001).
Type: Papua New Guinea. West Sepik Prov. Oenake Mts, on road to Niau Kono from Vanimo, 2°45.89' S, 141°04.06' E, 500 m alt., 26 Nov. 1996, *A. Damborg 418 with A. S. Barfod* (holotype AAU; isotype BRI, K, LAE).

Functionally dioecious(?) palm. **Trunk** to 20 m tall, 15-20 cm dbh, erect, grey, slightly swollen at the base, nodes slightly raised, narrow, dark grey, internodes c. 15 cm long. **Leaves** 24-40 in an open spherical crown; petiole 150-200 cm long, proximally c. 10 cm wide, distally c. 1.5 cm wide, adaxially flat, abaxially rounded, arching, glabrous, green, margins with single, recurved, green spines 1-2 mm long throughout its length, but larger and more closely spaced in the proximal portion, margins lacerate fibrous in extreme basal portion; leaf-base fibres prominent, in 2 layers of more or less equal coarseness, persistent in sheets, chestnut brown; ligule to 60 cm long; hastula raised, small, semi-circular; lamina sub-circular, 150-200 cm long, 120-150 cm wide, adaxially bluish-green, abaxially silvery glaucous; segments regular, 60-75, rigid, apices becoming pendulous only with extreme age or damage, free for 62-85% of length, apical cleft 1-3% of length of free segment, 3-4 cm wide at the disjunction; parallel veins 6-7 each side of midrib, more prominent than transverse veins, these very thin and extending across 2-7 parallel veins, density c. 33 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical collateral axes, each c. 200 cm long with 5-6 partial inflorescences, those on fruit-bearing plants branched to 3 orders; prophyll to 30 cm long, 10.5 cm wide, yellow, coriaceous basally, brown chartaceous distally, glabrous apart from ferruginous woolly tomentum along the carinae; peduncle with one tubular, papery and loosely sheathing peduncular bract, densely scaled at the apex otherwise glabrous; peduncle of individual axes basally subterete, becoming dorsi-ventrally compressed distally, edges angular, furfuraceous in parts enclosed in bracts, otherwise patchily furfuraceous or glabrous on exposed surfaces; rachis bracts tubular, papery, loosely sheathing, glabrous apart from some irregular pubescence toward the apex, apices more or less non-fibrous showing only minor disintegration; rachillae rigid, terete, 6-12 mm long, to 3 mm diam., glabrous, red, irregularly disposed. **Flowers** solitary; sepals fused, red, tri-lobed, with lobes to 1-1.2 mm long; petals broadly triangular, c. 2 mm long, basally connate for about half their length, thick, fleshy, red, apical

margins recurved, inner surface with impression of stamens, outer surface minutely warty; stamens much shorter than petals, basal part fused to petal, shoulders flat; filament very short; anthers 0.2 mm long, cream. **Fruit** globose with a basal constriction, 35-43 mm diam., orange-red, stigmatic remains apical; epicarp with scattered lenticellular dots, glossy, longitudinal stripe of suberised epidermal tissue usually visible for the full length of the fruit; mesocarp 13-15 mm thick, softly fibrous, mealy, orange; endocarp to 2 mm thick, bony; pedicel 2.5-5 mm high, c. 2 mm wide. **Seed** globose, 22-28 mm diam., endosperm deeply intruded by orange pulpy tissue; embryo lateral. *Tot-hur and yu bbraal (Bewani language)*. Fig. 2.7.



DISTRIBUTION. Papua New Guinea. In West Sepik Province, Oenake Mts [2°S]. The dot on the map represents two collections.

HABITAT AND ECOLOGY. Rainforest on ridges, limestone and metamorphic rocks, at 400-600 m alt. Flowers Nov.-Jan.; fruits Feb.-Mar.

ETHNOBOTANY. Bows are made from the split trunks, roofs and umbrellas from the leaves, and salt is extracted from the ash of burned petioles (M. D. Ferrero, pers. comm.).

SPECIMENS SEEN. PAPUA NEW GUINEA: West Sepik Prov. Oenake Mts, Apol area, on road to Niau Kono from Vanimo, 2°45.89S, 141°04.06E, 500 m alt., 15 Feb. 1998, *J. L. Dowe 516 with M. D. Ferrero* (JCT, LAE); Oenake Mts, Niau, 2°46.276'S, 141°03.611'E, 425 m alt., 2 Mar. 2000, *A. S. Barfod 510 with R. Banka and A. Kjaer* (AAU, BRI, JCT, K, LAE).

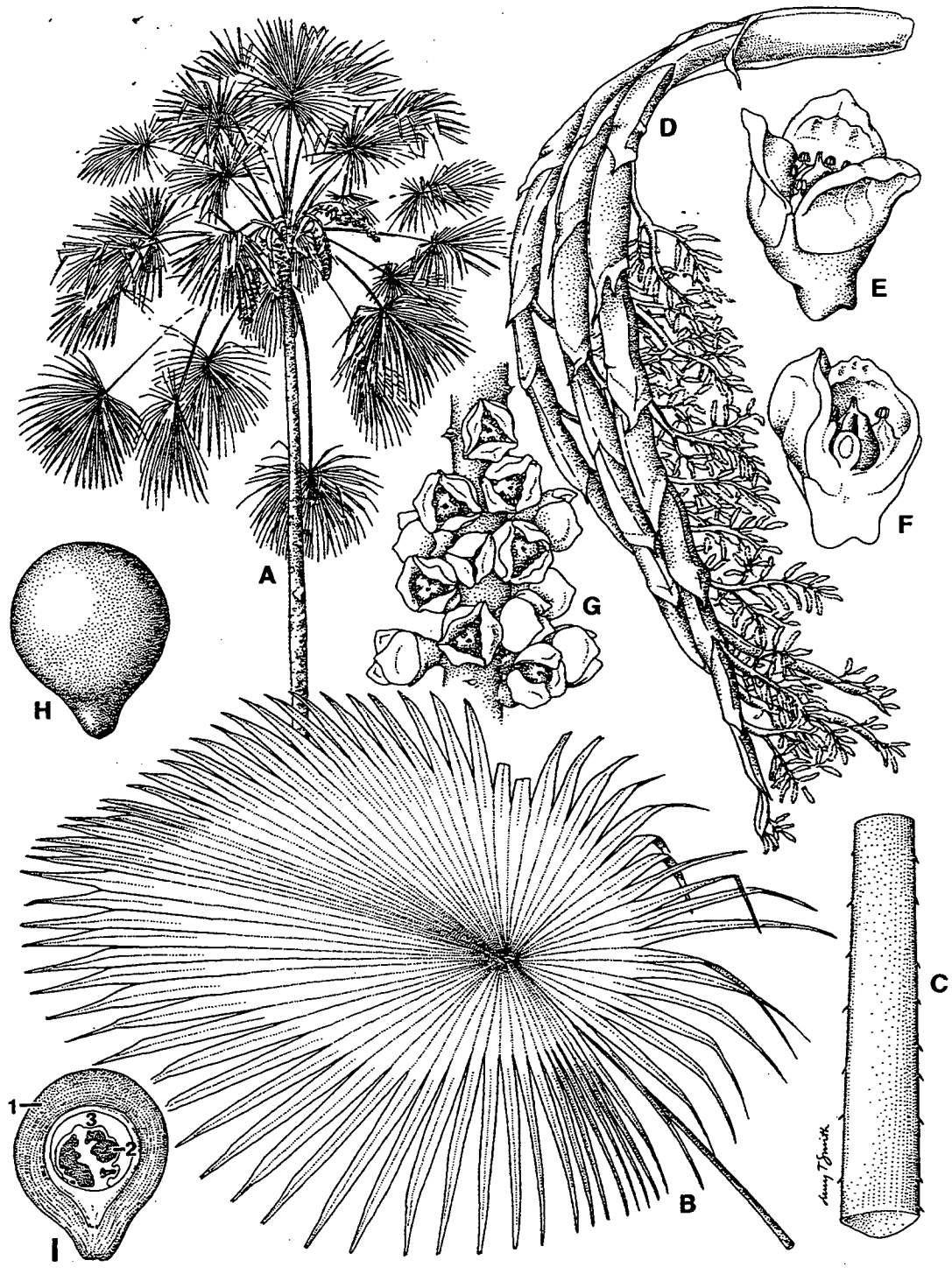


Figure 2.7. ***Livistona tothur.*** A. Habit. B. Leaf, adaxial view x 0.04. C. Mid-section of petiole x 0.15. D. Inflorescence x 0.06. E. Flower, side view x 15. F. Flower, LS, showing orientation of the ovule x 15. G. Flowers attached to rachilla x 5.25. H. Fruit, side view x 0.4. I. Fruit, LS, showing mesocarp [1], seedcoat intrusion [2], and homogeneous endosperm [3] x 0.4. A, D, E, F, G, *Barfod 510*; B, *Dowe 516*; C, H, I, *Damborg 418*. Illustration by Lucy T. Smith.

NOTES. What appears to be the first recognition of this species in the literature was an informal note by Essig and Young (1981) who described a palm seen from their helicopter as "a large *Livistona* bearing red fruit". Upon landing nearby, they were only able to find juveniles that they photographed, and which closely resemble those that are now known in populations of *L. tothur*. Subsequently, field work in New Guinea was undertaken by Ferrero (1997) who investigated reports of palm populations throughout Papua New Guinea and who was to eventually collect and record the populations of this species in the Oenake Mountains of West Sepik Prov. Further field work undertaken by Barfod and Damborg resulted in collections, including the type, *Damborg 418* [AAU], upon which this taxon was described. The species' name was taken from the vernacular, *tot-hur*, used in the Bewani area, West Sepik Prov., Papua New Guinea.

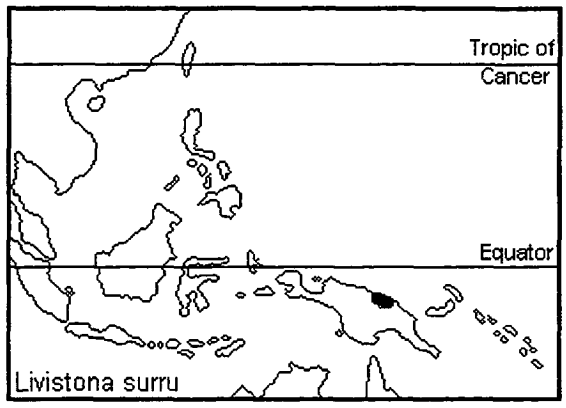
8. *Livistona surru* Dowe & A. S. Barfod, Austrobaileya 6: 169 (2001).
Type: Papua New Guinea. West Sepik Prov. Miwaute, 03° 25'S, 142° 07'S, 950-1000 m alt., 20 Nov. 1996, *A. S. Barfod 390 with M. D. Ferrero & A. Damborg* (holotype AAU; isotypes BRI, LAE).

Functionally dioecious(?) palm. **Trunk** to 20 m tall, 18-25 cm dbh, erect, slightly broader at the base, light grey, usually covered by crustaceous lichens, nodes slightly raised, internodes narrow, petiole stubs not retained. **Leaves** 17-29 in a spherical to an oblong crown; petiole 140-180 cm long, slightly arching, green, proximally c. 19 cm wide, triangular in cross section, adaxially flat, abaxially rounded, glabrous except for scattered lepidote scales that are brown in the centre and grey at the margin, more densely so on the abaxial surface, margins with single or grouped black spines 5-10 mm long, larger and more closely inserted in the proximal portion, becoming smaller and wider spaced in the distal portion; leaf-base fibres in 2 layers, the outer with thick fibres, the inner with thin coirmat-like fibres, reddish brown, persistent until leaf fall then deciduous in sheets; ligule to 1 m long, to 10 mm thick; hastula very prominent, 2 cm tall, 5 cm across, open, thick edged; lamina sub-circular to ovate, undulate, 180-224 cm long, 143-160 cm wide, adaxially mid green, abaxially similar green; segments regular, 70-90, free

for 45-80% of their length, apical cleft c. 6% of length of free segment, apices pendulous; mid-lamina segments 4.5-7 cm wide at the disjunction; parallel veins 5-6 each side of midrib, more prominent than transverse veins which are thin, extend across 2-6 parallel veins, density c. 22 per unit area of 15x10 mm. **Inflorescences** trifurcate with ± identical axes, c. 120 cm long; each axis with 5-7 partial inflorescences, branched to 3 orders on non-fruit-bearing plants, to 2 orders on fruit-bearing plants, otherwise similar; prophyll 37-42 cm long, 12.5-15 cm wide, glabrous, lacerate-fibrous at the apex; peduncle of individual axes subterete, to 3 cm wide, without empty bracts; rachis bracts 40-45 cm long, loosely tubular, fibrous, disintegrating at the apex with maturity, pubescent throughout but more densely so toward the apex; rachillae 14-24 cm long, subterete to angular, densely covered with long coarse red appressed scales in the proximal portion, distally with long white scales, less dense to absent in the extreme distal portions. **Flowers** in clusters of 2-4 (only decayed ones seen). **Fruit** globose to obovoid, 55-65 mm long, 50-55 mm diam., orange-red; epicarp with scattered lenticellular dots and light 3 mm long lines pointing in longitudinal direction toward the apex; stigmatic remains apical; longitudinal stripe of suberised epidermal tissue usually visible for full length of fruit; mesocarp fleshy, fibres thick, distributed throughout but more densely aggregated toward the endocarp and shallowly embedded in the surface of the endocarp; endocarp to 2 mm thick, bony; pedicel 6-12 mm long, 3 mm thick, green, with prominent scars of fallen flowers. **Seed** globose to subglobose; endosperm intruded by the seedcoat to about two-thirds across, intrusion broadly kidney-shaped, crystalline/spongy, orange; embryo lateral. *Surru (Olo language at Miwaute).* Fig. 2.8.

HABITAT AND ECOLOGY. In rainforest and swamp forest. Flowers all year; fruits all year.

ETHNOBOTANY. Leaves are used for roof thatch and umbrellas, stem portions for axe handles and house frames, and leaf sheath fibres for brooms and sago strainers (M. D. Ferrero, pers. comm.).



DISTRIBUTION. Papua New Guinea. In Madang Prov. near Bosmun village at the mouth of the Ramu River, and in West Sepik Prov. in the Miwaute area and Mt Ekwai [4°S]. The dots on the map represent three collections.

SPECIMENS SEEN. PAPUA NEW GUINEA: West Sepik Prov. Miwaute, 03°25'S, 142°07'E, 950-1000 m alt., 21 Nov. 1996, *A. S. Barfod 399 with M. D. Ferrero & A. Damborg* (AAU, LAE); Upper Freida River, Mt Ekwai, 1200-1300 m alt., 21 Feb. 1998, *M. D. Ferrero 980029* (LAE); Madang Prov. Goinbang near Bosmun 2, mouth of Ramu River between Bogia and Bosmun 2, 18 Jan 1996, *W. J. Baker WJB582* (K).

NOTES. The first mention of this species, as an unnamed taxon, was by Hay (1984) who noted a *Livistona* at Ramu River: "...here the Livistonas grow in a remarkable rainforest dominated almost to the exclusion of dicotyledonous trees by palms of the genera *Actinorhytis*, *Rhopaloblaste, Cyrtostachys*, *Ptychococcus*, *Orania*, *Gulubia*, *Caryota* and *Livistona*". Subsequently, this report was investigated by Baker in 1996 and then by Ferrero (1997). Other populations were reported in the West Sepik Province, from where Barfod collected the type specimen, *Barfod 390* [AAU], from Miwaute. The species' name was taken from the vernacular, *surru*, from the Olo language used in the Miwaute area of West Sepik Province.

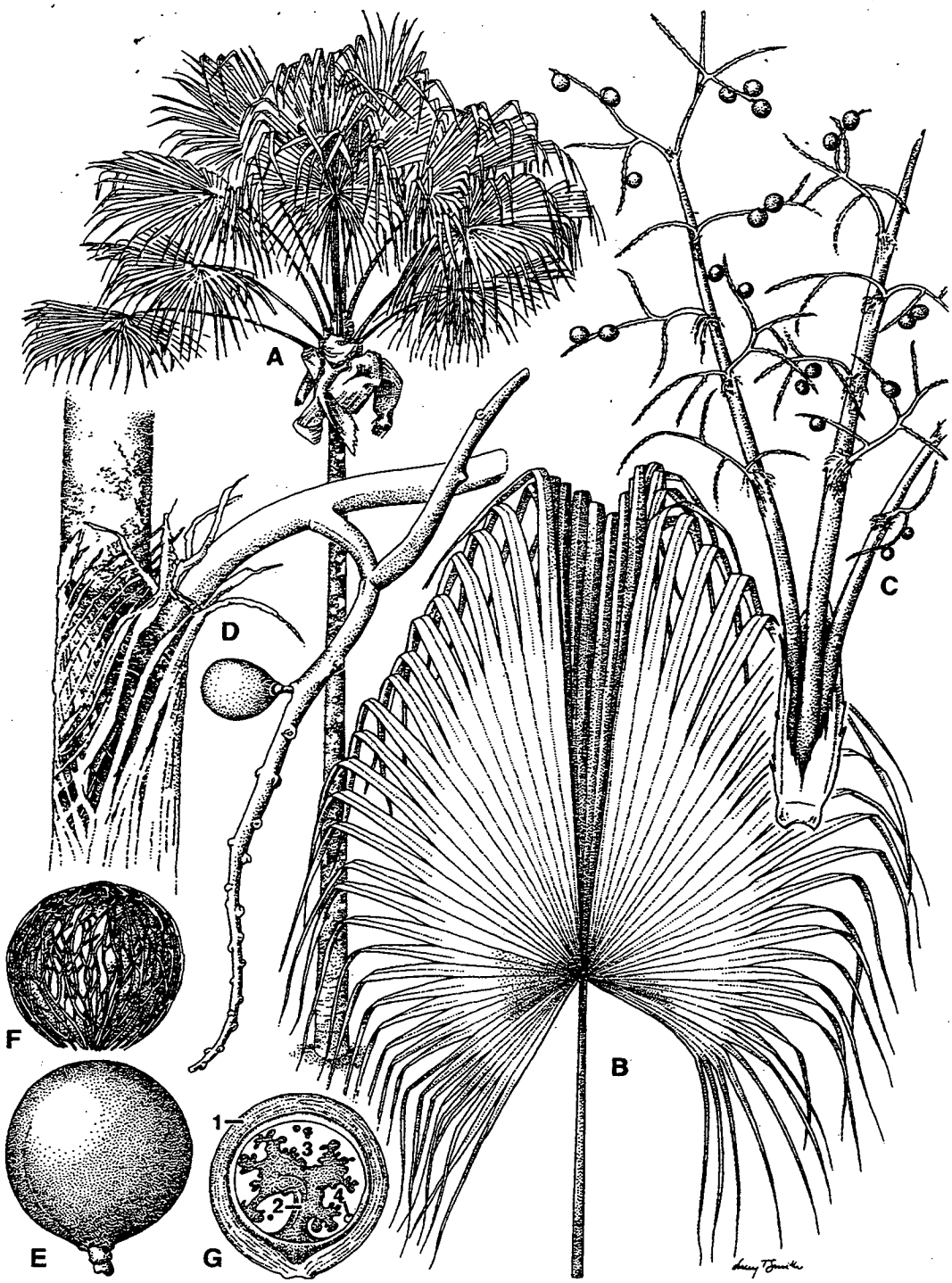


Figure 2.8. ***Livistona surru.*** A. Habit. B. Leaf, adaxial view x 0.05. C. Infructescence x 0.07. D. Basal portion of partial infructescence showing rachis bract apex and immature fruit x 0.3. E. Fruit, side view x 0.3. F. Fruit with epicarp removed exposing mesocarp fibres x 0.3. G. Fruit in LS, showing mesocarp [1], seedcoat intrusion [2], homogeneous endosperm [3] and embryo [4] x 0.3. A, C, D, E, *Barfod 390*; B, F, G, *WJBaker 582*. Illustration by Lucy T. Smith.

9. *Livistona jenkinsiana* Griff., Calcutta J. Nat. Hist. 5: 334 (1844); Palms Brit. E. Ind. 128 (1850); Anderson, Journ. Linn. Soc. 11: 13 (1871). *Livistona jenkinsii* Griff. ex Mart., Hist. nat. palm. 3: 242 (1849) *orth. var. Latania jenkinsiana* (Griff.) Devansaye, Rev. Hort. 47: 34 (1875). *Saribus jenkinsii* (Griff.) Kuntze, Revis. gen. pl. 736 (1891). Type: Lectotype here chosen. Illustration in Griffith, Palms Brit. E. Ind. t. 226 A, B (1850).

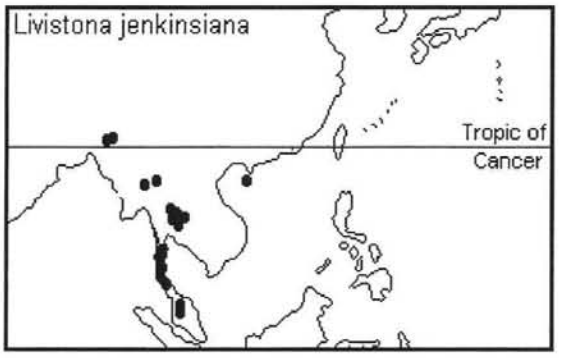
Livistona speciosa Kurz, J. Asiat. Soc. Bengal 43(2): 204 (1874) ***syn. nov.*** *Saribus speciosus* (Kurz) Kuntze, Revis. gen. pl. 736 (1891). Type: Lectotype (*fide* Beccari, 1931). Burma (Myanmar). Pegu Yomas, Chounmenahchy, Feb. 1871, *Kurz 3330 and 3331* (lectotype B, destroyed; isolectotypes BM, K).

Livistona fengkaiensis X. W. Wei and M. Y. Xiao, J. S. China Agric. Coll. 8(1): 22 (1982) ***syn. nov.*** Type: China. Guangdong, Fengkai, Heishi Ding, 450 m alt., 6 Dec. 1981, *Fengkai Exped. 1587* (holotype CANT).

Hermaphroditic(?) palm. **Trunk** to 22 m tall, 20-40 cm dbh, erect, broader at the base, nodes prominent, narrow, roughened, light coloured, internodes dark coloured, petiole bases persistent in the proximal portion. **Leaves** 20-50 in a globose or oblong crown; petiole 130-200 cm long, 20-25 mm wide distally, triangular in cross section, adaxially slightly ridged, abaxially rounded, margins armed throughout with single or double kris-like reddish to brown spines 15-25 mm long, 10-12 mm wide on a swollen base; leaf-base fibres not prominent, coarse, disintegrating or persistent; ligule to 25 cm long; lamina circular to sub-circular, 110-210 cm long, 150-200 cm wide, adaxially shiny green, abaxially slightly paler and sub-glaucescent grey or bluish; segments regular, 70-100, free for 50-75% of their length, apical cleft 2-10% of the length of the free segment, 3.5-8 cm wide at the disjunction, apices rigid; parallel veins most prominent, 9-10 each side of midrib; transverse veins thin, extending across 2-5 parallel veins, density c. 26 per unit area of 15x10 mm; hastula cordate. **Inflorescences** not branched at the base, 60-200 cm long; partial inflorescences 3-6, branched to 3 orders; prophyll 30-45 cm long, woody, keeled; peduncular bracts lacking; rachis bracts loosely tubular, reddish-brown, glabrous, expanded distally into lanceolate acuminate lobes, sometimes longitudinally split, terminating in a ligule-like

appendage, scurfy to glabrous; rachillae puberulous or nearly glabrous, 10-30 cm long, 3-5 mm thick, rigid, yellow-green. **Flowers** solitary or in clusters of 2-6, sessile, greenish/yellow, with inconspicuous bracteoles, broadly ovate, 2.5-4 mm long, 2.5-3 mm wide, ovate-acute in bud; sepals fused basally, fleshy, lobes broadly ovate, with thin and subhyaline margins; petals twice as long as sepals, basally fused, deltoid, acute; stamens with basally fused filaments, thick and short, contracted into elongate subulate apices, connective very short, narrow; anthers oblong-ovate, sagittate; pollen asymmetrically elliptical/ellipsoid; aperture symmetrically monosulcate, as long as the long axis; apices of sulcus acute; long axis (25-) 26.8 (-37) μm; wall thickness 1–1.5 μm; tectum semi-tectate; ornamentation dissimilar over entire grain, aperture margins perforate/micro-channelled; tectum surface psilate; ornamentation foveolate, lumina average to large, densely distributed; carpel turbinate-obconical, yellow, distinctly sculptured, and contracted into a short trisulcate, filiform style; stigma simple. **Fruit** globose, ellipsoid, obpyriform to reniform, 19-35 mm long, 16-25 mm diam., somewhat asymmetrical, rounded above, slightly tapering below to an acute base when ellipsoid, leaden blue to dark bluish-purple; epicarp very thin, with scattered lenticellular pores; suture line extends full length of the fruit, marked with lip-like structures; mesocarp succulent, moderately fibrous or lacking fibres; endocarp woody, brittle, whitish to cinnamon brown inside, 0.5-1 mm thick; pedicel 3-6 mm long, 2.5-4 mm thick. **Seed** globose to ellipsoid, 17-20 mm diam., slightly flattened on one side; intruded broadly and deeply by the testa with spongy tissue; embryo lateral to sublateral. **Eophyll** 7-ribbed. Fig. 2.9.

DISTRIBUTION. India, Sikkim, Bangladesh, Myanmar, China, Thailand and Malaysia [4-27°N]. In north-eastern India in the Naga Hills, Nowgong, Darjeeling Hills, and in Siang, Lohit and Tirap Valleys in Assam. In Sikkim in the Teesta Valley; Bangladesh in Chittagong; Burma, in Pegu Yoma and Tenasserim; China, in Yunnan and Hainan Island at Mo San Leng; throughout Thailand at 100-1200m alt., most common in the south; and Peninsula Malaysia, Gunung Inas to Genting Sempah in the west and Gunung Stong and Gunung Mandi Angin in the east at 700-1200 m alt. The dots on the map represent 22 collections.



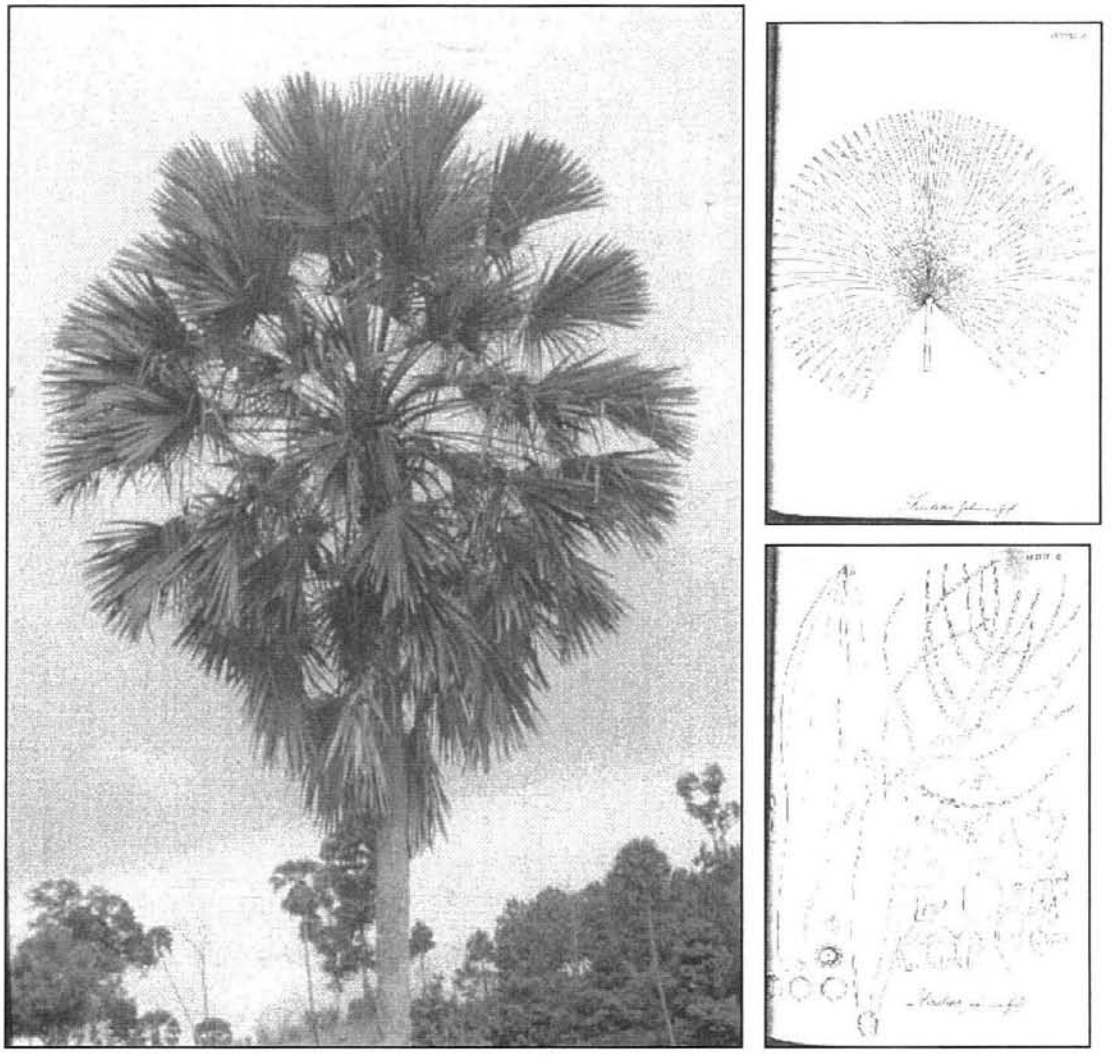


Figure 2.9. ***Livistona jenkinsiana.*** ***Left:*** Habit, Khao Kai, Thailand. ***Right:*** Type, Plates 226.A. and 226.B in W. Griffith, *Palms of British East India* (1850).

HABITAT AND ECOLOGY. In high rainfall areas in moist evergreen forest mostly on sandy loam with a laterite mixture, at 100-2500 m altitude. Flowers July–Aug.; fruits Oct.– Nov.

ETHNOBOTANY. Leaves are used for thatch and hats (Lepchas tribe of north-eastern India and Sikkim). The endosperm, presumably prior to maturity, is reported to be edible (Basu and Chakraverty, 1994).

SPECIMENS SEEN. INDIA: Valley of the Mali Itka, Masum, Putoo Road, 1000-2500 m alt., 18 July 1937, *F. Kingdon-Ward 1288* (BM); Assam. undated, *Griffith 1205* (BM). MYANMAR: Tharapon, Mar. 1911, *A. Meebold 14335, 14423* (M). CHINA: Yunnan. You-louh shan, Che-li Hsien, Sept. 1936, *W. Wang 78114* (A); Hainan. Mo San Leng, 3000 ft alt., Nov. 1932-33, *N. K. Chun & C. L. Tso 44362* (A, NY, US); Hainan. Sept. 1933 – Mar. 1934, *H. Y. Liang 36627* (NY). THAILAND: Chiang Mai Prov. road to Doi Chang Dao, 19°21'N, 98°47'E, 900-1100 m alt., 10 Feb. 1994, *A. Barfod 45208 with R. Pooma & T. Burholt* (AAU, K, NY); Doi Sutep, c. 1500 m alt., 23 Dec. 1920, *A. F. G. Kerr 4686* (AAU, BM, NY); Doi Sutep, c. 1200 m alt., Oct. 1914, *A. F. G. Kerr 3430* (NY); Loei, Phu Kradang, 16°53'54"N, 101°47'49"E, 1150-1250 m alt., 1 Nov. 1984, *G. Muata 49918 with C. Phengklai, S. Mitsuta, T. Yahara, H. Nagamusa & N. Natasan* (A, L); Kaw Tao, c. 200 m alt., 19 Sept. 1928, *A. F. G. Kerr 16023* (AAU, BM); Petchaburi Prov., Kaenkrachan N. P., 12°54'N, 99°20'E, 500-700 m alt., *A. Barfod 45194* (AAU); Chumphon, Bang Son, 100 m alt., 10 Jan. 1927, *A. F. G. Kerr 11342* (AAU, BM); Ranong Prov. 37 km NE of Ranong, less than 200 m alt., 16 July 1963, *R. M. King 5586* (US); La-un, 1 Jan. 1929, *A. F. G. Kerr 16372* (AAU); Pu Kio Chaiyapum, c. 1000 m alt., 24 Feb. 1931, *A. F. G. Kerr 20241* (AAU, BM, NY); 07°30'N, 99°45'E, 200 m alt., 13 Nov. 1990, *A. Barfod 41333 with W. Ueacharakan* (AAU); Songkhla, Ton Nga Waterfall, 20 km W of Hadyai, 07°00'N, 100°00'E, 100-250 m alt., 1 Nov. 1990, *A. Barfod 41040 with W. Ueacharakan* (AAU); Hadyai, Nathawi Road, 17 Apr. 1972, *T. Whitmore 3100* (K); Pattani, Kao Kalakiri, c. 900 m alt., 10 Sept. 1923, *A. F. G. Kerr 7791* (AAU, BM). MALAYSIA: Perak. Ulu Batang Padang, on Pahang boundary, c. 6000 ft alt., 22 Apr. 1930, *M. R. Henderson 23665* (BO, BRI, SING, NY); Gunong Pondok, c. 700 ft alt., 1930, *M. R. Henderson s. n.* (SING). CULTIVATION: Indonesia. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (FI); Singapore Botanic Gardens, Apr.–May 1936, *C. X. Furtado 31108* (L).

NOTES. *Livistona jenkinsiana* was first described by Griffith (1844), based on observations of wild plants at Gubro and a collection made in 1836 from Assam by the British Commissioner of Assam, Major-General F. Jenkins [1793-1866], and named in his honour. This collection is not extant. Martius (1849) published the orthographic variation *L. jenkinsii* and provided a description of the inflorescence and flowers based on information given to him by Griffith. Griffith (1850) provided an expanded description, with illustrations [Plates 226.A. and

226.B] of a leaf, a partial inflorescence, flowers and fruit, that are hereby chosen as the lectotype (Fig. 2.9).

Livistona speciosa was described by Kurz (1874) from the mountains of Pegu Yoma of central Myanmar, based on *Kurz 3331* [BM, K], but without direct reference to the choice of species name which means showy or beautiful. The similarity of this taxon to *L. jenkinsiana* was noted by Kurz in the protologue, although Beccari (1931), still noting a close relationship between the taxa, provided descriptions of some characters that he considered readily separated the species. However, these characters are variable and of limited taxonomic use when a range of collections are examined. On this basis, I consider *L. speciosa* to be conspecific with *L. jenkinsiana* and accordingly provide synonymisation.

There is considerable variation in fruit shape and size in this species, being either globose or ellipsoid. Populations with globose fruits are common in north-eastern India and northern Thailand. Plants with ellipsoid fruit occur in north-eastern Myanmar, southern Thailand, Malaysia, southern mainland China and Hainan Island. There are interspersed populations with intermediate fruit, thus making any taxonomic decisions based on fruit to be arbitrary.

Livistona fengkaiensis was the name given to a population occurring in the mountains of the Fengkai area in Guandong, southern China, based on the collection *Fengkai Exped. 1587* [CANT]. This taxon is hereby synonymised under *L. jenkinsiana.*

10. ***Livistona endauensis*** J. Dransf. & K. M. Wong, Malayan Nat. J. 41: 121 (1987). Type: Malaysia. Johore, G. Janing, Ulu Endau, *J. Dransfield JD5089* (holotype K; isotype KEP).

Hermaphroditic(?) palm. **Trunk** to 15 m tall, 12-20 cm dbh, erect, cylindrical, slightly broader at the base, pale grey brown, nodes obscure, internodes compressed, petiole stubs at first persistent but deciduous with age, vertical fissures shallow. **Leaves** c. 75 in a globose to conical crown; petiole c. 175 cm

long, arching, orange to reddish-brown, c. 15 mm wide by 12 mm thick, triangular in cross-section, covered in thin, caducous, grey-brown indumentum, margins unarmed in the distal half, armed in the proximal one-half with single kris-like black spines, regularly spaced, 10-14 mm long, 6-15 mm apart, distally becoming more widely separated. Leaf-base fibres prominent, coarse, disintegrating; distally the fibres form a prolonged triangular, chocolate-brown ligule to 35 cm long, to 10 cm wide; lamina circular to subcircular in profile, costapalmate, c. 100 cm long, flat in juveniles, slightly undulate in adults, bright green adaxially, lighter green abaxially, glabrous on both surfaces; segments regular, 60-70, free for c. 61% of their length, apical cleft for c. 8% of the length of the free segment, apices rigid to occasionally pendulous mainly through damage or age; mid-leaf segments c. 3 cm wide at the disjunction; outer segments c. 0.8 cm wide at the disjunction; parallel veins prominent, 4-5 each side of mid rib; transverse veins very thin, extending across 2-4 parallel veins, density c. 25 per unit area of 15x10 mm; hastula conspicuous, c. 10 mm high, triangular, crescent shaped. **Inflorescences** not branched at the base, to 150 cm long, arching; partial inflorescences c. 8, branched to 3 orders; peduncle c. 60 cm long, laterally compressed at the base, 3 cm wide by 0.5 cm thick, c. 2.5 cm wide distally by 1.0 cm thick; prophyll tubular, 30 cm long by 2.5 cm thick, bicarinate at the base, dark brown, glabrous except for scattered caducous rust coloured indumentum; peduncular bracts lacking; rachis bracts tubular, glabrous; partial inflorescences to c. 35 cm long; rachillae 6-10 cm long, c. 0.25 cm thick, rigid, yellow at floral maturity, thinly covered in scattered unbranched hairs. **Flowers** solitary or in clusters of 2-3, sessile, globular, c. 1 mm high, 1.5 mm wide, golden yellow; calyx basally tubular, c. 0.3 mm high, glabrous, 3-lobed, lobes triangular to 0.4 mm long by 1 mm wide; petals broadly triangular, to 1 mm long by 0.8 mm wide, glabrous, rugulate abaxially, adaxially striate; stamens basally fused to form a tube c. 0.4 mm high; filaments very short, free; anthers rounded c. 0.1 mm diam.; carpels wedge-shaped, c. 0.6 mm high, abruptly narrowed to form a short common style to c. 0.2 mm high, stigma punctiform. **Fruit** obovoid to pyriform, c. 16 mm long, 14 mm wide, bluish green; epicarp smooth, wrinkled on drying; mesocarp c. 2 mm thick; endocarp crustaceous c. 1 mm thick; pedicel 1-2 mm long. **Seed** globose c. 1 cm diam, intruded shallowly by the testa. **Eophyll** 5-ribbed. Fig. 2.10.

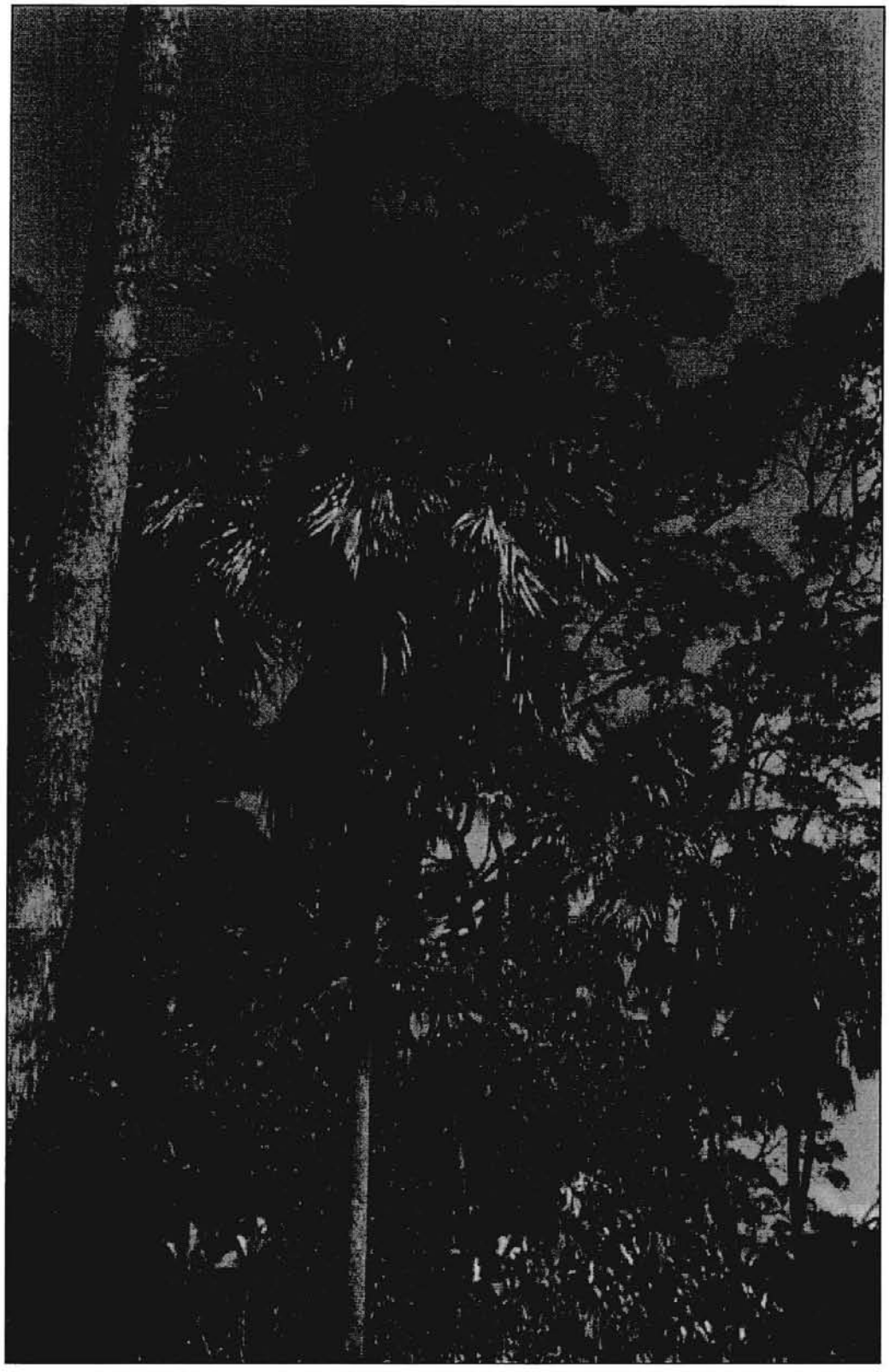
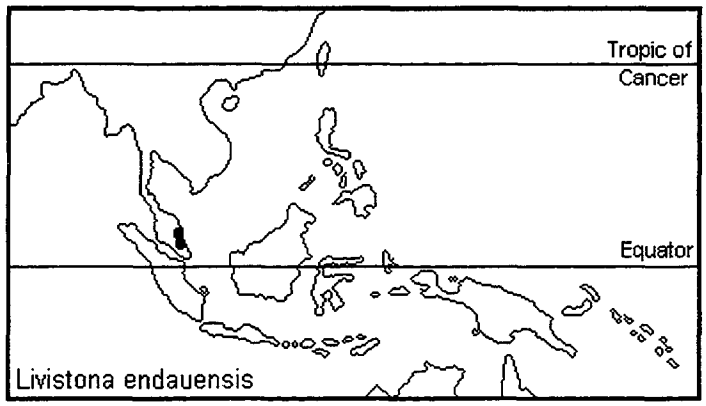


Figure 2.10. ***Livistona endauensis.*** Habit, Bukit Bauk, Trengganu, Malaysia.



DISTRIBUTION. Malaysia. In Johore at Ulu Endau, on Gunung Janing, Gunung Janing Barat and Bukit Peta, and the eastern hills of Trengganu at Bukit Bauk [2-5°N]. The dots on the map represent four collections.

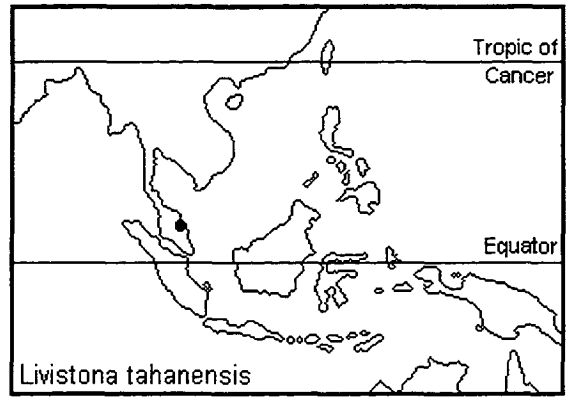
HABITAT AND ECOLOGY. In rainforest at 90-660 m alt. Flowers all year; fruits all year.

SPECIMENS SEEN. MALAYSIA: Johore. Kuala Jasin, S. Endau, 300 ft (c. 90 m) alt., 12 Nov. 1972, *E. A. Heaslett & Ahmad Shukor s. n.* (SING); Johore. Gunung Janing via Kahang, 350 ft (c.110 m) alt., 30 July 1972, *E. A. Heaslett, M. Shah, Samsuri & A. Shukor 2609* (SING); Trengganu. Kuala Dungun, Bukit Bauk, 350 m alt., 7 Aug. 1968, *J. Dransfield 915* (K); Trengganu. Kemaman, Compt. 4, Rasau Kerteh Ulu Chukai Forest Reserve, 2 June 1962, *Dr. Meijer & F. C. Yong 94940* (L).

NOTES. *Livistona endauensis* was described by Dransfield and Wong (1987) from a population on Gunung Janing in the Ulu Endau area, Johore, Malaysia, based on the collection *Dransfield JD5089* [K]. In the protologue, a population of a then unidentified *Livistona* in Trengganu was compared to this taxon, though maintained as a distinct species pending further study. With the subsequent examination of collections from Trengganu, that population is now included as a northern extension of *L. endauensis*.

11. *Livistona tahanensis* Becc., Webbia 5: 17 (1921); in Ridley, J. Fed. Malay States Mus. 6: 189 (1915), *nomen*. Type: Malaysia. Pahang, Gunung Tahan, 1 June 1905, *L. Wray & H. C. Robinson 5355* (holotype BM; isotype FI).

Hermaphroditic(?) palm. **Trunk** to 8 m tall, c. 12 cm dbh, erect, slightly broader at the base, petiole stubs persistent. **Leaves** 30-40 in a globose to oblong crown; petiole to c. 70 cm long, 12-15 mm wide in the middle, 5-6 mm wide distally, triangular in cross section, adaxially flat, abaxially rounded, with scattered appressed hyaline ciliate-margined scales, margins with short, flat, brown, blunt triangular 5-8 mm long spines throughout, distally reducing in size; leaf-base fibres prominent, fine, disintegrating; ligule 40-50 cm long, membranous, bright mahogany red, polished on both surfaces; lamina sub-circular, 57-76 cm long, c. 90 cm wide, rigid, flat to undulate, adaxially dark green, abaxially grey-green; segments regular, 49-50, free for c. 58% of their length, apical cleft c. 16% of the length of the free segment; parallel veins 6-7 each side of midrib, more prominent than transverse veins which extend across 2-4 parallel veins, density c. 14 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 80-91 cm long; partial inflorescences c. 4, branched to 3 orders, longest to c. 23 cm long; prophyll not seen; rachis bracts loosely tubular; peduncle 2.5 cm wide at the base; rachillae thin, red, scurfy, 7-10 cm long. **Flowers** c. 1 mm long; sepals ovate, tipped red, half as long as petals; petals oblong, blunt, tip thickened, incurved; anthers white; style short, conic. **Fruit** globose to ellipsoid, 12-14 mm long, green, glossy; epicarp smooth; suture line extends for the full length of the fruit, marked with lip-like structures; pedicel 2-3 mm long. *Tahan serdang, daun tau.* Fig. 2.11.



DISTRIBUTION. Malaysia. In Pahang, endemic to Gunung Tahan at 900-1500 m alt. [5°N]. The dots represent six collections.

HABITAT AND ECOLOGY. In moist montane forest. Wild elephants are reported to eat the cabbage (Kiew and Davison, 1989).

SPECIMENS SEEN. MALAYSIA: Pahang. Gunung Tahan, 3500-4000 ft alt., 18 June 1922, *M. Nur 8006* (SING); Gunung Tahan, 3500-4500 ft alt., 28 Aug. 1928, *R. E. Holttum 20631* (BO, SING, UC); Gunung Tahan, 3000 ft., 15 Sept. 1937, *E. J. H. Corner 36597* (BO, SING); Gunung Tahan, 3500 ft, Jan. 1923, *H. Pendlebury s. n.* (K); Gunung Tahan, 3500 ft, Jan. 1923, *H. M. Pendlebury & C. B. Kloss s. n.* (BM); Gunung Tahan, Tahan Woods near Wrays Camp, 23 Feb. 1968, *J. Dransfield 659* (K).

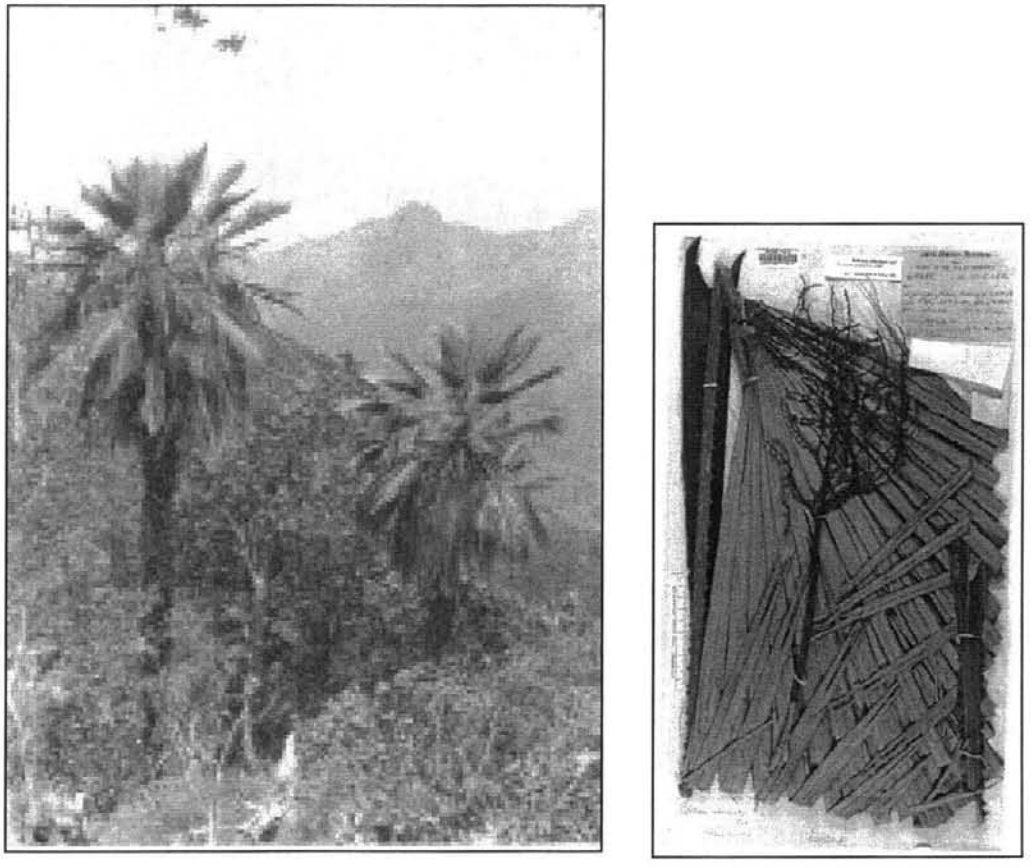


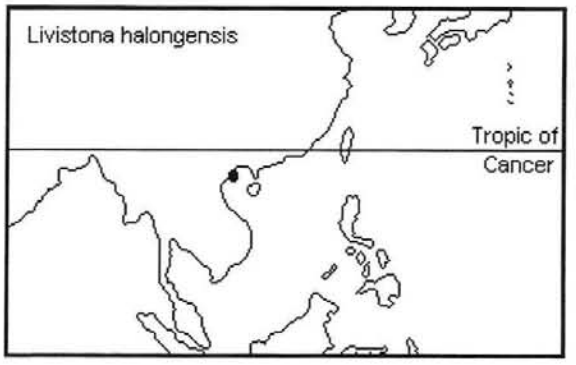
Figure 2.11. ***Livistona tahanensis.*** ***Left:*** Habit, Gunung Tahan. Malaysia ***Right:*** Type specimen, *Wray and Robinson 5355* [BM], collected 1905 from about 1000 m on Gunung Tahan.

NOTES. The name *Livistona tahanensis* was first used by Ridley (1915) in an annotated list of plants of Gunung Tahan, Pahang, Malaysia. There was no description provided, but Ridley noted that the species was pending description by Beccari. Beccari (1921) provided the first formal description, based on the collection *Wray and Robinson 5355* [BM] from 1000 m on Gunung Tahan (Fig. 2.11).

12. ***Livistona halongensis*** T. H. Nguyen and Kiew, Gard. Bull. Singapore 52: 198 (2000). Type: Vietnam. Quang Ninh Prov., Ha Long Bay, 12 May 1999, *T. H. Nguyen, L. Averyanov and V. C. Nguyen NTH2630* (holotype HN *n. v.*; isotype: SING *n.v.*)

Hermaphroditic(?) palm. **Trunk** to 10 m tall, c. 20 cm dbh, slightly broader at the base, nodes conspicuous, close. **Leaves** c. 40 in a globose to oblong crown; petiole 125-130 cm long, c. 2 cm wide at the base, c. 1.5 cm wide distally, triangular in cross section, adaxially flat, abaxially rounded, green with a light yellow band along the margin, margin with irregularly spaced triangular hooked dull orange spines along entire length but more aggregated proximally; leaf-base fibrous, triangular, ligule rich brown, fibrous, distally tattered into ribbons; hastula papery, persistent to 2.5 cm high; lamina circular, 75-80 cm long, strongly costapalmate, undulate, adaxially dark green, abaxially lighter green; segments regular, 45-64, free for 42-73% of their length, apical cleft c. 40% the length of the free segment; mid-leaf segments c. 4 cm wide at the disjunction; parallel veins 11-13 each side of midrib, more prominent than transverse veins which are thin, extending across 2-4 parallel veins, density of 23-26 per unit area of 15x10 mm; basal part of outer segment with c. 2 cm long row of fine teeth on the margin. **Inflorescences** not branched at the base, c. 340 cm long, erect, projecting above the crown; partial inflorescences 6-7, branched to 3 orders, longest to 95 cm; peduncle c. 160 cm long, 2 cm diam.; prophyll to 33 cm long, basally 5 cm wide, distally to 3 cm wide; peduncular bracts 5, each c. 50 cm long, tubular, thick leathery fibrous, tightly sheathing; rachis bracts c. 27 cm long, otherwise similar to peduncular bracts; rachillae about 10 per partial inflorescence, 1-1.5 mm diam., with soft fawn velvety tomentum. **Flowers** in pairs, ovoid in bud, pale cream-yellow; sepals basally fused with lobes c. 1 mm long, glabrous; petals c. 2 mm long; stamens c. 1 mm long, subulate, staminal tube rich brown, filament very short; anthers subglobose, glistening white, c. 0.3 mm long; carpel obovoid, deeply ridged, dark reddish brown, c. 1 mm long; style pale brown, c. 0.3 mm long; stigma minute. **Fruit** globose, 10-12 mm diam., epicarp smooth, glossy dark green; mesocarp leathery; endocarp crustaceous, brittle, c. 0.75 mm thick; endosperm intruded by integument to about halfway through; pedicel 2-5 mm long. Fig. 2.12.

DISTRIBUTION. Vietnam. Islands in Ha Long Bay [21°N]. The dot on the map represents three collections.



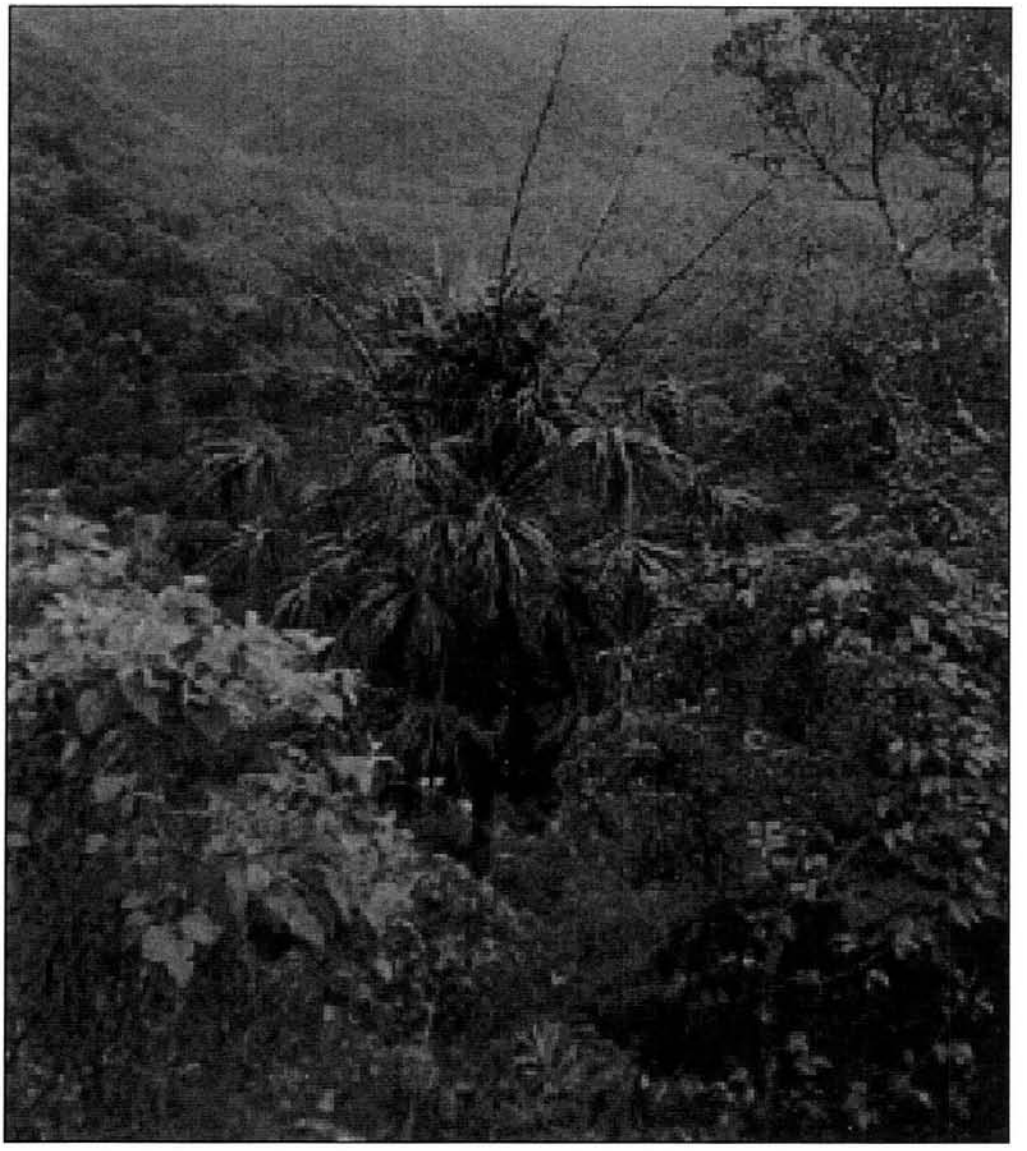


Figure 2.12. ***Livistona halongensis*.** Habit, Cat Ba Islands, Gulf of Tonkin, Vietnam.

HABITAT AND ECOLOGY. Limestone islands, in soil-filled crevices on rocky limestone substrate, sometimes gregarious, 100-300 m alt. Flowers May-June; fruits July.

SPECIMENS AVAILABLE. VIETNAM: Quang Ninh Prov. Ha Long Bay, 15 July 1999, *T. H. Nguyen and R. Kiew s. n.* (HN, *n.v.*); Ha Long Bay, 11 Apr. 2000, *T. H. Nguyen and R. Kiew s. n.* (HN, *n.v.*); Hai Phong Prov. Cat Ba NP, limestone hill, c. 300 m alt., 2 June 2001, *Nguyen Tien Hiep NTH 4853* (HN).

NOTES. Nguyen and Kiew (2000) described *Livistona halongensis* from limestone islands in Ha Long Bay, Gulf of Tonkin, Vietnam, based on *Nguyen Tien Hiep NTH 2630* [HN]. This is the only *Livistona* known to be restricted to limestone. It was previously mentioned by Yang (1996) as an 'unidentified species of *Livistona*' from Cat Ba Island.

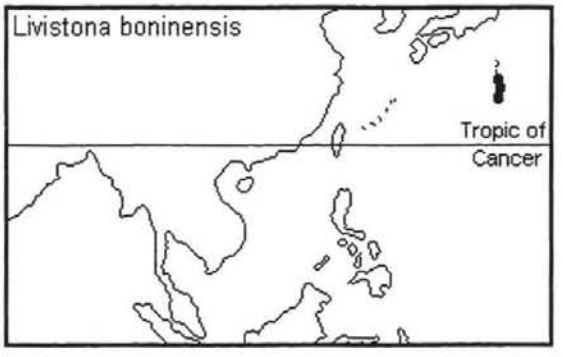
13. *Livistona boninensis* (Becc.) Nakai, J. Jap. Bot. 11: 222 (1935); Nakai, in Sci. World (Japan) 26(4): 10 (1928), *nomen*; Bull. Biogeogr. Soc. Japan 1 (3): 255 (1930), *nomen. Livistona chinensis* var. *boninensis* Becc., Webbia 5: 12, 16 (1921). Type: Lectotype (*fide* Beccari, 1931). Japan. Bonin Islands, Haha-jima, 23 Apr. 1917, *Wilson 8271* (lectotype A; isolectotypes BM, K, US).

[*Corypha japonica* Kittlitz, Veg.-Ansicht. 48, t.14-16 (1844), *nom. illeg.* (Nakai, 1936). Type: not designated.]

Hermaphroditic palm. **Trunk** to 20 m tall, c. 30 cm dbh, nodes raised with remnant leaf-base fibres, internodes congested, petiole stubs not persistent. **Leaves** 40-60 in a globose to flattened crown; petiole triangular in cross section, adaxially moderately ridged, abaxially rounded, margins with single curved green spines well spaced in proximal portion of petiole; leaf-base fibres not prominent, very coarse, persistent; lamina subcircular, 120-200 cm long, grey-green adaxially, lighter grey-green abaxially, non-waxy; segments regular, 50-82, free for 45-75% of their length, apex cleft for c. 20% of the length of the free segment; apex pendulous; 5-6 parallel veins each side of midrib, more prominent than transverse veins which are thin and extend across 2-5 parallel veins, transverse

vein density c. 18 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 130-220 cm long; 6-7 partial inflorescences, branched to 3 orders; rachillae 4-16 cm long, glabrous; prophyll not seen; 1 peduncular bract, tubular, glabrous; rachis bracts tubular, glabrous. **Flowers** in clusters of 5-8, 2-2.8 mm long, cream. **Fruit** globose to pyriform, 19-30 mm long, 14-28 mm diam., bright green; epicarp very glossy; pedicel 3-4 mm long. **Seed** reniform. *Bonin Island fan-palm.* Fig. 2.13.

DISTRIBUTION. Japan. Bonin and Volcano Islands [24-27°N]. The dots on the map represent ten collections.



HABITAT AND ECOLOGY. Coastal and near coastal forest to 500 m alt. Flowering Apr.–May; fruiting Oct.–Dec.

SPECIMENS SEEN. JAPAN: Bonin Islands. Haha-jima, Okimura, 3 Jan. 1975, *M. Furuse 7719* (K); Haha-jima, Koshin-dzuka to top of Mt. Sekimon, 200-400 m alt., 18 Mar. 1972, *Y. Momiyama, S. Kobayashi & M. Ono s. n.* (MAK); Chichi-jima, 75 m alt., 13-14 Feb. 1950, *F. R. Fosberg 31545, 31547, 31548* (US); Chichi-jima, Mt. Mikazuki, 18 Apr. 1976, *N. Fujita & Y. Shimizu 23* (A); Chichi-jima, vicinity of Tsutsujiyama, 4 July 1975, *G. Murata 171, with H. Tabata, K. Tsuchiya & K, Takada* (A); Chichi-jima, Futami Graveyard, 3 July 1976, *H. Kanai & M. Ono s. n.* (MAK); Chichi-jima, Mt Mikadzuki, S slope, 250 m alt., 11 Nov. 1970, *M. Ono & S. Kobayashi 79009* (MAK); Chichi-jima, enroute from the northern valley of Mt Akahatayama to Mt Tori-yama, 50-150 m alt., 6 May 1974, *M. Ono, S. Kobayashi & M. Wakabayashi s. n.* (MAK); Mei-jima, 24 Aug. 1980, *M. Ono, S. Kobayashi, K. Sugawara & T. Sugawara s. n.* (MAK); [Bonin Islands], 1853-56, *C. Wright s. n.* (US).

Figure 2.13. ***Livistona boninensis.*** ***Left:*** Habit, Chichi-jima, Bonin Islands, Japan. ***Right:*** Type specimen *Wilson 8271* (A), Haha-jima, Bonin Islands, collected 1917.

NOTES. The first mention of this palm was by Kittlitz (1844) in an account of his voyage through the north-western Pacific, where he wrote: " ....eine grosse schöne Fächerpalme [*Corypha japonica*?]...." and included it in various illustrations of the Bonin Islands. The name *Corypha japonica* has no nomenclatural formality and is considered an ambiguous name, as argued by Nakai (1936). The first formal recognition was by Beccari (1921) who described it as a subspecies of *L. chinensis* in a diagnostic key to *Livistona* species, as *L. chinensis* var. *boninensis*, based on specimens from the Bonin Islands, Japan. The first use of the name raised to specific level as *L. boninensis*, was by Nakai (1928) in his *Plants in Ogasawara Islands*. Beccari (1931) maintained it as a subspecies of *L. chinensis*, apparently not being aware of Nakai's implementation, and provided an expanded description and established the type as *Wilson 8271* [A] (Fig. 2.13). However, Nakai (1935) continued using the name at specific level, and placed Beccari's subspecies in synonymy. Moore and Fosberg (1956) re-

established it as a subspecies, placing Nakai's name in synonymy, and provided comparative illustrations of it and other subspecies.

Recently collected specimens seen at MAK carry larger fruits than described for the type, up to 30 mm long as opposed to 25 mm long. Fruit are globose to subglobose with a tapered base. These differ from those in *L. chinensis* where they are only up to 26 mm long in the largest specimens seen, varying from globose to ovoid but lacking any basal tapering. A peduncular bract is present in *L. boninensis* but is absent in *L. chinensis*. There is also considerable difference in the degree of tomentum carried on the inflorescence bracts. In *L. chinensis*, the tomentum is dense and persistent, while in specimens from the Bonins bracts are glabrous or only mildly tomentose becoming glabrous at maturity. Thus the taxon formerly known as *L. chinensis* var. *boninensis* is hereby reassigned to specific status in accordance with the taxonomy of Nakai (1935).

14. *Livistona chinensis* (Jacq.) R. Br. ex Mart., Hist. nat. palm. 3(7): 240 (1838).

Latania chinensis Jacq., Fragm. bot. 16 (1801). *Saribus chinensis* (Jacq.) Blume, Rumphia 2: 49 (1838). *Livistona sinensis* Griff., Palms Brit. E. Ind. 131 (1844), *ortho. var.* Type: Lectotype (*fide* Moore, 1979). Illustration in Jacquin, Fragm. bot., t. 11, fig. 1 (1801).

[*Latania borbonica auct. non* Lam., Encyclop. 3: 427 (1792)].

Livistona mauritiana Wall. ex Mart., Hist. nat. palm. 3: 240 (1838), *nomen.* Type: not designated.

Chamaerops (?) biroo Sieb., Syn. Pl. Oecon. Jap. 11 (1830); Martius, Hist. nat. palm. 3: 242 (1838). Type: Lectotype here chosen. Japan. undated, *Siebold s. n.* (lectotype L).

Livistona olivaeformis (Hassk.) Mart., Hist. nat. palm. 3: 319 (1850); Miquel, Fl. van Ned. Ind. 3: 59 (1855); Miquel, Palm. archip. ind. 13 (1868). *Saribus*

olivaeformis Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 176 (1842). *Latania olivaeformis* (Hassk.) Devansaye, Rev. Hort. 47: 34 (1875). Type: Lectotype here chosen. Indonesia. Cultivation. Bogor Botanic Gardens, 'nel viale presso la chieta', May 1878, *Beccari s. n.* (lectotype FI, sheets 1131, 1131-B and 1131-C).

Livistona subglobosa (Hassk.) Mart., Hist. nat. palm. 3: 319 (1850); Miquel, Fl. van Ned. Ind. 3: 59 (1855); Miquel, Palm. archip. ind. 13 (1868); Nakai, J. Jap. Bot. 11: 224 (1935). *Saribus subglobosus* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9: 177 (1842); Hasskarl, Cat. hort. bot. bog. 65 (1844). *Livistona chinensis* var. *subglobosa* (Hassk.) Becc., Webbia 5: 12, 16 (1921) ***syn. nov.*** Type: Lectotype here chosen. Indonesia. Cultivation. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (lectotype FI, sheets 11333 and 11333-B).

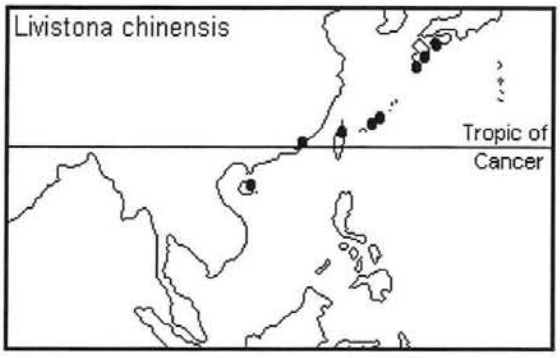
Livistona japonica Nakai ex Masam., [as *Livistonia japonica* (sic)], Prelim. Rep. Veg. Yak. 50 (1929); Masamune and Suzuki, Ann. Rep. Taihoku Bot. Gard. 1933, 3: 73 (1933). Type: not designated.

Livistona ovaliformis Hort. ex. R. M. Grey, in Rep. Harvard Botanic Garden, Cienfuegos, Cuba 66 (1927) (Beccari, 1931). Type: not designated.

Hermaphroditic palm. **Trunk** erect, leaning or arching, to 15 m tall, slightly broader at the base, 20-30 cm dbh, nodes obscure, roughened, light coloured, internodes narrow, irregular, brown to grey with age, petiole stubs not persistent, longitudinal fissures prominent. **Leaves** 40-60 in a globose to ovate crown; petiole slightly arching, to 180 cm long, c. 15 cm wide in the middle, flat or slightly ridged adaxially, rounded abaxially, surface glabrous; margins with single curved green to black spines in the proximal one-half or less or sometimes absent, distal margins otherwise sharp and slightly winged; spines 2-20 mm long, subulate, brown; leaf-base fibre not prominent, coarse, and disintegrating; lamina sub-circular to reniform, 120-200 cm long, 120-180 cm wide, light yellowish green on both surfaces, dull to glossy, non-waxy; segments regular, 50-90, free for 45-55% of their length, 5-7 cm wide at the disjunction, apex deeply cleft for c. 13% of the length of the free segment, apical portion pendulous to form a neat fringe;

lower segments 2-5 mm wide, filamentous, apex cleft almost to the hastula; parallel veins 8-9 each side of midrib, more prominent than the transverse veins which are thin, and extend across 2-4 parallel veins; transverse vein density c. 36 per unit area of 15x10 mm; hastula raised 3 cm. **Inflorescence** not branched at the base, 100-120 cm long, slightly curving; 6-7 partial inflorescences, branched to 3 orders; rachillae 10-18 cm long, to 9 mm thick, glabrous; peduncular bracts lacking; rachis bracts glabrous to moderately tomentose, brown, chartaceous with age, tubular, apex acute. **Flowers** in clusters of 4-7, subglobose in bud, 2-2.5 mm long, white to yellowish; sepals imbricate, c. 1.5 mm long, rounded, margins hyaline, inner surface striate; petals triangular, apically pointed, fleshy, c. 2.2 mm long, c. 2 mm wide; filaments united at the base, free in the upper part, subulate, connective thickish, c. 0.5 mm long; anthers c. 0.5 mm long, ovate, dorsifixed below the middle, bifid at the base, apex rounded; style sharply tapered about the same height as the anthers; pollen symmetrically elliptical; aperture monosulcate, as long as long axis, apices of sulcus acute; long axis (25-) 27.0 (-29) μm; wall thickness c. 1.5 μm; tectum tectate; distribution of ornamentation similar over entire grain; tectum surface psilate; ornamentation insulate and rugulate. **Fruit** globose, subglobose, ellipsoid or pyriform, 15-26 mm long, 9-18 mm wide, blue-green to bright green; epicarp glossy, ceramic-like; suture line extends for full length of fruit, marked with lip-like structures; mesocarp c. 1.5 mm thick, fleshy, slightly oily, moderately fibrous, endocarp woody, c. 0.5 mm thick; pedicel 2-3 mm long. **Seed** globose, subglobose to ellipsoid, brown to greyish, variously reniform in longitudinal section, c. 14 mm long, c. 10 mm wide; hilum elongate; raphe spreading; endosperm homogeneous, intruded by the testa to about one-half to two-thirds through to form a cavity filled with loose brown crystalline tissue; embryo lateral to supralateral. **Eophyll** 7-ribbed. *Chinese fan palm, Biro (Japanese).* Fig. 2.14.

DISTRIBUTION. Japan, China and Taiwan [20-34°N]. In Japan, on the Ryukyu Islands of Okinawa, Iriomote and Aharen, and on Kyushu, Aoshima (Yoshida *et al.*, 2000) and Shikoku (Horikawa, 1972; Suzuki, 1982). In Taiwan on Kisanto Island, and in China on Hainan Island and formerly in Guangdong Prov. but now presumably extinct. The dots on the map represent 15 collections.



HABITAT AND ECOLOGY. Coastal forests on various soils, often in sand, sometimes in dense mono-specific colonies, otherwise in small isolated colonies. Flowers Feb.-Apr.; fruits Apr.-Sept.

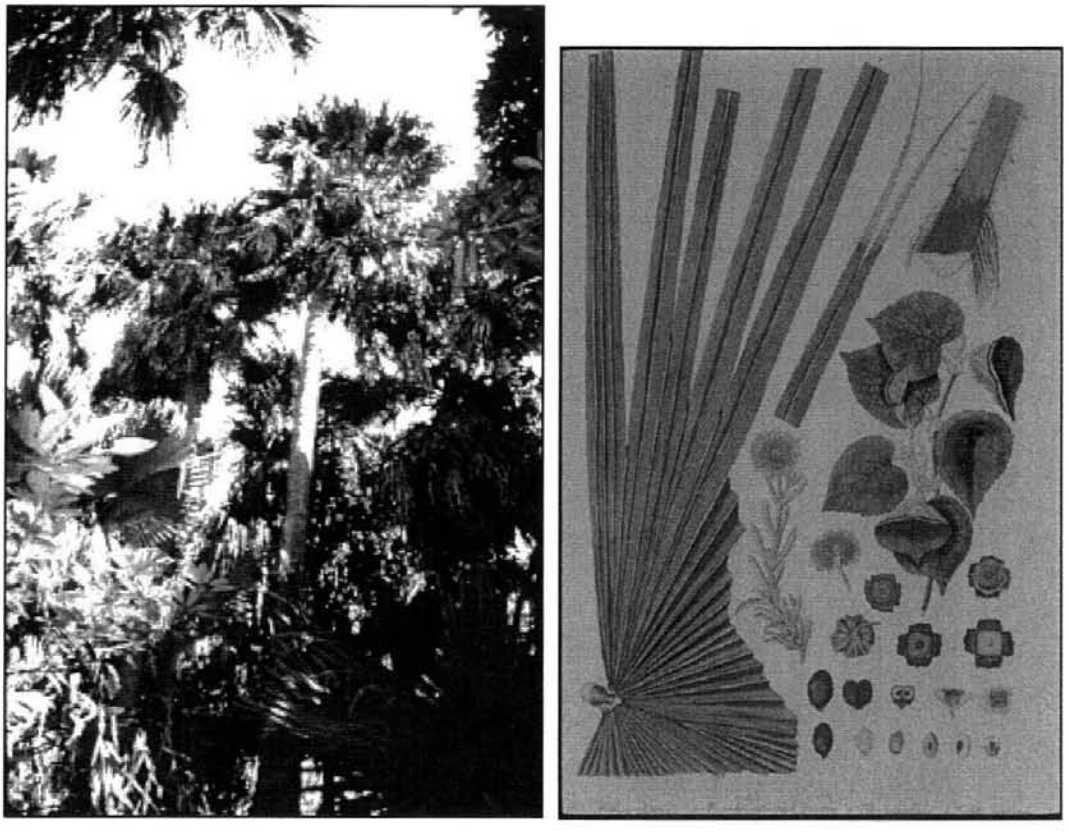


Figure 2.14. ***Livistona chinensis***. ***Left:*** Habit, Aoshima, Kyushu, Japan. ***Right:*** Type, illustration in Jacquin (1801), Tab. 11, Fig. 1.

SPECIMENS SEEN. JAPAN: Ryukyu Islands. Yaeyama Islands, Yonakuni, 13 Nov. 1973, *M. Furuse 4579* (K); Ryukyu Islands. Okinawa Island, Motobu Peninsula, Mt Awa, 10 Dec. 1953, *E. H. Walker 7636* (S); Yakushima, Ambo, 24 Oct. 1953, *J. Ohwi & Okamoto 995* (A, B, BM, BR, L, NY, UC, US); Ryukyu Islands [Loo-Choo Islands]. 1853-56, *C. Wright s. n.* (A). TAIWAN. Bankinsing Mts, c. 1894, *A. Henry 821* (K, NY). CHINA: Hainan Island. Loktung, 17 June 1936, *S. K. Lau 27175* (A); Guangdong Prov., 10 Apr. 1917, *C. O. Levine 479* (US); Guangdong Prov. 29 Mar. 1923, *To Kang Ping 10956* (BO, NY). No location: 1904, *Burch 1591* (L). CULTIVATION: Indonesia. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (FI); Florida. Fairchild Tropical Gardens, 2 Sept. 1992, *M. Balick 3388* (NY); Singapore Botanic Gardens, 15 July 1935, *C. X. Furtado 29396* (A); Hawaii. University of Hawaii campus, 80 ft alt., 10 Feb. 1962, *V. J. Krajina 6288* (NY); Hong Kong. Victoria Island, Deep Water Bay, 21 Apr. 1969, *Shiu Ying Hu 7067* (US). Japan. Ryukyu Islands, Okinawa, Gesashi, 26°36'N, 128°08.75'E, 1955, *R. Morgan 5058* (UC, US); Guam. Merizo, undated, *F. R. Fosberg 35668* (BH, US); Sabah, undated, *Melgriko 10029* (K).

NOTES. *Livistona chinensis* was first described as *Latania chinensis* (Jacquin, 1801), from plants cultivated and subsequently naturalised in Mauritius and brought to Schoenbrunn Gardens, Vienna in 1788. It is lectotypified by the illustration in that work, Tab. 11, Fig. 1 (Fig. 2.14). The species name was taken from that used for the palm in Mauritius, "*Latanier de la Chine*". Bretschneider (1898) provided some evidence to suggest that the naturalist and traveller Pierre Poivre was responsible for introducing the palm, during the mid 1700s, to Mauritius where it soon became naturalised. Poivre had made extensive collections of plants from south-eastern China and Indochina during the period 1740-1767. Brown (1810) maintained it as *Latania chinensis*, and Martius (1838) provided the formal transfer to *Livistona*.

Numerous other names have been applied to the species, including *Latania mauritiana, L. borbonica* and *Chamaerops biroo* (Martius, 1838); *Saribus chinensis* (Blume, 1838), the orthographic variation *L. sinensis* by Griffith (1844); and *L. japonica* (Nakai, 1928). Of these names, a lectotype is here chosen for *C. biroo* (Siebold, 1830), it being *Siebold s. n.* [L], a specimen that was located in the Siebold collections at Leiden. Types for *Latania mauritiana and Livistona japonica* have not been designated, while *Latania borbonica* is a misapplied name.

Livistona olivaeformis and *L. subglobosa* were established by Hasskarl (1842) from cultivated plants in Bogor Botanic Gardens as species of *Saribus*, but placed as *Livistona* species by Martius (1849). The species names were derived from the fruit shapes, being "*olivaeformibus*" and "*subglobosis*" respectively. *Livistona olivaeformis* was synonymised under *L. chinensis* by Beccari (1921), and the specimens collected by Beccari in May 1878 from the plants in Bogor Botanic Gardens that Hasskarl based the name upon are here chosen as the lectotype. Those specimens are sheets 11331, 11331-B. and 11331-C in FI. However, *L. subglobosa* was retained by Beccari as a valid taxon and subsequently made a subspecies. *Livistona chinensis* var. *subglobosa* was described as differing from *L. chinensis forma typica* only by fruit shape (Beccari, 1921), it being subglobose to ovoid rather than olive-like. Although the original description of *L. subglobosa* was from cultivated plants in Bogor Botanic Garden, Beccari (1931) applied the name to specimens collected in the Ryukyu Islands of southern Japan. Beccari visited Bogor Botanic Gardens in May 1878 and collected specimens from the plants upon which Hasskarl established the name. These specimens, sheets 11333 and 11333-B in FI are here chosen as the lectotype. Nakai (1935) and Kanehira (1936) elevated the taxon to specific status. However, it is most commonly referred to as a subspecies (Moore and Fosberg, 1956; Li, 1963; Ohwi, 1965; Walker, 1976; Li, 1978; Suzuki, 1982; Yoshida *et al.*, 2000). Collections from the distributional range of *L. chinensis* var. *subglobosa* (Horikawa, 1972) exhibit such variation in fruit shape that no reasonable taxonomic distinctions can be made between *L. chinensis forma typica* and *L. chinensis* var. *subglobosa*. Accordingly, *L. chinensis* var. *subglobosa* is placed as a synonym of *L. chinensis*.

Beccari (1921, 1931) described a third subspecies, *L. chinensis* var. *boninensis*, and its taxonomic history is discussed in Notes under *L. boninensis*.

15. *Livistona saribus* (Lour.) Merr. ex. A. Chev., Bull. Écon. Indo-Chine. ser. 2, 22: 501 (1919). *Corypha saribus* Lour., Fl. cochinch. 1: 212 (1790); Gmelin, Syst. nat. 2: 569 (1791). Type: Vietnam. Loureiro (holotype P, lost). Neotype to be designated.

Livistona spectabilis Griff., Calcutta J. Nat. Hist. 5: 336 (1844); Palms Brit. E. Ind. 130 (1850). [as a synonym of *L. rotundifolia* in Miquel, Fl. van Ned. Ind. 3: 58, and Kerch., Palmiers 250 (1878)]. Type: Lectotype here chosen. Illustration in Griffith, Palms Brit. E. Ind. t. 226.C (1850).

Livistona cochinchinensis (Blume) Mart., Hist. nat. palm. 3: 242 (1849); Beccari and Hooker f., Fl. Brit. India 6: 434 (1892). *Saribus cochinchinensis* Blume, Rumphia 2: 49 (1838). Type: not designated.

Livistona hoogendorpii Hort. ex Teysm. and Binn. ex Miq., Palm. archip. ind. 14 (1868) [as *L. Hoogendorpi*]; Teysmann and Binnendijk, Cat. 'slands Plant. Buitenzorg 71 (1866), *nomem*; Ill. Hort. 21: 108, 121, t. 174 (1874); Kerchove, Palmiers, t. 32 (1878). *Saribus hoogendorpii* (Hort. ex Teysm. and Binn. ex Miq.) Kuntze, Revis. gen. pl. 736 (1891). Type: Lectotype here chosen. Indonesia. Cultivation. Bogor Botanic Gardens, May 1878, *Beccari s.n.* (lectotype FI, Beccari collection, sheets 11330 and 11330-B).

Livistona hasseltii (Hassk.) Miq., Palm. archip. ind. 14 (1868) [as *L. Hasselti*]; H. Wendl., in Kerch., Palmiers 250 (1878); Backer and Bakhuizen van der Brink, Fl. Java 3: 174 (1968). *Saribus hasseltii* Hassk., Flora 2: 16 (1842). Type: Indonesia. Batam Prov., Tjikoi and Tjilakatan, undated, *van Hasselt s. n.* (type not located).

Livistona inaequisecta Becc., Philipp. J. Sci. 4: 616 (1909). Type: Philippines. Laguna Prov., Santa Maria Mavitae, Feb. 1908, *Curran 10079* (holotype PNH).

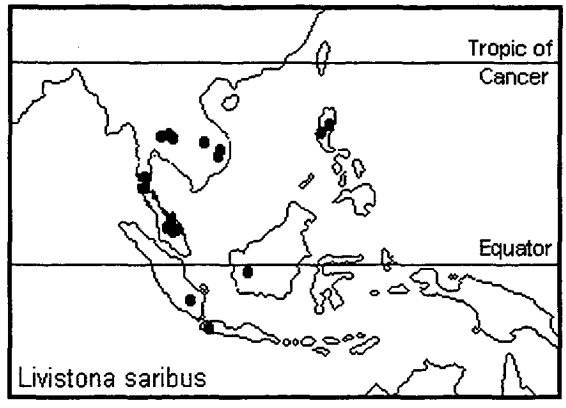
Livistona tonkinensis Magalon, Contr. étude Palmiers Indoch. 54 (1930) ***syn. nov.***; Feddes Repert. Spec. Nov. Regni Veg. 28: 239 (1930); Feddes Repert. Spec. Nov. Regni Veg. 29: 23 (1931); Gagnepain, Fl. Indo-Chine 6: 983 (1937). Type:

Lectotype here chosen. Vietnam. Rivieré Noire and the middle region of the Tonkin River, 25 Jan 1930, *M. Magalon s. n.* (lectotype P).

Functionally dioecious palm. **Trunk** to 40 m tall, 15-65 cm dbh, erect, leaning, broader at the base, nodes raised, internodes 2-15 cm long, petiole stubs persistent in the basal 2 m or so. **Leaves** 25-30 in an oblong to globose crown; petiole arching, 100-200 cm long, to 12 cm wide in proximal portion, to 15 mm wide in distal portion, adaxially flat to slightly ridged, abaxially rounded, glabrous, green to green-purple to green-red, glossy; margins with large, single, kris-like, green to brown spines 1-6 cm long, larger and closer in the proximal portion; leaf-base fibres moderately fibrous, coarse, persistent; lamina sub-circular, 80-200 cm long, 150-170 cm wide, adaxially green, abaxially a similar green; segments 80-90, irregularly divided into groups of 2-12 separated from adjacent groups by a deep split that almost reaches the hastula; segments 3-7 cm wide at the disjunction, free portion 37-78% of their length, apical cleft 19-50% of the length of the free segment, apical lobes pendulous; parallel veins 6-7 each side of midrib, more prominent than transverse veins which are thin, extending across 2-5 parallel veins, density c. 19 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 60-230 cm long, curving; partial inflorescences 4-9, branched to 4 orders, 45-60 cm long; prophyll not seen; peduncular bracts lacking; rachis bracts loosely sheathing, glabrous; rachillae 15-45 cm long, glabrous, drooping, yellow. **Flowers** in clusters of 3-5, 1.5-1.75 mm long, yellow; sepals suborbicular; petals broadly triangular, obtuse; anthers broadly ovate-suborbicular; pollen ellipsoid, c. 43 μm long, c. 25 μm wide. **Fruit** globose, or ellipsoid to reniform, 11-25 mm long, 10-18 mm diam., often bilobed, glossy, blue to purple; epicarp thin with scattered lenticellular pores; suture line extends for full length of the fruit, marked with lip-like structures; mesocarp fleshy, 1-1.5 mm thick; endocarp crustaceous; pedicel 1-3 mm long, c. 3 mm wide. **Seed** globose to ellipsoid, 9-24 mm long, 9-10 mm diam., apically mucronate, grey; endosperm intruded for about half its width; embryo lateral. **Eophyll** 6-8-ribbed. *Serdang, sar (Trengganu).* Fig. 2.15.

DISTRIBUTION. Laos, Vietnam, Kampuchea, Thailand, Malaysia, Indonesia and the Philippines [2°S-22°N]. Widespread but rare in Laos, Vietnam and Kampuchea, Thailand and Malaysia due to forest clearance. In Indonesia confined

to Batam, Sumatra and Kalimantan, and in the Philippines on Luzon, in Cagayan and Laguna Provinces. The dots on the map represent 26 collections.



HABITAT AND ECOLOGY. In rainforest as scattered individuals or in small to very large colonies, at 0-600 m alt. Occurs in peatforest and mangroves in central Sumatra (Dransfield, 1974; Laumonier, 1997). Occasionally in watercourse beds and adjacent slopes. Flowers Mar.-July; fruits June-Sept.

COMMON AND LOCAL NAMES. Philippines, Tarao (Cagayan Prov.).

SPECIMENS SEEN. VIETNAM: West Tonkin, undated, *M. P. Bonn 6184* (P); Cay Ke, July 1866, *L. Pierre 4837* (A, BO, L, P, UC); Cay Ke, 28 Mar. 1921, *M. Poilane* 1222 (BO, P). Location not specified, June 1918, *Lecomte s. n.* (P). KAMPUCHEA: Foret de Phnom Penh, 16 Feb. 1934, *M. Bejaud s. n.* (P). THAILAND: Ta Sumet, Nakawn Sritamarat, less than 50 m alt., 28 Jan. 1928, *A. F. G. Kerr 14313* (BM, NY); Phitsanulok, 7 km E of Tung Salaeng Luang, 600 m alt., 23 July 1966, *Kai Larsen 792, with T. Smitinand & E. Warncke* (AAU); Ranong, Klaeng, Nam Groi (outside N. P.), farmland on boundary of park, 17 Dec. 1986, *G. Smith 132, with Watana Sumawong* (AAU); Krabin, Bupram, 500 m alt., 4 Jan. 1925, *A. F. G. Kerr 9836* (AAU, NY); Songkhla, Kha Kok Hng, Hatyai, 07°00'N, 100°20'E, 150-250 m alt., 11 Nov. 1990, *Kai Larsen 41280* (AAU). MALAYSIA: Trengganu, Kemaman, Compt. 4, Rasau Kerteh Ulu Chukai F. R., 2 June 1962, *Meijer & F. C. Yong 94940* (KEP, SING); Perak, Gunong Pondok, c. 700 ft alt., 7 June 1930, *M. R. Henderson s. n.* (BO, SING); Selangor, Tanjong Karang, Sungai Tingi, low alt., 19 Oct. 1937, *M. Nur 34149* (A, BM, L, K, SING); Selangor, 5 July 1902, *A. Burn-Murdoch s. n.* (K); Selangor, Jugua, 1902, *A. Burn-Murdoch 11352* (BM). INDONESIA: Kalimantan. Djaro Dam, Muara Uja, 100 m alt., 13 Nov. 1971, *J. Dransfield & Sauerudin 2141* (BO); South Sumatra. Rasau, Waikambas Reserve, 10 m alt., 17 Feb. 1971, *J. Dransfield 1245* (BO); Java. Track to Tjisunar, Udjang Kulai, 17 Apr. 1071, *J. Dransfield 1459* (BO); Java. Bantam, Tjimura, 2 Aug. 1892, *S. H. Koorders 35163* (BO); Java. 5 Feb. 1899, *S. H. Koorders 35163* (BO). PHILIPPINES: Luzon. Zambales, Pannubuan, hills between San Marcelino and Mt

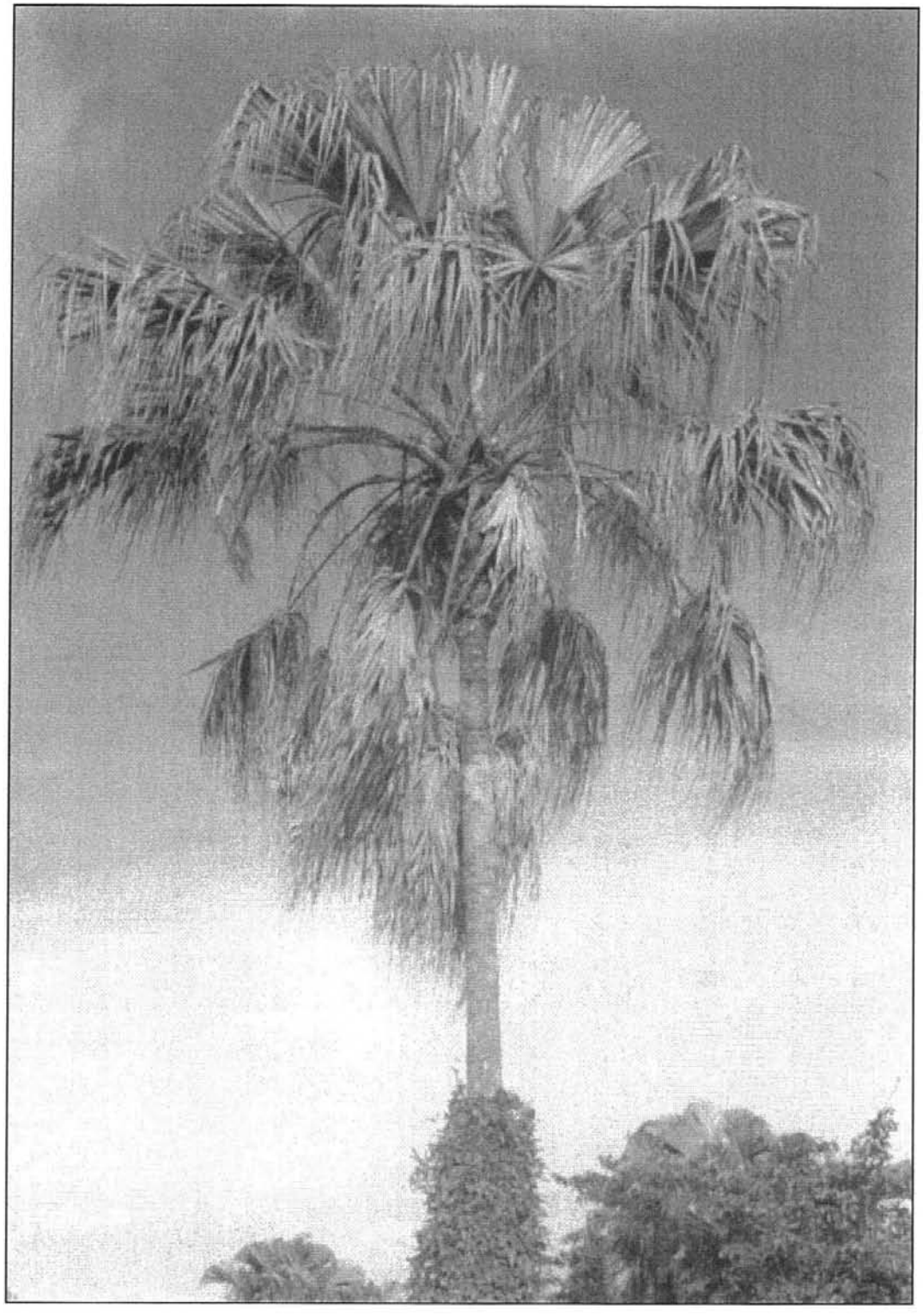


Figure 2.15. ***Livistona saribus***. Habit, Chumphon, Thailand.

Pinatubo, 28-29 May 1935, *H. H. Bartlett 14236* (K); Luzon, Nueva Vizcaya, c. 350 m alt., 24 Apr. 1987, *E. S. Fernando 7286* (K); Nueva Vizcaya Prov. Diadi, Magat, 350 m alt., 24 Apr 1987, *E. S. Fernando EF671* (LBC). CULTIVATION: Indonesia. Bogor Botanic Gardens, May 1878, *Beccari s. n.* (FI); Singapore Botanic Gardens. 13 Oct. 1937, *C. X. Furtado 34149* (US); Vietnam. Saigon Botanic Garden, 3 Oct. 1936, *M. Poilane s. n.* (P, PNH, UC).

NOTES. *Livistona saribus* is a variable species with some distinct regional forms, mainly expressed in fruit size, but otherwise unable to be reliably taxonomically differentiated. Dransfield (1999) noted the over-description of palm taxa based on political boundaries, with particular reference to *L. saribus* and its synonyms, with *L. hasseltii* and *L. hoogendorpii* originally named for Java, and *L. cochinchinensis* for Peninsula Malaysia, Indochina and the Philippines. The taxonomy of *L. saribus* is the most complex for all the Livistonas. There is also a paucity of type specimens, with only four of the eight names having been typified.

Livistona saribus was first named as *Corypha saribus* (Loureiro, 1790) for plants collected from Vietnam, based on the specimen *Loureiro s. n.* [P] but this specimen was unable to be located and is presumed lost (M. Pignal [P], pers. comm.). The species name was taken from the Rumphian mononomial *Saribus*, the vernacular name used by the Macassans of eastern Indonesia. Devansaye (1875) provided the first listing under *Livistona* but this combination had no nomenclatural validity as it was only a name included in a list of species. Chevalier (1919) applied the first formal combination. A neotype needs to be chosen for *L. saribus*.

Livistona cochinchinensis was first named, as *Saribus cochinchinensis* by Blume (1838), who based it in part on Loureiro's *C. saribus* and Brown's *C. australis*, and suggested that *S. cochinchinensis* was the appropriate name for the species occurring in Cochinchina (Vietnam). It was transferred to *Livistona* by Martius (1838) who similarly related it to Loureiro's *C. saribus* but also, in part, to Griffith's *L. jenkinsiana*. Miquel (1855) suggested that *L. cochinchinensis* was a synonym of *L. chinensis*, but did not elaborate. Beccari (1886) clearly recognised the conspecifity of *L. cochinchinensis* and *L. saribus* but refrained from making the appropriate combination based on the earliest name, stating " *Il nome di L.*

cochinchinensis, è per questo da preferirsi, come più antico." Beccari (1921, 1931) continued this scheme, despite the formalisation of *Livistona saribus* (Chevalier, 1919; Merrill, 1925). However, most taxonomists have listed it correctly as a synonym (Burret, 1936, 1941; Moore, 1963b; Pei *et al.*, 1991).

Griffith (1844) described *Livistona spectabilis* for plants collected from Malacca, Malaysia, possibly with the name referring to the remarkable height attained by the palm. The cited specimen, *Penang, Mr Lewes*, is not extant, and the illustration, Tab. 226.C, provided by Griffith (1850) in a subsequent description, is hereby chosen as the lectotype. Beccari (1886) included *L. spectabilis* as a synonym of *L. cochinchinensis* and it is therefore a synonym of *L. saribus.*

Teysmann and Binnendijk (1866) first used the name *L. hoogendorpii* in a list of palms cultivated in Bogor Botanic Gardens, with no explanation for the choice of specific epithet. Miquel (1868) provided the first description thus formalising the name, and André (1874) described and illustrated juveniles in cultivation in Europe. Kerchove (1878) provided a brief description and an illustration of a juvenile plant. Beccari visited Bogor Botanic Gardens in May 1878 and collected specimens from the plants upon which Teysmann and Binnendijk established the name, and those specimens, sheets 11330 and 11330-B in FI are here chosen as the lectotype. Although indigenousness of the species remained unknown, Blatter (1926) noted the habitat as the "*Indian Archipelago*". Moore (1963b) was the first to designate *L. hoogendorpii* as a synonym of *L. saribus.*

Livistona hasseltii was described by Hasskarl (1842) as *Saribus hasseltii* from a collection by *van Hasselt s. n.* [location unknown], from Batam Prov. in Indonesia, and named for the collector, the Dutch botanist J. C. van Hasselt [1797-1823]. Miquel (1868) provided the transfer to *Livistona.* The name has been applied to plants growing in Bogor Botanic Gardens, and cited in Backer and Bakhuizen van der Brink's (1968) Flora of Java, although with the proviso that it "...may be only a form of continental *L. saribus*...".

Livistona inaequisecta was described by Beccari (1909) from the collection *Curran 10079*, from Luzon in the Philippines, and named for the "*unequally parted*" leaves. Beccari (1919a) placed it as a synonym of *L. cochinchinensis*.

The name *L. vogamii* was first used as a horticultural name for *L. cochinchinensis* (Beccari, 1921, 1931), and *L. tonkinensis* was applied to a population in the Tonkin region of Vietnam by Magalon (1930) based on his own collection now in P. These names are hereby synonymised under *L. saribus*.

16. *Livistona exigua* J. Dransf., Kew Bull. 31(4): 760 (1977). Type: Brunei. Belait District, Ulu Ingei, c. 60 m alt., Aug. 1959, *Ashton BRUN 5513* (holotype K; isotypes BH, BO, L, NY, SAR).

Small understorey palm. **Trunk** to 5 m tall, 1.5-2.5 cm dbh, erect, cylindrical, slightly broader at the base, nodes raised, irregular in width, internodes c. 4 mm long, irregular in length, pale brown, petiole stubs not persistent. **Leaves** 16-20 in a vertically ovate crown; petiole 40-60 cm long, slightly arching, proximally c. 6 mm wide, tapered to c. 3 mm wide distally, flat adaxially, rounded abaxially, armed on the margins in the lower one-third, upper margins sharp, slightly winged, spines kris-like, brown, to 4 mm long, bases swollen, reflexed, regularly placed at c. 5 mm apart, petiole surface with scattered caducous pseudo-parenchymatous peltate scales on both surfaces; leaf-base fibres prominent, coarse, closely netted, dull dark brown, persistent; ligule to c. 30 cm long; lamina circular, c. 50 cm wide, midgreen adaxially, lighter green abaxially, glabrous adaxially, scattered brown scales abaxially; segments 16-30, single or grouped, irregular, united portions with 2-6 segments, apices pendulous with age; segments to 25 cm long, widest at mid segment 1-1.5 cm wide, acuminate toward both apex and base, free for c. 42% of their length, apical cleft c. 8% of the length of the free segment, apices finely toothed, rigid; parallel veins 5-6 each side of midrib, ± equal to transverse veins, which extend across 2-3 parallel veins and have a density of c. 25 per unit area of 15x10 mm; hastula conspicuous, to 5 mm wide and 2-3 mm high. **Inflorescences** not branched at the base, 15-40 cm long, straight to slightly curving; partial inflorescences 3-4, branched to 2 orders;

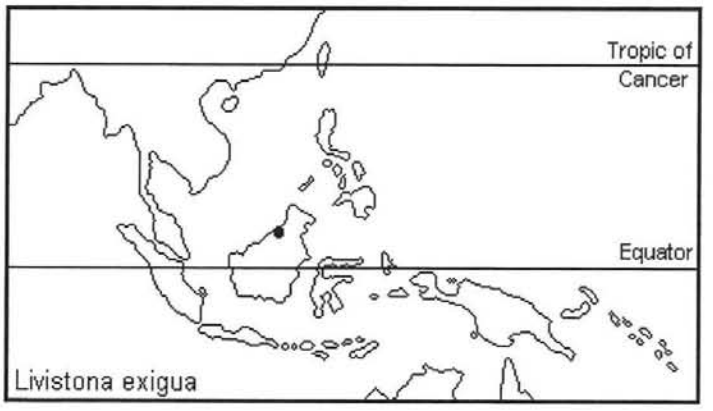
peduncle 20-25 cm long, elliptical in cross-section; prophyll tubular, to 18 cm long, dark brown with pale brown scurfy indumentum along the keels, minutely longitudinally striate, ancipitous, the apices acute; peduncular bract lacking; rachis bracts loosely tubular; partial inflorescence axes densely covered with indumentum and papillae; rachillae 6-10 in each partial inflorescence, 6-10 cm long, rigid. **Flowers** solitary or paired, sessile, purplish, subtended by a fimbriate bract c. 0.2 mm high, c. 1 mm diam; sepals fused for about half their length to form a short tube c. 0.3 mm high, lobes c. 0.2 mm high, rounded, fimbriate, abaxially densely covered with indumentum; petals broadly triangular, glabrous, c. 0.4 mm high, basally fused for about one-quarter their length; stamens c. 2 mm high, basally fused, swollen; anthers minute; pollen yellowish; carpels glabrous, style c. 0.2 mm high. **Fruit** globose, c. 9 mm diam., purplish green; epicarp smooth; suture line extending the full length of the fruit; mesocarp c. 1.5 mm thick with numerous tannin cells; endocarp crustaceous, c. 0.3 mm thick; pedicel 1-2 mm long. **Seed** globose, brown, intruded by the testa. Fig. 2.16.

HABITAT AND ECOLOGY. In forest transitional between lowland Dipterocarp forest and kerangas (heath forest) on sandstone at 60-260 m alt.

SPECIMENS SEEN. BRUNEI: Belait District. Ulu Ingei, Bukit Batu Patam, 04°5'N, 114°42'E, 200 m, ridgetop kerangas forest, transitional to mixed Dipterocarp forest, abundant miniature serdang forming thickets on ridge tops, 9 June 1989, *J. Dransfield JD6568 with Wong Khoon Meng, S. Dransfield & P. C. Boyce* (A, SING); Ulu Ingei, 150 m alt., Jan 1982, *P. R. Morgan s. n.* (SING).

DISTRIBUTION. Brunei. Belait District, Ulu Ingei [4°N]. The dot on the map represents three collections.

NOTES. *Livistona exigua* was described by Dransfield (1977) based on the collection *Ashton BRUN5513* [K] collected from the Belait District, Brunei, in 1959, and named with reference to the palms small stature. This collection had remained as unmounted material in Kew, but after examination by Dransfield was described as a new species. It has provided a considerable ecological extension for the genus, as a rainforest understorey palm in kerangas heath was hitherto not recorded in *Livistona*.



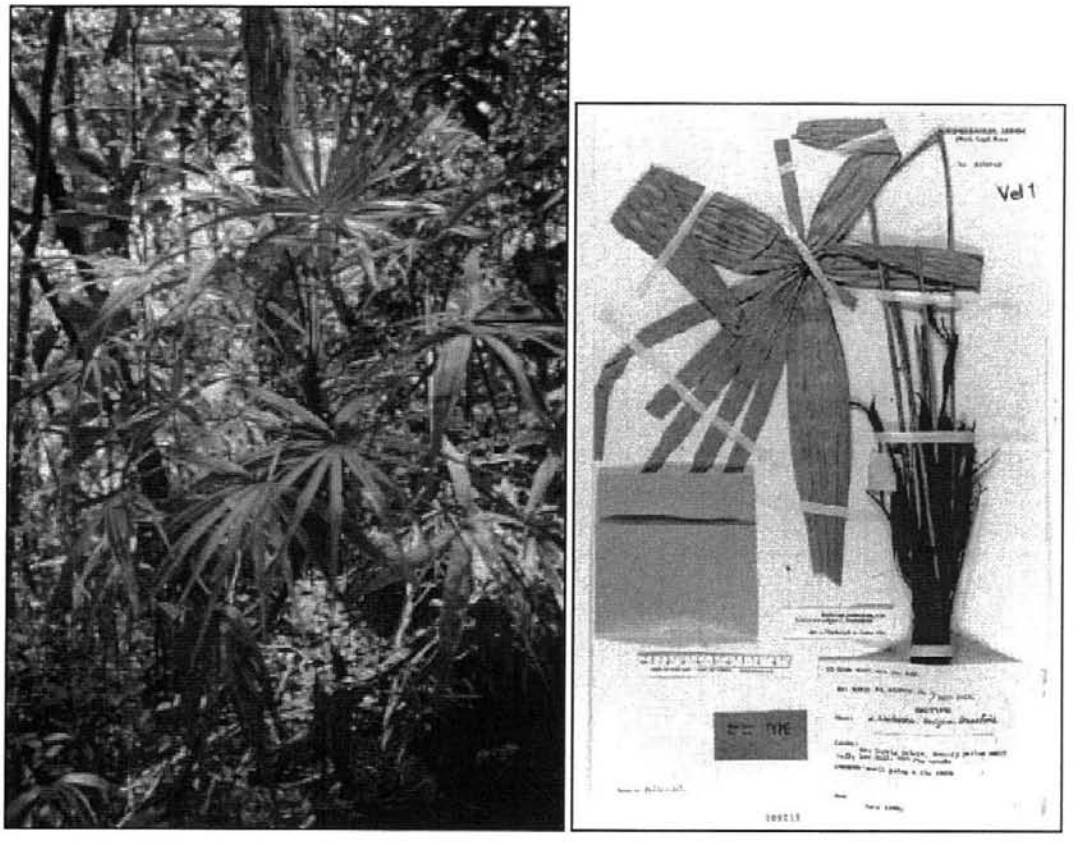


Figure 2.16. ***Livistona exigua.*** ***Left:*** Habit, Ulu Ingei, Brunei. ***Right:*** Type specimen, *Ashton BRUN 5513* (L), Belait District, Brunei, 1959.

17. *Livistona muelleri* F. M. Bailey, Queensl. fl. 5: 1683 (1902). *Livistona humilis* R. Br. 'var.', F. M. Bailey, Queensland Agric. J. 2: 130 (1898). Type: Australia. Queensland, Cairns, Oct. 1900, *E. Cowley s. n.* (holotype BRI; isotype FI).

Livistona humilis R. Br. var. *sclerophylla* Becc., Webbia 5: 76 (1921). Type: Lectotype (*fide* Rodd, 1998). Australia. Queensland, Bloomfield R., *Miss Ellis Bauer 3* (lectotype FI).

Livistona humilis R. Br. var. *novoguineensis* Becc., Webbia 5: 76 (1921). Type: Indonesia. Papua, Merauke Division, Merauke River, Apr. 1901, *Jaheri s. n.* (holotype FI; isotype BO).

Livistona brassii Burret, Notizbl. Bot. Gart. Berlin-Dahlem 12: 309 (1935). Type: Papua New Guinea. Western Prov., Dagwa, Oriomo R., Feb. 1934, *L. J. Brass 5950* (holotype A; isotypes BM, BO, BRI, NY).

Livistona crustacea Burret, J. Arnold Arbor. 20: 189 (1939). Type: Papua New Guinea. Western Prov., Middle Fly R., Lake Daviumbo, Sept. 1936, *Brass 7668* (holotype A; isotypes A, BO, BM, BRI, L; photos BRI).

[*Corypha juncea*, in mss, D. Solander, Plantae Novae Hollandiae 3: 158 (1768-71)].

Functionally dioecious palm. **Trunk** to 12 m tall, 15-25 cm dbh, grey, nodes raised, internodes congested, petiole stubs persistent, or deciduous with extreme age or fire. **Leaves** 25-35 in a globose crown, held erect; petiole 70-100 cm long, 14-20 mm wide, triangular in cross section, adaxially channelled, abaxially rounded, margins with single curved black spines 2-12 mm long throughout, largest and closer spaced in the proximal portion; both adaxial and abaxial surfaces with rows of corky scales, persistent, at first red-brown aging to grey; leaf-base fibres not prominent, fine, disintegrating; lamina circular, 60-90 cm long, rigid, flat, chartaceous, adaxially olive green to grey green, abaxially dull bluish green, glabrous except for a few scales on ribs; segments regular, 48-60,

rigid, free for 50-65% of their length, apical cleft 5-14% of the length of the free segment; apical lobes acute, rigid; parallel veins c. 8 each side of midrib, very prominent; transverse veins very thin, extending across 2 parallel veins, density c. 13 per unit area of 15x10 mm. **Inflorescences** not branched at the base, apparently not sexually dimorphic, 80-160 cm long; partial inflorescences 5-10, branched to 4 orders; peduncular bracts lacking; rachis bracts loosely tubular, with silver scales, splitting and disintegrating with age, but margins not lacerate; rachillae minutely papillose, 2-13 cm long. **Flowers** solitary or in clusters of 2-3, 1.3-1.6 mm long; sepals broadly triangular, 0.8-1 mm long, maroon, fleshy, cuspidate; petals ovate, 1.3-1.6 mm long, yellow, subacute; stamens c. 1.4 mm long, yellow; pollen ellipsoid, c. 23 μm long, c. 19 μm wide; carpels pink to maroon. **Fruit** ellipsoid, 10-12 mm long, 8.5-10 mm diam., reddish black or bluish black, dull; epicarp smooth, pruinose; suture line extends for full length of the fruit, marked with lip-like structures; mesocarp thin, dry; endocarp very thin, brittle; pedicel 0.5-1 mm long. **Seed** globose, 8-9 mm long. **Eophyll** 3-ribbed. *Cairns fan palm*. Fig. 2.17.

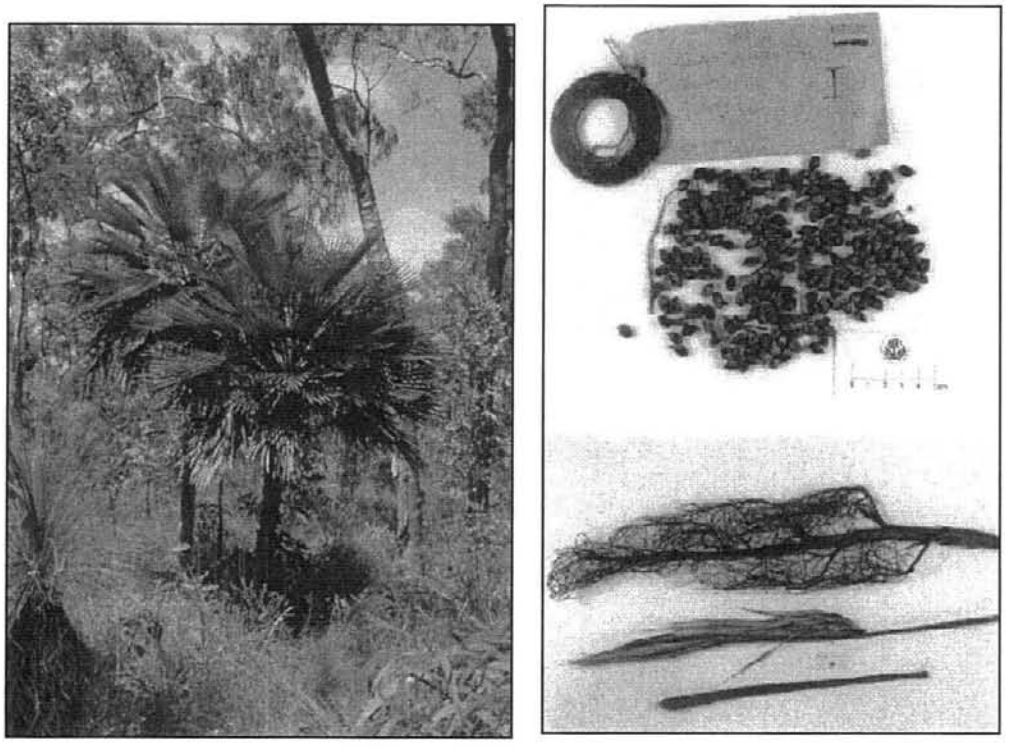
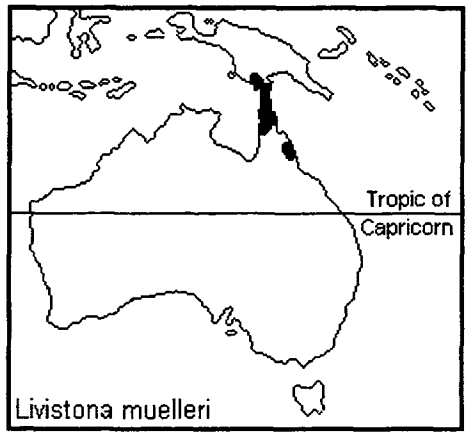


Figure 2.17. ***Livistona muelleri.*** ***Left:*** Habit, near Jardine River, Cape York Peninsula, Australia. ***Right:*** Type specimen, *E. Cowley s. n.* [BRI], Cairns, 1900.



DISTRIBUTION. Australia, Indonesia and Papua New Guinea [8-17°S]. In northern Queensland from the Torres Strait islands to Innisfail. In Papua New Guinea in the Western Prov.; and in Indonesia, in Papua, Merauke Division. The dots on the map represent ten collections.

HABITAT AND ECOLOGY. Grows in grassy open forest, woodland, moist sclerophyll forest, and less commonly on the margins of vine thickets, 0-300 m alt. Flowers Sept.-Mar.; fruits Nov.-May.

SPECIMENS SEEN. AUSTRALIA: Queensland. Prince of Wales Is., Torres Strait, *E. Cameron 20335* (QRS); between Nesbit and Chester Rivers, *B. Hyland 6834* (QRS); Starke Homestead, along track 7.5 km N, 14°59'S, 145°08'E, c. 40 m alt., 7 Aug. 1978, *A Kanis 1947* (L); Daintree River, *P. Hind 216* (QRS); Captain Cook Hwy, W side of road, 2.5 km N of the Cook Hwy and Kennedy Hwy junction, *A. K. Irvine 1777* (QRS); Trinity Beach, 16°47'S, 145°42'E, 24 Aug. 1957, *L. S. Smith, & L. Pedley 10001* (L); NW of Walsh R., 7.2 km NW of Nolans Ck, 16°45'S, 144°06'E, 200 m alt., 19 Oct. 2000, *J. L. Dowe 608* (BRI). PAPUA NEW GUINEA: Western Prov. Daua [Daru] Island, 09°05', 143°10'E, 70 m alt., 5 Oct. 1972, *A. N. Gillison 45* (LAE). INDONESIA: Papua. Merauke Division, road from Mopa Airstrip to Manggatrikke, c. 10 m alt., 2 Aug. 1954, *van Royen 4545* (BO, K, LAE); Papua. Merauke Division, *Jaheri 197* (BO); Merauke Division, *Jaheri s. n.* (BO).

NOTES. *Livistona muelleri* was first recognised as distinct and described as '*L. humilis* R. Br. 'var.'' by Bailey (1898), and then as *L. muelleri* in 1902 based on the collection *Cowley s. n.* [BRI] (Fig. 2.17) collected from Cairns, Queensland. It was named for Ferdinand von Mueller [1825-1896], Victorian Government botanist, 1853-1896. Previously, Solander (1768-1771) had included it as the manuscript name '*Corypha juncea*' in his hand-written *Plantae novae hollandiae,* based on plants he saw near the Endeavour River, Queensland, but this account

was never published. Previous to Bailey's account, Wendland, in a contribution to Kerchove (1878), used the name *Livistona mülleri* in a list of Australian palms, but this was merely a name in a list without a description or reference to specimens and therefore a *nomem nudum* (see section 2.7). Bailey (1898) made no reference to Wendland's *Livistona mülleri* and I assume there is no connection with Bailey's choice of the name *L. muelleri* to Wendland's use. Bailey named both *L. muelleri* and *L. benthamii* to honour the authors of *Flora Australiensis*.

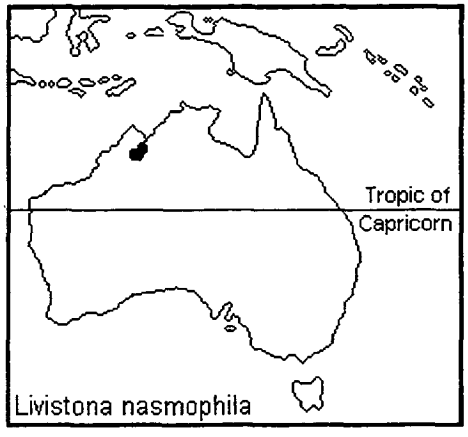
Beccari (1921) described two varieties of *L. humilis* that are attributable to *L. muelleri*: *L. humilis* var. *sclerophylla*, based on *Bauer 3* [FI] from the Bloomfield River, Queensland, and *L. humilis* var. *novoguineensis*, based on *Jaheri s. n.* [FI], from Merauke, Papua, Indonesia.

Burret (1935, 1939) described *L. brassii* and *L. crustacea* from Western Prov., Papua New Guinea, based on the collections *Brass 5950* [A] and *Brass 7668* [A] respectively. Rodd (1998) synonymised both taxa under *L. muelleri*.

Although the relationships of *L. muelleri* are obscure, its closest resemblance is to *L. eastonii* from the Kimberleys, Western Australia. However, this may be an example of ecological convergence, and its true relationships may possibly be with moist forest species such as *L. benthamii*, with which it shares at least a close association in distribution. *Livistona muelleri* also bears some resemblance to *L. fulva* of central Queensland, with similarity in both leaf and inflorescence morphology.

18. *Livistona nasmophila* Dowe and D. L. Jones, Flora of Australia 39 (*ined.*). *Livistona mariae* subsp. *occidentalis* A. N. Rodd, Telopea 8: 81 (1998). Type: Australia. Western Australia, Durack Range, SE base of Mt King, *A. N. Rodd 2868* (holotype NSW; isotypes BH, K, PERTH, QRS).

Functionally dioecious palm. **Trunk** to 30 m tall, 30-60 cm dbh, grey, nodes raised, internodes 2-10 cm long, petiole stubs persistent in basal 1 m. **Leaves** 35-55 in a dense globular crown; petiole 165-230 cm long, 4-10 cm wide, triangular in cross section, adaxially flat, abaxially rounded, margins with single or double kris-like reddish spines confined to the proximal portion, margin distally smooth; leaf-base fibres moderately prominent, coarse, persistent; lamina folded, circular, 130-175 cm long diam., rigidly coriaceous, adaxially glossy grey-green, adaxially dull grey to glaucous; segments regular, 52-58, apices rigid, or becoming semi-pendulous with age or as the result of damage; segments free for c. 48% of their length, apical cleft c. 48% of the length of the free segment; parallel veins very prominent, 7-9 each side of midrib; transverse veins very thin, extending across 2-3 parallel veins, density c. 9 per unit area of 15x10 mm. **Inflorescences** not branched at the base, apparently not sexually dimorphic, 260-300 cm long; partial inflorescences 9-11, branched to 5 orders; peduncular bracts 1 or lacking; rachis bracts loosely tubular, with scattered long scales, becoming fully glabrous with age, not disintegrating or becoming marginally lacerate; rachillae glabrous, 5-9 cm long. **Flowers** in clusters of 4-6, angular in bud, 1.4-1.5 mm long, cream to yellow; sepals ovate, c. 1.2 mm long, thin, acute; petals triangular, 1.4-1.5 mm long, obtuse; stamens c. 0.9 mm long; pollen ellipsoid, c. 35 μm long, c. 27 μm wide. **Fruit** globose, 11-14 mm diam., purple-black; epicarp with lenticellular pores; mesocarp fibrous, dry; endocarp thin, crustaceous; pedicel to 1 mm long. **Seed** globose, 7-11 mm long. Fig. 2.18.



DISTRIBUTION. Australia. Western Australia. In the Durack Range and Cambridge Gulf area [17-18°S]. The dots on the map represent four collections.

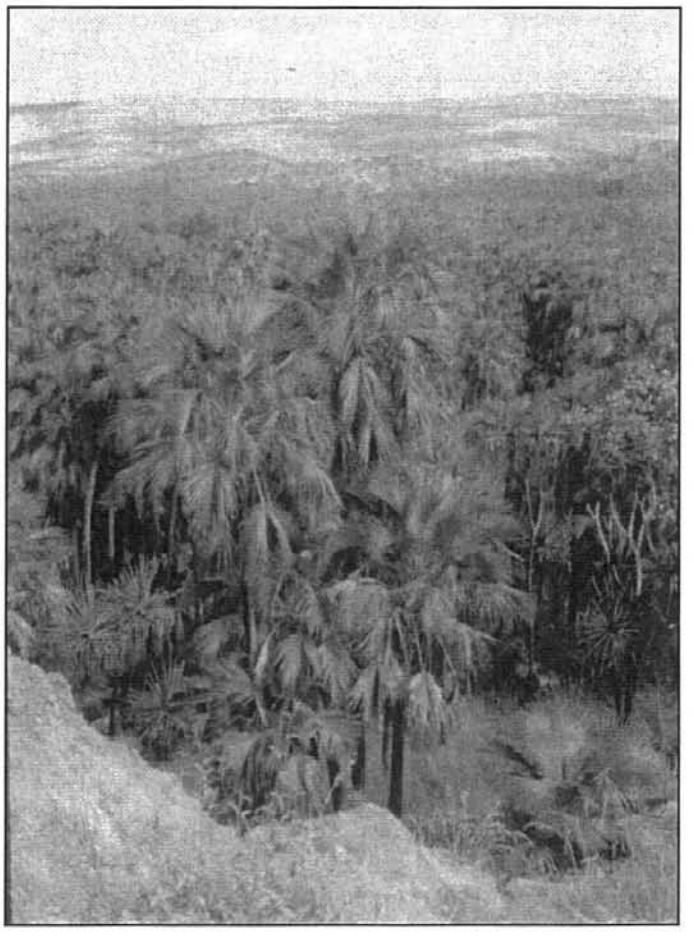


Figure 2.18. ***Livistona nasmophila.*** Habit, Zebedee Springs, Western Australia.

HABITAT AND ECOLOGY. Along intermittent or permanent water-courses, in open forest; occurs in very large colonies in some areas. Flowers July-Oct.; fruits Oct.-Dec.

SPECIMENS SEEN. AUSTRALIA: Western Australia. North-east Kimberleys, Bens Springs, 3 km E of El Questro Homestead, 16°01'S, 128°01'E, 29 June 1989, *K. F. Kenneally 10965* (PERTH). Cambridge Gulf, El Questro Station, Zebedee Springs, 16°02'S, 128°02E, 80 m alt., 5 May 1996, *J. L. Dowe 363* (BRI, FTG); Durack Range, SW base of Mt King, 17°20'S, 127°23'E, 24 Oct. 1974, *A. N. Rodd 2869* (PERTH); King Leopold Ranges, Mt Ord Gorge, 20 miles SSW of Mt House Station, 29 June 1959, *M. Lazarides 6453* (MEL).

NOTES. Rodd (1998) established this taxon as *L. mariae* subsp. *occidentalis*, based on the collection *Rodd 2868* [NSW], from Mt King, Western Australia. In the protologue, Rodd wrote: "Recognition of this population as a separate

subspecies on the basis of a single wild collection (and one from cultivation) is arguably rather premature". Following field-work in the Kimberleys, with collections of fruit and flowers from both wild and cultivated sources, I established that this taxon was distinct enough from both *L. mariae* and *L. rigida* to be raised to species level. However, the usual nomenclatural procedure would have been to take Rodd's varietal name '*occidentalis*' and use it as the specific epithet, but the name '*Livistona occidentalis*' had previously been used by Hooker (1884) as a synonym for *Brahea dulcis* Mart. and was therefore unavailable. The new name, '*nasmophila*' was chosen to illustrate the palm's habit of occupying permanent water-courses fed by springs, through much of its range.

The relationships of *L. nasmophila* are with *L. mariae*, but probably not as close as suggested by Rodd (1998). Petiole armature in *L. nasmophila* is considerably less than in *L. mariae*. In *L. nasmophila*, the inflorescence bracts are glabrous rather than tomentose, and branching of the partial inflorescences is to five rather than four orders. In *L. nasmophila*, fruit is purple-black rather than black as in *L. mariae*.

19. *Livistona decora* (Bull) Dowe, ***comb. nov.*** *Corypha decora* Bull, Catal. 10 (1887). Type: needs to be designated. See Notes below.

Livistona decipiens Becc., Webbia 3: 301 (1910). Type: Lectotype (*fide* Rodd, 1998). France. Cultivation. Nice, May 1908, *A. Robertson-Proschowsky* (lectotype FI).

Livistona decipiens var. *polyantha* Becc., Webbia 5: 15, 18 (1921). Type: Indonesia. Cultivation. Bogor Botanic Gardens, undated, *Beccari s. n.* (holotype FI, *n. v.*; isotype BO).

[*Livistona inermis auct. non* R. Br., Wendland and Drude, Linnaea 39: 229 (1875) *pro. parte*].

[*Livistona australis auct. non* (R. Br.) Mart., Bentham, Fl. austral. 7: 146 (1878) *pro. parte*].

Functionally dioecious palm. **Trunk** to 18 m tall, 25-30 cm dbh, brown in newly exposed parts, grey with age, nodes 1-2 cm wide, bare, internodes 2-15 cm long, smooth, with shallow vertical fissures, petiole stubs frequently retained at the base of the trunk. **Leaves** 30-60 in a broad, flattish crown; petiole 150-280 cm long, 18-24 mm wide, adaxially flat or slightly channelled, green throughout, margins with single curved black spines to 20 mm long in the proximal portion; leaf-base fibres moderately prominent, coarse, disintegrating; lamina ± circular 120-185 cm long, coriaceous, adaxially bright green, abaxially lighter green; segments regular, 70-84, free for 82-88% of their length, apical spilt 44-54% of the length of the free segment, apex deeply bifid, lobes pendulous; parallel veins 6-7 each side of midrib, more prominent than transverse veins which are thin, and extend across 2-5 parallel veins; transverse vein density c. 23 per unit area of 15 x 10 mm. **Inflorescences** not branched at the base, 100-350 cm long, with 8-13 partial inflorescences, branched to 4 orders; longest partial inflorescence to 110 cm, each subtended by a single rachis bract; prophyll 37 cm long, 11-16 cm wide, woody; peduncular bract lacking; rachis bracts glabrous to sparsely papillate; primary rachis bract tubular, apically fibrous-lacerate, bracts subtending each partial inflorescence basally tubular, becoming winged distally, apex pointed; in the most distal partial inflorescence there are 2 vestigial bracts at the base; peduncle more or less terete, 6 cm wide at the base, glabrous; rachillae minutely papillose, 5-20 mm long. **Flowers** solitary or in clusters of 2-6, funnel-shaped, 1.5-2 mm long, yellow; sepals ovate-triangular, c. 1.3 mm long, membranous, obtuse; petals broadly ovate, 1.5-1.8 mm long, fleshy, obtuse; stamens c. 1.5 mm long; pollen ellipsoid, monosulcate, c. 19.6 μm long, c. 15.6 μm wide. **Fruit** globose, 12-18 mm diam., black, shiny; epicarp with scattered lenticellular pores; suture line extends about ½ length of fruit; mesocarp 1-3 mm thick, spongy, moist, fibres aggregated toward the endocarp; endocarp thin, brittle; pedicel to 2 mm long; **Seed** globose, c. 10 mm diam.; intrusion ½-¾ across endosperm. **Eophyll** 5–ribbed. *Weeping cabbage palm, Ribbon fan palm.* Fig. 2.19.

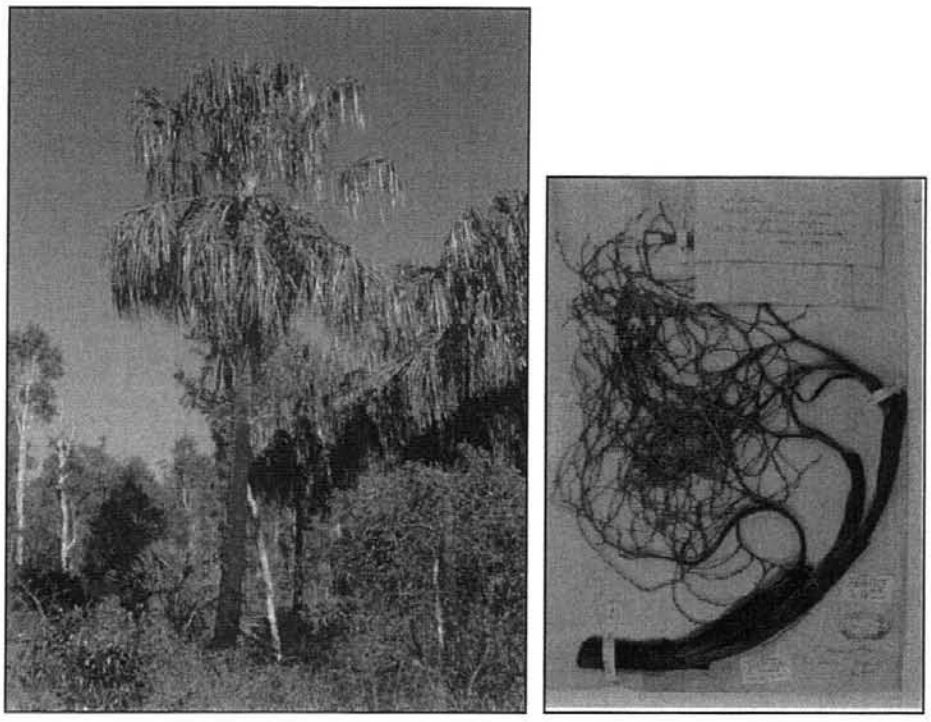
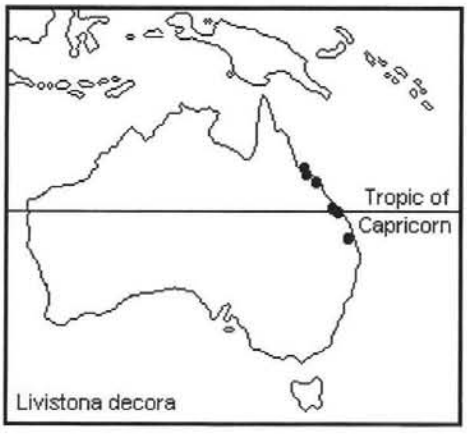


Figure 2.19. ***Livistona decora.*** ***Left:*** Habit, Cape Cleveland, Queensland, Australia. ***Right:*** Type specimen of *Livistona decipiens* Becc., *Robertson-Proschowsky s. n.* [FI], cultivation, Riviere, France, 1908.



DISTRIBUTION. Australia. Queensland. From Magnetic Is. near Townsville, south to Rainbow Beach [19-25°S]. The dots on the map represent six collections.
HABITAT AND ECOLOGY. Grows in coastal and near-coastal lowlands in large dense colonies or in scattered groups, in open forest, littoral rainforest and dry rainforest at low elevations. Flowers July–Dec.; fruits Dec.-Apr.

SPECIMENS SEEN. AUSTRALIA: Queensland. Magnetic Island, Gustav Creek, on track 1.5 km from Mandalay Rd, 10 Feb. 1996, *J. L. Dowe 250* (BRI, FTG); East Barratta Creek, near

Bruce Hwy, 21 Jan. 1977, *A. K. Irvine 1816* (QRS); 35 km NNE of Proserpine, E of Dingo Beach Road, on Earlando Beach turnoff, 13 May 1976, *A. N. Rodd 3077* (BRI); Joskeleigh, 15 miles E of Rockhampton, 17 Mar. 1964, *S. L. Everist 7634* (L); [Queensland] Moore's Creek Range, undated, *Thozet s. n.* (MEL); Tewantin, 25 June 1972, *S. T. Blake 23786* (BRI).

NOTES. The new combination chosen for this species is based on the name *Corypha decora* which was first used by Bull (1887) for plants introduced into horticulture from his nursery at Chelsea, and subsequently discussed by Watson (1889) in a paper on the cool cultivation of tropical and subtropical plants. Bull's (1887, p.10) description was: "*Corypha decora*: An elegant and ornamental species introduced from Queensland. It early develops characterized leaves, which are fan-shaped in outline and divided almost to the petiole into linear-lanceolate segments each about half-an-inch in breadth. The petioles are sparsely furnished with small hooked prickles. This species will undoubtedly be found one of the most useful of greenhouse palms". Watson's (1889, p. 294) account of this palm, included in the section on *Livistona*, included: "...The most interesting of this genus, however, is a very fine example of the rare *L. inermis* of R. Brown, in the gardens of Villa Valetta. It has a bare stem 6 feet high by 1½ feet in diameter at the base. The head is made up of a large number of shining green leaves, the petiole of which is 6 feet long and margined with spines at the base. The blade is divided almost to the base, and it has a distinct midrib that is curved so as to produce a very extraordinary effect. The form of the leaf may be called a combination of the pinnate and palmate characters. A plant of this rare palm is in the Kew collection; there is also a fine example of it in the collection at Blenheim. A large specimen was also noted in Baron Vigier's garden at Nice. Mr Bull distributed plants of it some years ago under the name of *Corypha decora*". The use of this name precedes that of *L. decipiens*, and is therefore the prior name. The descriptions provided by Bull and Watson are undoubtedly attributable to the taxon. The place of publication is also acceptable as the rules of nomenclature allow for the validation of names published at that time under such circumstances.

Beccari (1910) was apparently unaware of the use of the name *Corypha decora* when he named *Livistona decipiens* from the collection, *Robertson-Proschowsky s. n.* [FI] (Fig. 2.19) taken from a cultivated plant at Nice, France, and named for

the deception that it had caused as to its true identity: "....*il nome di L. decipiens, per gli errori di cui è stata causa*....". In cultivation in the Riviera during the mid to late 1800s it had incorrectly been referred to by local horticulturists as '*Copernicia cerifera*', and it was with the intention of clarifying the species' identity that Beccari provided the description and established the name. Although unaware of its origin, but suggesting that it came from eastern tropical Australia, Beccari (1931) related it to other Australian species, primarily *L. australis*. Despite it being well known and widely cultivated throughout the world, its indigenousness continued to remain speculative until relatively recent times. For example, Bailey (1976) noted (with reference to the name *L. decipiens*): "....described from cult., supposedly Australian....". The first unequivocal application of the name to natural populations was by Johnson (1981) who recorded distribution from Miriamvale to Townsville, Queensland.

Through the lack of understanding of the true identity of *L. inermis*, and the incorporation of misapplied specimens into descriptions, *L. decora* was inadvertently identified as that species. Both Wendland and Drude (1875) and Bentham (1878) cited the specimen *Thozet s. n.*, [MEL] from Moore's Creek near Rockhampton, central Queensland, now known to be of *L. decora* in their accounts of *L. inermis* and *L. australis* respectively. Upon this basis, many specimens in both the wild and in cultivation with a deeply segmented leaf were identified as *L. inermis sensu* H. Wendl. (Hill, 1873, 1875). It is highly probable that *L. inermis* R. Br. was never in cultivation in Europe as it is an exceedingly difficult plant to propagate (pers. obs.) and maintain while *L. decora* is exceptionally easy to germinate, one of the fastest growing and horticulturally adaptable species of *Livistona*.

Beccari (1921) described a variety, *L. decipiens* var. *polyantha*, from plants cultivated in Bogor Botanic Gardens based on *Beccari s. n.* [FI], but this is attributable to *L. decora*. *Livistona decora* is most closely related to *L. australis*, but is readily distinguished by the deeply segmented leaves and pendulous segment apices. The range of these species overlaps in the Fraser Island/Rainbow Beach area of south-eastern Queensland, and it may be that hybridisation has occurred as some individuals in that area are difficult to assign to either species.

20. *Livistona inermis* R. Br., Prodr. 268 (1810). *Saribus inermis* (R. Br.) Kuntze, Revis. gen. pl. 2: 736 (1891). Type: Australia. Northern Territory, Gulf of Carpentaria, Sir Edward Pellew Group, [island 'h'] North Is., 16? Dec. 1802, *R. Brown* (holotype BM; isotypes FI, K).

Functionally dioecious palm. **Trunk** to 10 m tall, 6-10 cm dbh, grey, nodes prominently raised, internodes congested, base with persistent petiole stubs. **Leaves** 10-30 in an open globose crown, usually arcuate to drooping; petiole 60-90 cm long, 6-10 mm wide, triangular in cross section, adaxially shallowly channelled or flat, abaxially rounded, margins with small single curved reddish to black spines to 5 mm long restricted to the proximal portion, distally smooth or with widely spaced small reddish to black calli; leaf-base fibres moderately prominent, coarse, persistent; lamina circular to sub-circular, 30-70 cm long, coriaceous, adaxially light green to green-grey, abaxially lighter green-grey glossy to lightly pruinose; segments regular, 24-48, widely spaced, rigid, free for 80-97% of their length, apical clefts 70-84% of the length of the free segment; apices pendulous, lobes acuminate to filiform; parallel veins prominent, 8-10 each side of midrib; transverse veins thin, extend across 2 parallel veins, density c. 11 per unit area of 15x10 mm. **Inflorescences** not branched at the base, apparently not sexually dimorphic, 40-90 cm long; partial inflorescences c. 3, branched to 3 orders; the most basal partial inflorescence about as long as the remainder of the inflorescence; prophyll 12-28 cm long, 2-3 cm wide, papyraceous, glabrous; peduncular bracts lacking; rachis bracts loosely tubular, papyraceous, glabrous, slightly pubescent toward the apex; rudimentary bracts subtend the distal partial inflorescences; rachillae glabrous, 1-9 cm long. **Flowers** solitary or in clusters of 2-3, funnel-shaped, 1.5-2.3 mm long, white to cream or yellow; sepals narrowly triangular, 0.7-1.4 mm long, membranous, acute; petals triangular to broadly ovate, 1.5-1.9 mm long, thick, acute to apiculate; stamens 1.5-1.6 mm long; anthers minute, bright yellow. **Fruit** obovoid to pyriform, 10-13 mm long, 6-7 mm diam., glossy black; epicarp smooth; suture line extends the length of the fruit, marked with lip-like structures; mesocarp fleshy; endocarp thin. **Seed** ellipsoid, 8-9 mm long. **Eophyll** 3-ribbed. Fig. 2.20.

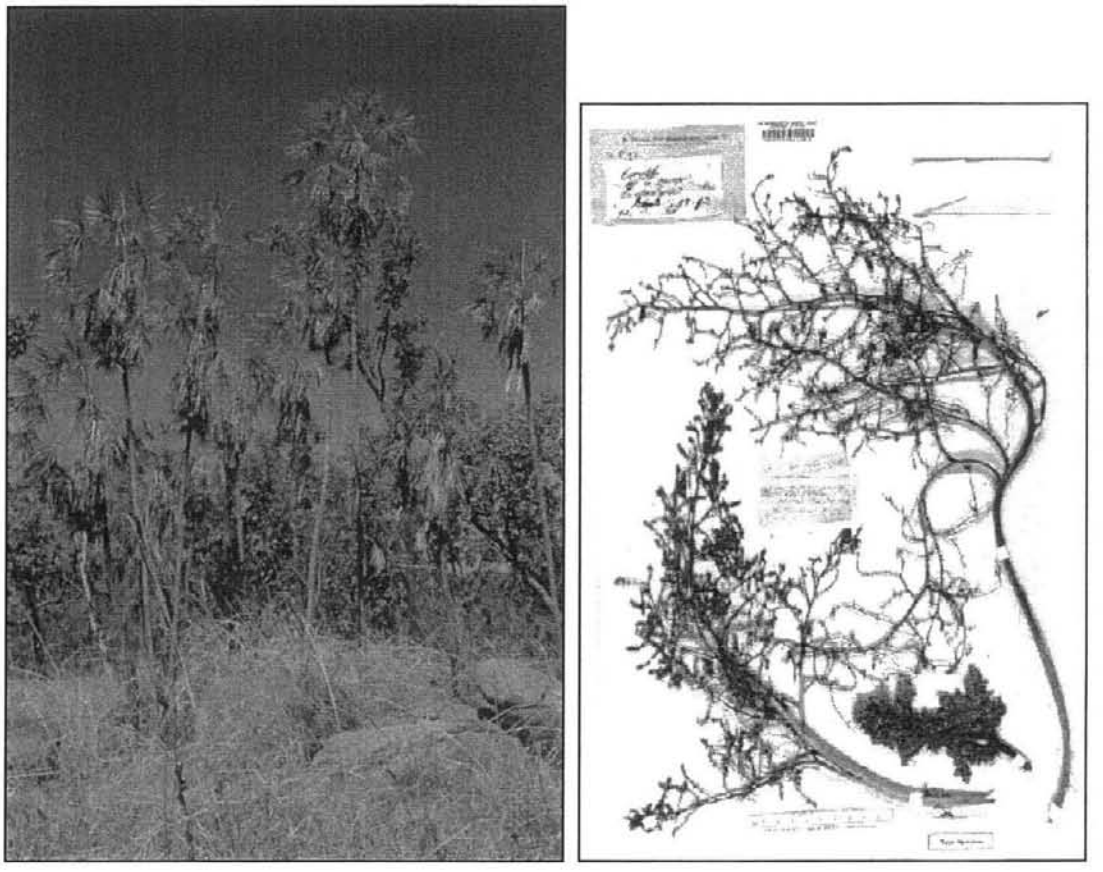
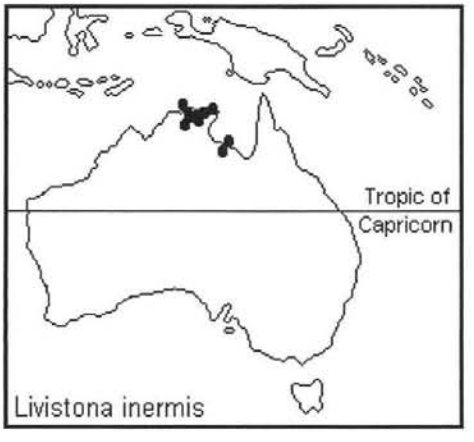


Figure 2.20. ***Livistona inermis.*** ***Left:*** Habit, Mt Bundey, Northern Territory, Australia. ***Right:*** Type specimen, *R. Brown s. n.* [BM], North Island, Gulf of Carpentaria, 1802.

DISTRIBUTION. Australia. Northern Territory and Queensland [11-18°S]. In the northern part of the Northern Territory from the headwaters of the Daly River across the Top End inland to Katherine. In north-western Queensland, including islands in western and southern Gulf of Carpentaria. The dots on the map represent nine collections.



HABITAT AND ECOLOGY. Grows in open forest and woodland and in sandstone gorges and outcrops. Flowers Aug.–Mar.; fruits June–Sept.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Melville Island, July–Aug. 1911, *W. Baldwin-Spencer s. n.* (MEL); 72 km E of Kakadu NP boundary on Kakadu Hwy, 12°46'S, 131°29'E, 20 m alt., 9 Jan. 1996, *J. L. Dowe 200* (BRI, FTG); Kakadu NP, 28 May 1980, *L. A. Craven 6053* (MEL); Banks of Liverpool River, Aug. 1819, *A. Cunningham s. n.* (M); W of Liverpool River, June 1869, *B. Gulliver s. n.* (MEL); headwaters of Liverpool River, 12°46'S, 133°44'E, 2 Apr. 1984, *L. A. Craven & G. M. Wightman 8410* (A, MEL); Katherine Gorge, *M. Lazarides 7040* (DNA, L); 90 miles S of Maningrida, 12°51'S, 134°32'E, 25 June 1972, *J. R. Maconochie 1581* (K); Queensland. Westmoreland Stn, near Burketown, 16 June 1991, *J. Birch* (BRI).

NOTES. *Livistona inermis* was one of two initial species described by Brown (1810) in establishing *Livistona*, based on the collection *Brown s. n.* [BM] (Fig. 2.20) collected from Sir Edward Pellew Islands, Gulf of Carpentaria, Australia in 1802, and named for the unarmed petioles. The other species was *L. humilis*. Many taxonomists have confused the identity of *L. inermis*. For example, Wendland and Drude (1875) established their description of *L. inermis* on specimens of what is now known to be *L. decora* while Bentham (1878) suggested that "...it may prove to be a variety only of *L. humilis*". Drude (1893) placed it as a possible synonym of *L. leichhardtii* (= *L. humilis*). Beccari (1931) applied considerable discussion as to the true identity of *L. inermis* and provided the first account that succinctly characterised the species, thus profoundly separating it from *L. humilis*. *Saribus inermis* was a combination proposed by Kuntze (1891).

Subsequent records of *L. inermis* in various flora and regional accounts have been somewhat variable. It was correctly recorded and described by Ewart and Davies (1917) and Blake (1954), while Specht and Mountford (1958) confused it with *L. humilis* and Chippendale (1972) identified it as *L. lorophylla*. Gardner (1930) named the Western Australian populations of *L. lorophylla* as *L. inermis*.

Livistona inermis appears to be most closely related to *L. lorophylla*, from which it is distinguished by its smaller size, both in height, stem diameter and lamina length; in having black rather than red spines on the petiole; by the absence of a peduncular bract; and by having glossy rather than dull pruinose fruit.

Rodd (1998) described *L. inermis* with a 'sometimes branching' trunk. Although the stem may be damaged and form 'spontaneous branching' ('freak branching' *cf.* Tomlinson, 1990), it is not a normally occurring event. Spontaneous branching is usually the result of physical damage to the apical meristem, with the result that a single apical meristem is able to create two or more branches. There is no genetic control in this form of branching as it is environmentally controlled. Davis (1988) reported similar cases of spontaneous branching for *L. chinensis* in cultivation in Singapore.

During field-work, I observed populations in which individuals were tightly grouped and may be incorrectly recognised as clustering. However, a close examination of these palms revealed that 'branches' were separate plants.

21. *Livistona benthamii* F. M. Bailey, Queensl. fl. 5: 1683 (1902) [as *L. Benthami*]. *Livistona humilis* R. Br., var., F. M. Bailey, Queensland Agric. J. 2: 130 (1898). Type: Australia. Queensland, Cape York Peninsula, Somerset, Dec. 1897, *F. L Jardine s. n.* (holotype BRI).

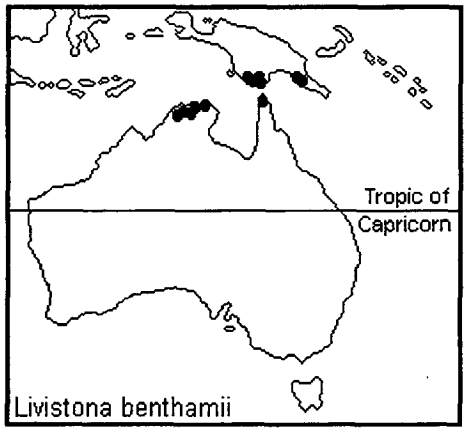
Livistona holtzei Becc., Webbia 5: 18 (1921). Type: Australia. Northern Territory, Port Darwin, undated, *Holtze s. n.* (holotype FI, *n. v.*).

Livistona melanocarpa Burret, J. Arnold Arbor. 20: 190 (1939). Type: Papua New Guinea. Western Prov., Daru Is., 9 Mar. 1936, *L. J. Brass 6310* (holotype BRI; isotypes A, BO, BM, L).

Functionally dioecious palm. **Trunk** to 18 m tall, 13-20 cm dbh, grey, nodes raised, internodes congested, petiole stubs long, persistent. **Leaves** 30-50 in a globose crown; petiole 120-200 cm long, 10-18 mm wide, adaxially moderately ridged, abaxially rounded, margins with single curved black spines congested in the proximal portion; leaf-base fibres prominent, coarse, persistent; lamina circular, 90-160 cm long, chartaceous, dark green adaxially, lighter green abaxially, glossy, non-waxy, segments regular, 50-80, free for 60-75% of their length, apical cleft for 60-75% of the length of the free segment; segment apices

pendulous, lobes acute; c. 8 parallel veins either side of midrib, more prominent than transverse veinlets which are thin and extend across 2-3 parallel veins; transverse vein density c. 19 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 120-210 cm long; 7-9 partial inflorescences, branched to 2 orders; prophyll not seen; peduncular bract lacking; rachis bracts tightly sheathing, light brown, with sparse scurfy silver scales; rachillae 5-12 mm long, patchily pubescent. **Flowers** solitary or in clusters of 2-3, tubular, whitish/cream to pale yellow; sepals triangular, 0.8-2 mm long, membranous, acute; petals broadly triangular, 1-1.3 mm long, fleshy, acute; stamens c. 1 mm long. **Fruit** globose to obovoid or pyriform, 9-13 mm long, 9-11 mm diam., purple-black, pruinose; epicarp smooth, suture line for the length of the fruit; pedicel 2-3 mm long. **Seed** ovoid, 8-9 mm long. Fig. 2.21.

DISTRIBUTION. Australia, Indonesia and Papua New Guinea [8-14°S]. In Australia in the Northern Territory from Daly R. across the Top End to eastern Arnhem Land, and in Queensland from Moa Is. in Torres Strait through Cape York to McIlwraith Range. In Papua New Guinea in the Western and Central Provinces, and in Indonesia in Papua, Merauke Division. The dots on the map represent 16 collections.



HABITAT AND ECOLOGY. Grows in swamp forests, on alluvial flats, on the leeward side of mangroves and in moist to wet areas in monsoonal thickets and gallery forests at low elevations. Flowers Sept.-Jan.; fruits Nov.-Apr.

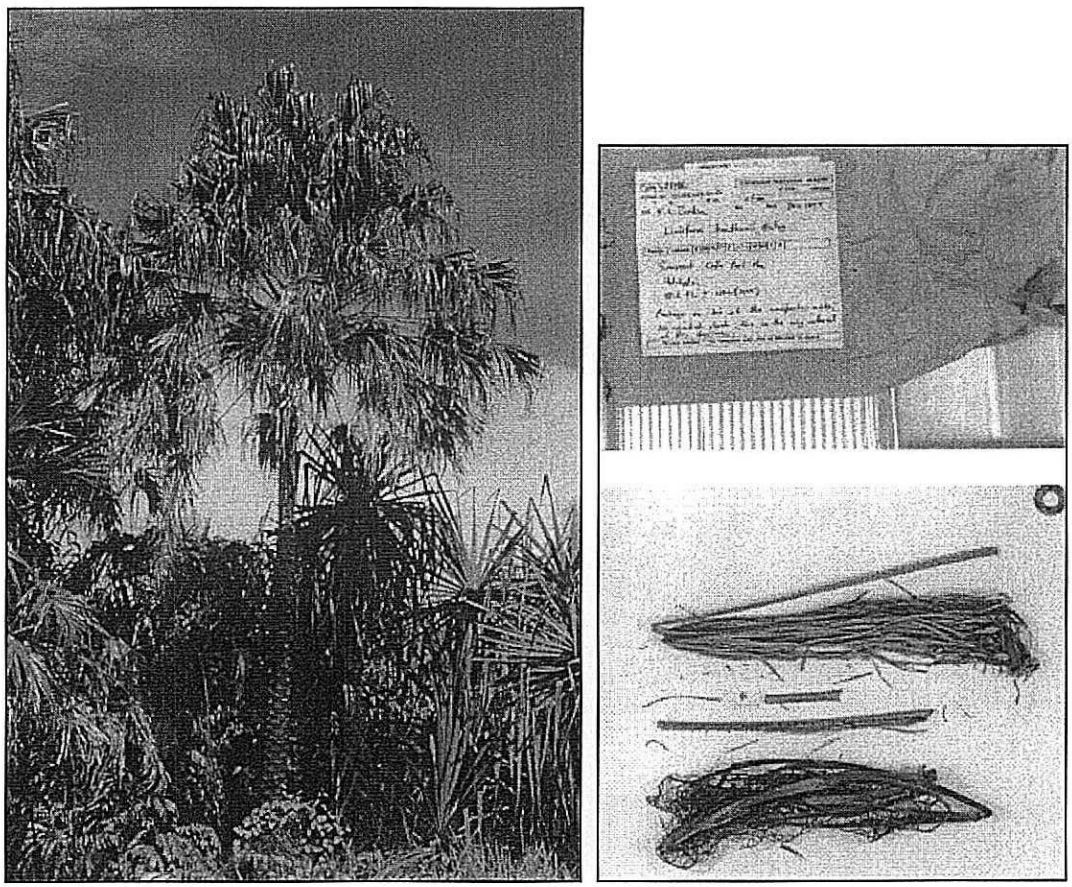


Figure 2.21. ***Livistona benthamii.*** ***Left:*** Habit, near Darwin, Northern Territory, Australia. ***Right:*** Type specimen, *Jardine s. n.*, [BRI], Somerset, Queensland, Australia, 1897.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Kakadu NP, Cooinda, Home Billabong, *J. L. Dowe 206* (BRI); Elcho Island, Warangaiyu Lagoon, 11°57'S, 135°43'E, 19 July 1975, *P. K. Latz 6273* (K, L); Howard Springs, c. 3 km N of Howard Springs, 23 km E of Darwin, 12°25'S, 131°03'E, 20 Oct. 1974, *A. N. Rodd 2904 & 2905* (K); S of Koolpinyah, 13°32'S, 131°14'E, *S. T. Blake 16967* (L); [Port Darwin], undated, *N. Holtze 539* (MEL); Oenpelli, 12°18'S, 133°04'E, 14 Oct. 1948, *R. L. Specht 1187* (US). Queensland. Lockerbie Scrub, Bamaga-Pajinka Road, c. 15 km S of Pajinka, 10°48'S, 142°29'E, 20 m alt., 24 Sept. 1997, *J. L. Dowe 406 with L. T. Smith* (JCT). PAPUA NEW GUINEA: Western Prov. Daru Island, Mar. 1936, *L. J. Brass 6406* (A, BM, L); Daru Island, 9°05'S, 143°10'E, 2 m alt., 21 Sept. 1972, *H. Streimann & Y. Lelean 18472* (L, LAE); Upper Wassi Kussa River, left branch, Jan. 1937, *L. J. Brass 8645* (A, BM, BO, L); Bula village at mouth of Morehead River, 7 Aug. 1967, *R. Pullen 7027* (L, LAE); Central

Prov. c. 7 miles W of Kanosia Plantation, Kairuku, c. 10 ft alt., 18 July 1962, *P. J. Darbyshire 685* (LAE); Waigani Swamp, 9°30'S, 147°10'E, 8 Dec. 1964, *A. N. Gillison 22018* (A, L); Brown River, 9°15'S, 147°20'E, 100 ft alt., 20 Nov. 1969, *A. N. Millar 38385* (L, LAE); Brown River, c. 6 miles W of Karema, 50 ft alt., 30 July 1962, *R. Schodde 2677* (LAE). INDONESIA: Papua. Merauke Division. Wasur NP, Kali Maro, 13 Oct. 1992, *Widjaja, Wally and Subari EW6031* (BO).

NOTES. As with *L. muelleri*, Bailey (1898) first described *L. benthamii* as a possible new variety of *L. humilis*, but subsequently described it based on the specimen *Jardine s. n.* [BRI] (Bailey, 1902) (Fig. 2.21). He noted "....I place this and a palmate-leaved palm from Cairns as varieties of Dr. Robt. Brown's *Livistona humilis* for the present: but hope to have full and complete material for a more satisfactory arrangement when working up the order for my work now in hand on the Queensland Flora". In naming both *L. benthamii* and *L. muelleri*, Bailey (1902) wrote: "...I....give them specific rank bearing the names of the authors of the Flora Australiensis".

For the population occurring in the Northern Territory, Australia, Beccari (1921) provided the name *L. holtzei* based on *Holtze s. n.* [FI] and for New Guinea Burret (1939) provided the name *L. melanocarpa* based on *Brass 6310* [BRI] collected from Western Prov., Papua New Guinea. Both of these taxa are attributable to *L. benthamii*.

Although *L. benthamii* was described for Queensland in the early 1900s, it was not identified as occurring in the Northern Territory until Blake (1954) provided an account noting: "....previously known only from the neighbourhood of Cape York, Queensland. Except for the slightly smaller leaves, these specimens match the type exactly."

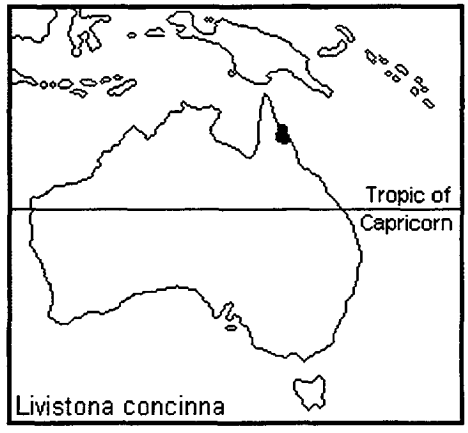
On morphological grounds, *L. benthamii* is most closely related to *L. australis*, but is readily distinguished by its smaller leaves; the retained petiole stubs on the stem; a much less robust inflorescence in which the rachis bracts are non-fibrous and tightly tubular rather than fibrous and loosely sheathing; and the much smaller fruit, only to 13 mm diam., rather than up to 22 mm diam.

22. *Livistona concinna* Dowe and Barfod, Austrobaileya 6: 166 (2001). Type: Australia. Queensland, c. 5 km N of Cooktown Airport, Barretts Creek, 15°25'S, 145°11'E, 5 m alt., 17 Oct 2000, *J. L. Dowe 607* (holotype BRI, isotypes AAU, K. QRS).

Functionally dioecious palm. **Trunk** to 30 m tall, 24-35 cm dbh, swollen at the base to 100 cm diam, grey; nodes raised; internodes narrow; petiole stubs not persistent. **Leaves** 50-65 in a globose to hemispherical crown; petioles 120-300 cm long, glabrous, green throughout, 5-11 cm wide proximally, 2.2-3.5 cm wide in mid area, c. 1.8 cm wide distally, triangular in cross-section, adaxially moderately ridged, abaxially rounded, margins with solitary symmetric or kris-like retrorsely or latrorsely curved, black spines 3-5 mm long congested in the proximal portion, distal margin unarmed, sharp, slightly winged; leaf-base fibres not prominent, coarse, persistent; lamina is subcircular in outline, strongly costapalmate, glabrous, adaxially mid-green, abaxially slightly lighter green, glossy on both surfaces, non-waxy, sub-circular in profile, 155-165 cm long, c. 200 cm wide, folded; segments regular, 60-78, apices deeply forked, distal portion pendulous, free for c. 60% of their length, apical cleft c. 41% of the length of the free segment, mid-lamina segments 2.6-4 cm wide at the disjunction, apices acuminate, filamentous; hastula raised, sharp, papery on the margins; parallel veins 9-10 each side of midrib, more prominent than the transverse veins, which are thin, and extend across 2-4 parallel veins; density of transverse veins c. 12 per unit area of 15x10 mm. **Inflorescences** not branched at the base, sexually dimorphic; non-fruit bearing (functionally male) inflorescences 120-180 cm long, slightly curved with 8-9 partial inflorescences, branched to 4 orders; peduncle 25 mm wide, 10 mm thick, glabrous; fruit bearing (functionally female) inflorescences 160-250 cm long, slightly curved, held horizontal to semi-pendulous with 8-9 partial inflorescences, branched to 5 orders; peduncle c. 30 mm wide; peduncular bracts lacking; prophyll 27-35 cm long, ancipitous, glabrous; rachis bracts 30-50 cm long, tubular, tightly sheathing, not disintegrating or splitting with age, glabrous, apically acute, margins entire, lateral splits uneven, one about twice as deep as the other; rachillae 5-20 cm long, glabrous. **Flowers** solitary or in clusters of 2-4, 1.6-2 mm high and 1.5-2 mm

wide, white to cream; sepals basally fused, cupular, 3-lobed, lobes triangular, margins hyaline, to c. 1.5 mm high, apices acute; petals triangular, slightly asymmetric, 2-2.2 mm long, 1.8-2 mm wide at the base, apex acute; stamen c. 1 mm high, filament subulate, connective 0.2 mm long; anthers didymous, ovate; carpels wedged-shaped, rounded, 1 mm high; stigma erect, trilobed. **Fruit** globose, 9-12 mm diam., shiny black; stigmatic remains subapical; epicarp smooth, with scattered lenticellular pores, drying slightly rugose; suture line extends for about ¾ the length of the fruit; mesocarp c. 1 mm thick, moist, oily, gritty; endocarp thin, crustaceous, light brown, tessellate, 0.1–0.2 mm thick; pedicel to 2 mm long. **Seed** globose to subglobose; intrusion extends to half or less of the width of the seed, contorted, light brown, crystalline, spongy; embryo lateral to sublateral, c. 2 mm long. **Eophyll** 5-ribbed. *Cooktown Livistona, Kennedy River Livistona.* Fig. 2.22.

DISTRIBUTION. Australia. Queensland. On Flinders Island, Kennedy River and tributaries, Barretts Creek north of Cooktown, and Archer Point [14-15°S]. The dots on the map represent eight collections.



HABITAT AND ECOLOGY. In seasonally moist open forest, seasonally inundated *Melaleuca* swamp, along creeks and riverbanks, and mangrove margins in non-saline environments at low elevations. Soils are usually alluvial; grows with *Corypha utan* in the Kennedy River area and with *L. muelleri* in the vicinity of Cooktown. Flowers Dec.-Mar.; fruits Apr.-Oct. Fire regularly occurs in most populations.

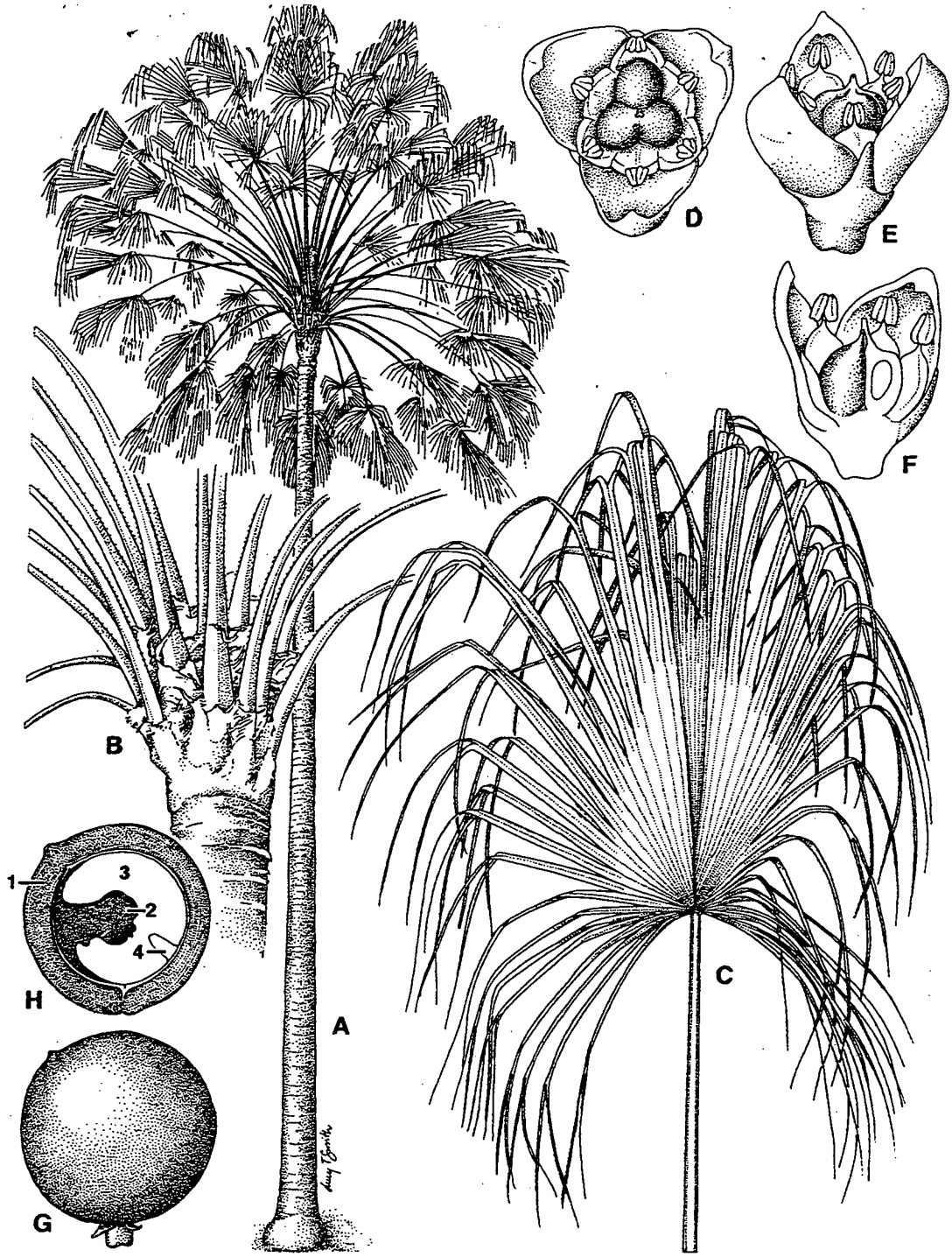


Figure 2.22. ***Livistona concinna.*** A. Habit. B. Leaf-bases and leaf-base fibres of crown x 0.05. C. Leaf in adaxial view x 0.06. D. Flower viewed from above. E. Flower in lateral view. F. Flower in LS view showing orientation of the ovule. D-F x 17.5. G. Fruit in lateral view. H. Fruit in LS view showing mesocarp [1], seedcoat intrusion [2], homogeneous endosperm [3] and embryo [4]. G-H x 2.7. A-C from *Dowe 607*; D-F from *Dowe s.n.,* 17 Oct. 1998; G-H from *Dowe 252*. Illustration by Lucy T. Smith.

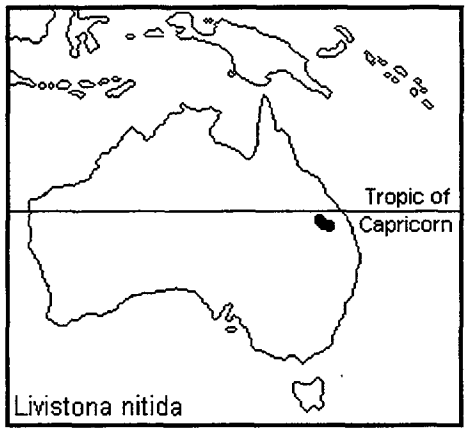
SPECIMENS SEEN. AUSTRALIA: Queensland. Lakefield NP, Kennedy Bend, 15°50'S, 144°15'E, 50 m, 1 Oct. 1997, *J. L. Dowe 415 with L. T. Smith* (JCT); Lakefield NP, Twelve Mile Waterhole, 2 Oct. 1999, *J. L. Dowe 604, 606 with A. Barfod* (BRI, JCT); Kennedy River, 5.5 km N of New Laura Station, 15°27'S, 144°18'E, 50 m alt., riparian forest, 26 Nov. 1981, *A. K. Irvine 2204, 2205* (QRS); near Cooktown airport, Barretts Ck, *B. Gray 2764* (QRS); 3.3 km NE of Cooktown Airport, Barretts Creek, NW boundary, 15°25'S, 145°12'E, 0 m alt., riparian evergreen mesophyll vine forest bordering mangroves, 18 Nov. 1981, *A. K. Irvine 2178, 2179, 2180* (QRS); Endeavour River, opposite the SW corner of the Cooktown Airport, 15°27'S, 145°11'E, 3 m alt., 18 Nov. 1981, *A. K. Irvine 2181* (QRS); 3.3 km off main road at N side of Cooktown Airport, 3 Aug. 1986, *Hind 4594, Hill & Healy* (NSW). CULTIVATION: Queensland, Townsville, Anderson Park Botanic Gardens, 17 Oct. 1998, *J. L. Dowe s. n.* (JCT).

NOTES. This taxon was placed tentatively under *L. drudei* by Rodd (1998), who cited three specimens, *Irvine 2204 & 2205* [QRS], and *Hind 4594* [NSW] that were collected in the distributional range of *L. concinna*. The latter consists of a fallen dead leaf and old infructescence. Dowe and Barfod (2001) described *L. concinna* based on *Dowe 607* [BRI], and named it in reference to the neat and regular appearance of the petioles in the crown. The species has been variously known as '*Livistona* sp. Cooktown', 'Kennedy River *Livistona*' and 'Cooktown Fan Palm' in informal accounts (Irvine, 1984; Jones, 1996; Tucker, 1988).

23. *Livistona nitida* A. N. Rodd, Telopea 8: 96 (1998). Type: Australia. Queensland, Cracow, Dawson River, Delusion Creek, 9 May 1976, *A. N. Rodd 3055 with S. Jacobs* (holotype NSW *n. v.*; isotypes BH, BRI, K).

Functionally dioecious palm. **Trunk** to 35 m tall, 25-40 cm dbh, grey, nodes raised; internodes short; petiole stubs persistent in the basal 1 m or so, otherwise deciduous. **Leaves** 35-50 in an open to dense globose crown; petiole 170-200 cm long, 20-26 mm wide, triangular in cross section, adaxially ridged, abaxially rounded, margins distally smooth, proximally with single, curved, dark red spines; leaf-base fibres moderately prominent, coarse, disintegrating; lamina ± circular, 160-190 cm long, coriaceous, adaxially dark green, glossy, abaxially lighter green; segments regular, 68-80, distally pendulous, free for 63-70% of their length, apical cleft 60-73% of the length of the free segment; parallel veins c. 7

each side of midrib, more prominent than transverse veins, which are very thin, extending across 2-6 parallel veins, with a density of c. 15 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 150-200 cm long; partial inflorescences 8-12, branched to 4 orders; peduncular bracts lacking; rachis bracts densely scaly; rachillae glabrous to papillose, 5-20 cm long. **Flowers** solitary or in clusters of 2-5, funnel-shaped, 2-3.2 mm long, cream-yellow; sepals triangular, c. 1.5 mm long, fleshy, subacute; petals broadly ovate, 2-2.2 mm long, thick, fleshy, acute; stamens c. 16 mm long; pollen ellipsoid, c. 22 μm long, c. 18 μm wide. **Fruit** globose, 13-20 mm diam., glossy black; epicarp with scattered lenticellular pores, suture line extends for about ½ the length of the fruit, marked with lip-like structures; mesocarp fibrous, dry; endocarp thin, brittle; pedicel to 0.5 mm long. **Seed** globose, 10-12 mm diam. **Eophyll** 5-ribbed. *Carnarvon Gorge cabbage palm. Dawson River fan-palm.* Fig. 2.23.



DISTRIBUTION. Australia. Queensland. In the upper catchments of the Dawson, Comet and Burnett Rivers, and Carnarvon and Isla Gorges [24-25°S]. The dots on the map represent five collections.

HABITAT AND ECOLOGY. Abundant along the margins of streams but also extends onto sandstone cliffs and gorges. Flowers Sept.-Dec.; fruits Nov.-Mar.

SPECIMENS SEEN. AUSTRALIA: Queensland. Delusion Creek, Theodore-Cracow Road, 25°11'S, 150°11'E, 150 m alt., 31 Mar. 1996, *J. L. Dowe 301* (BRI, FTG); Palm Tree Creek, 10 m [c. 16 km] N of Taroom, *H. Reeve 11* (CANB); Robinson Ck, NW of Taroom, *N. H. Speck 1986* (BRI, CANB); Carnarvon Gorge, *C. T. White 11374* (BRI); 61 km W of Eidsvold at start of Isla-Delusion Road, 21 Apr. 1986, *P. Ladiges, C. Humphries & T. Bean s. n.* (BM).

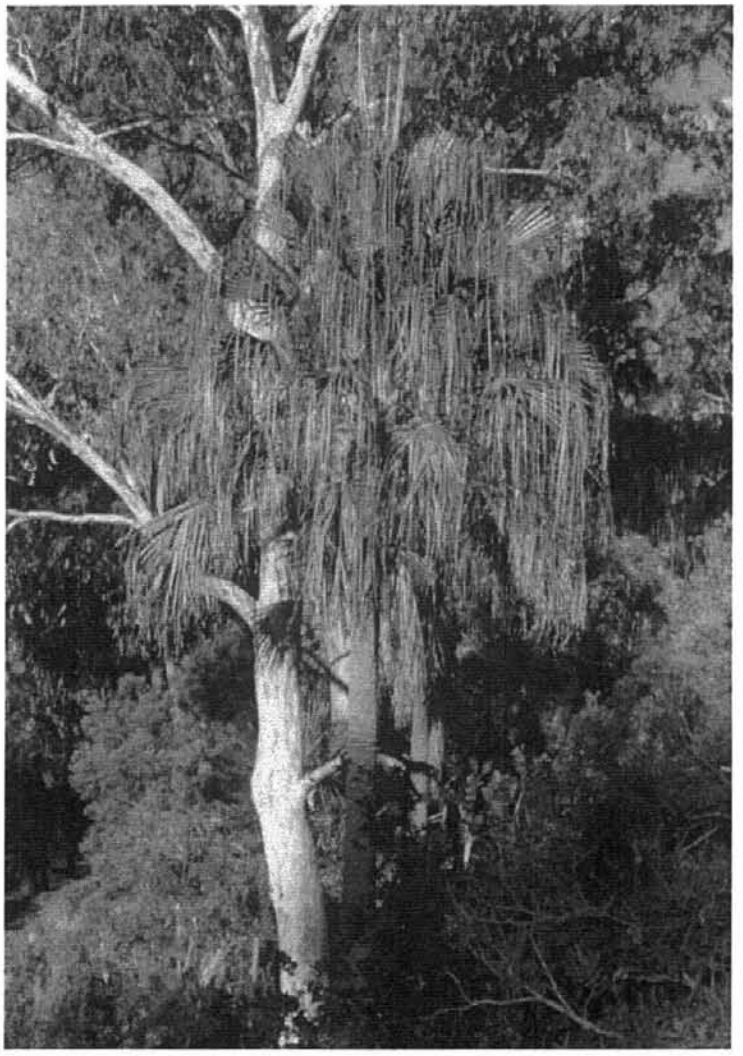


Figure 2.23. ***Livistona nitida.*** Habit, Delusion Creek, Queensland, Australia.

NOTES. *Livistona nitida* was described by Rodd (1998) based on *Rodd 3055* [NSW] collected from Delusion Creek near Cracow, Queensland, and named for its shiny fruits. The taxon had previously been informally known as the 'Carnarvon Gorge Fan Palm' and '*Livistona* sp. Carnarvon' (Irvine, 1984; Jones, 1996). An early account was provided by Leichhardt (1847) during his transcontinental expedition of 1845, when near the Dawson River, Queensland, he wrote in his diary: "....a creek with *Corypha* palms, growing to a height of 25 or 30 feet" and "several rocky gullies were passed, that were full of palm trees. The valley of Palm-tree Creek extends about nineteen miles from west to east" and "the *Corypha*-palm provided a good supply of cabbage".

24. *Livistona australis* (R. Br.) Mart., Hist. nat. palm. 3(7): 242 (1838).

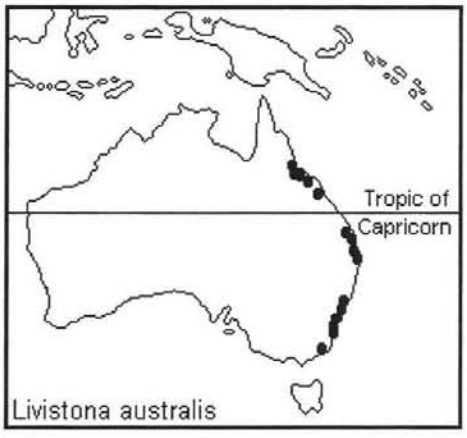
Corypha australis R. Br., Prodr. 267 (1810). *Saribus australis* (R. Br.) Kuntze, Revis. gen. pl. 2: 736 (1891). Type: Australia. New South Wales, Port Jackson, undated, *R. Brown s. n.* (holotype BM; isotype FI).

[*Livistona inermis auct. non* R. Br., H. Wendl. & Drude, Linnaea 39: 229 (1875)].

[*Corypha nuda*, in mss, D. Solander, Plant Novae Hollandiae 3: 11, 158 (1768-71)].

Functionally dioecious palm. **Trunk** to 25 m tall, 25-40 cm dbh, brown, nodes raised, internodes 2-12 cm long, longitudinal fissures prominent, petiole stubs retained in the basal 50 cm, otherwise deciduous. **Leaves** 35-60 in an open to dense crown; petiole 150-250 cm long, 10-20 mm wide, adaxially moderately ridged, abaxially rounded, margins smooth or with short single black curved spines congested in the proximal portion, a thin light green stripe usually present on the abaxial surface; leaf-base fibres prominent, finely woven, sheet-like, persistent; lamina ± circular, 100-130 cm long, chartaceous, adaxially dark green, glossy, abaxially slightly lighter green, non-waxy; segments regular, 80-100, distally pendulous, free for 49-69% of their length, apex cleft for 50-63% of the length of the free segment, lobes acute; parallel veins most prominent, c. 8 each side of midrib; transverse veinlets not as prominent, thin, crossing 2-3 parallel veins, density c. 23 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 140-250 cm long; partial inflorescences 6-9, branched to 5 orders; peduncular bracts lacking; rachis bracts loosely tubular, densely floccose; rachillae glabrous, 5-25 mm long. **Flowers** solitary or in clusters of 2-4, funnel-shaped, white/cream to pale yellow; sepals triangular, 1.2-2 mm long, fleshy, acute; petals triangular to ovate, 2-3.5 mm long, fleshy, subacute to obtuse; stamens c. 2.5 mm long. **Fruit** globose, 12-22 mm diam., reddish brown to dull black, occasionally glaucous; epicarp with scattered lenticellular pores; suture line almost the length of the fruit; pedicel 2-3 mm long. **Seed** globose, 10-16 mm diam. **Eophyll** 5-ribbed. *Cabbage palm, cabbage tree*. Fig. 2.24.

DISTRIBUTION. Australia. Queensland, New South Wales and Victoria [18-37°S]. In Queensland in the north confined to high elevation between Paluma Range and Eungella Range with a major disjunction to Fraser Island, and then at low elevation south through south-eastern Queensland, New South Wales and with a minor disjunction to the Brodribb River in eastern Victoria. The dots on the map represent 25 collections.



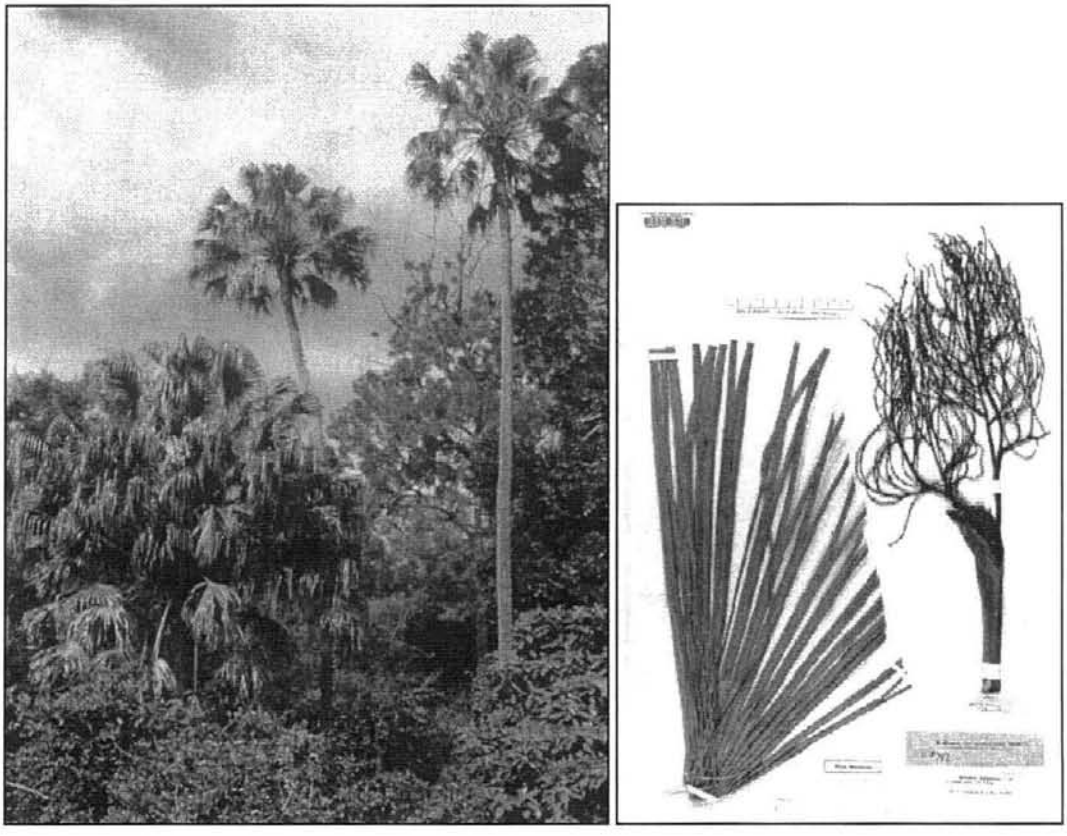


Figure 2.24. ***Livistona australis*.** ***Left:*** Habit, Eungella, Queensland, Australia. ***Right:*** Type specimen of *Corypha australis* (= *L. australis*), *Brown s. n.*, [BM] Port Jackson, New South Wales, Australia, undated.

HABITAT AND ECOLOGY. Grows in moist areas of open forest, swamp forest, moist sclerophyll forests, along stream banks and in rainforest. Often locally common and may grow in large colonies. In the north confined to high elevation above 400 m, and in central and southern parts to coastal and near-coastal lowland areas. Flowers irregularly at any time of year; fruits irregularly.

SPECIMENS SEEN. AUSTRALIA: Queensland. Paluma Range, Dotswood Holding, 22 km W of Bluewater Forestry Road, 19°13'S, 146°25'E, 620 m alt., 28 June 1979, *A. K. Irvine 1928* (MEL); Cathu State Forest, Clarke Range, North Road, 16 km along road to Palm Tree Lookout, 20°45'S, 138°35'E, 800 m alt., 4 Apr. 1996, *J. L. Dowe 313* (BRI, FTG, JCT); 18 km from Landsborough towards Nambour, *E. J. Carroll 1140 & I. R. Telford* (CANB); 13 km E of Cooroy on Tewantin Rd, *A. N. Rodd 3030* (BRI); Tin Can Bay, 20 Oct. 1946, *M. S. Clemens s. n.* (A). New South Wales. Warrah, Pearl Beach, *A. N. Rodd 2672* (QRS); Royal NP, above Garie Beach, 34°10'S, 151°03'E, 60 m alt., 28 Aug. 1975, *A. N. Rodd s. n.* (K); near Sydney, *anonymous s. n.* (MEL); near Mt Dromedary, 1881, *Miss Bates s. n.* (MEL); [Australia], Nov. 1806, *G. Caley s. n.* (BM); [New South Wales], 1864, *E. Daemel s. n.* (MEL); [New South Wales], undated, *Johnson s. n.* (MEL); Kiama, 1872, *J. Henry s. n.* (MEL); Illawarra, undated, *Kirton s. n.* (MEL); Ash Island, 25 Nov. 1842, *L. Leichhardt s. n.* (MEL); [Australia], undated, *J. Lhotsky s. n.* (BM); Royal NP, Feb. 1929, *A. Meebold 2631* (M). Victoria. Gippsland, Cabbage Tree Ck, near Marlo, 9 Mar. 1965, *R. N. Webb* (CANB); Palm Creek, S of Cabbage Tree, 13 Sept. 1970, *A. C. Beauglehole 34001 with G. & K. Beaton* (MEL); Palms Reserve, 5.4 km S from Princes Highway along Palm Track on Palm Creek, 37°44'45"S, 148°39'E, 40 m alt., 30 Apr. 1987, *S. J. Forbes 3222 with W. P. A. Worboys* (MEL); East Gippsland, 1888, *C. French s. n.* (MEL); East Gippsland, 1889, *C. French s. n.* (MEL); East Gippsland, Jan. 1889, *Searle s. n.* (MEL); East Gippsland, undated, *G. Weindorfer 2396* (MEL); NE of Marlo, Brodribb River, Curlip Jungle, 17 Jan. 1953, *R. Melville 2933 with N. Wakefield & W. Hunter* (K); 16 km E of Marlo, Cabbage Tree Ck on Cabbage Palms Track, 19 Dec. 1965, *E. J. Carroll 264* (CANB). CULTIVATION: Queensland. Brisbane Botanic Gardens, 1 July 1931, *C. T. White 7764* (A).

NOTES. Brown (1810) described *L. australis*, as *Corypha australis*, from a specimen that he collected from Port Jackson, New South Wales (Fig. 2.24), and which he distinguished from his *Livistona* species by the minor character of embryo position. Martius (1838) was the first to place it in *Livistona*. Previously, Solander (1768-1771) had included it as the manuscript name '*Corypha nuda*' in his hand-written and unpublished *Plantae novae hollandiae,* based on plants he saw at Botany Bay, the specimens of which are located in BM. This species is the first palm to be mentioned in European accounts of Australia. Beaglehole (1962) noted upon the first observations during Cook's Endeavour voyage of the

Australian coast in 1777 in southern New South Wales: "...trees were not very large and stood separate from each other without the least underwood; among them, we could discern many *cabbage trees*, but nothing else which we could call by any name...'. These 'cabbage trees' refer to *L. australis*.

The relationships of *L. australis* lie most closely with *L. nitida* and *L. decora*. From the former it is distinguished by its not so pendulous segment apices and dull rather than highly glossy fruits. *Livistona decora* is distinguished by its deeply segmented leaves and glossy fruits.

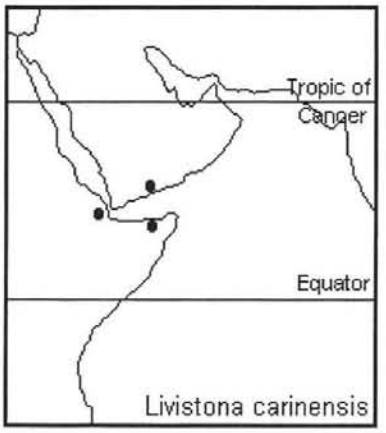
25. *Livistona carinensis* (Chiov.) J. Dransf. & N. W. Uhl, Kew Bull. 38(2): 200 (1983). *Hyphaene carinensis* Chiov. Fl. somala 1: 319 (1929). *Wissmania carinensis* (Chiov.) Burret, Bot. Jahrb. Syst. 73: 184 (1943): Monod, Bull. de l'I.F.A.N. 17: 338 (1955). Type: Somalia. Carin, Oasis of Uncud, 6 July 1924, *N. Puccioni & J. Stefanini 1027* (holotype FT).

Functionally dioecious palm. **Trunk** to 40 m tall, erect, leaning, cylindrical, c. 40 cm dbh, expanded at the base to c. 65 cm diam., c. 20 cm diam. just below the leaves, nodes prominent, slightly oblique, irregular in width, internodes irregular in width, petiole stubs not persistent. **Leaves** 30-40 in a hemispherical to globose crown; petiole to 125 cm long, 5-8 cm wide proximally, 1-2 cm wide distally, triangular in cross-section, flat to shallowly channelled adaxially, convex abaxially, bright orange-yellow-green, margins armed with large single or double, dark brown curved spines throughout, but largest and closer in the proximal portion; spines conical, basally swollen, apically acute, retrorsely hooked, brown-black, 7-19 mm long, 3-10 mm wide at the base, 8-15 mm apart, reduced to tubercles in the distal portion of the petiole, 4-6 cm apart; leaf-base fibres prominent, fine, persistent; ligule, rigid, 6-7 cm long, brown to black; lamina sub-circular, 80-95 cm long, thick, both surfaces waxy, glabrous, grey-green on adaxial surface, grey abaxially, drying chartaceous; segments regular, 50-70, free for 75-85% of their length, apical cleft for 40-50% of the length of the free segment; segment apex rigid, midrib very prominent; parallel veins 18-20 each side of midrib, much more prominent than transverse veins which are very thin, extending between 2 parallel veins; transverse vein density c. 5 per unit area of

15x10 mm; segment margins thickened, with a deciduous filament, the remains of which remain attached at the disjunction of the adjacent segments; lamina anatomically isolateral, hypodermis 1-layered below each surface (not with a 2–layered adaxial hypodermis as in other species, *cf.* Tomlinson, 1961). **Inflorescence**s not branched at the base, 200-240 cm long, extending beyond the leaves, slender, arching, eventually pendulous; partial inflorescences 6-12, branched to 3 orders; rachillae very thin, glabrous, yellowish; single peduncular bract, glabrous; rachis bracts tubular, brown red, striate, glabrous. **Flowers** in clusters of c. 5, c. 2 mm long, yellow-green, abaxial surface of perianth segments tomentose with branching hairs; sepals much shorter than the petals, irregular, margins hyaline; petals valvate in bud, apically pointed, less densely tomentose at the apex, adaxial surface with the residual impressions of the anthers, aligned as ½ an anther, one anther, ½ an anther; lobes dehiscing by a lateral fissure; filament apically very thin, widening basally; filaments basally connate; anthers versatile on a very thin connective; carpels scarcely fused, similarly the styles; styles short, less than half the height of the stamens, not broadening at the apex but remaining tripartite; pollen ellipsoid, monosulcate, 23-25 μm long, 17-18 μm wide. **Fruit** globose, 40-50 mm diam., dark brown to black; epicarp thin, dull, shallowly rugose in the fresh state, deeply rugose in the dried state; stigmatic remains apical; suture line extends for the length of the fruit; mesocarp greenish with very large sclerenchymatous cells; mesocarp very thin, adhering to the endocarp; pedicel narrow, 4-5 mm long. **Seed** globose; testa smooth, brown, glossy, separating from the endocarp; intruded by a large, pulpy, brown, vascularised excrescence; embryo sub-lateral. **Eophyll** 7-ribbed. *Bankouale palm, nakilto (Afar), daban, madah (Somali), N,tug, somm (Arabic).* Fig. 2.25.

HABITAT AND ECOLOGY. In semi-arid habitats at 200-975 m elevation with rainfall less than 400 mm per annum. Grows in or adjacent to intermittently flowing creeks or soaks in valley bottoms, locally termed 'wadis'.

DISTRIBUTION. Djibouti, Somalia and Yemen [11-14°N]. In the Horn of Africa, in Djibouti in the Goda Mts, and in Somalia at Carin, Uncad, Galgala, Marajo, Duud Shabeel and Xamur. In Yemen in the Hadramaut region at El Mintaq and Wadi Hadjer. The dots on the map represent three collections.



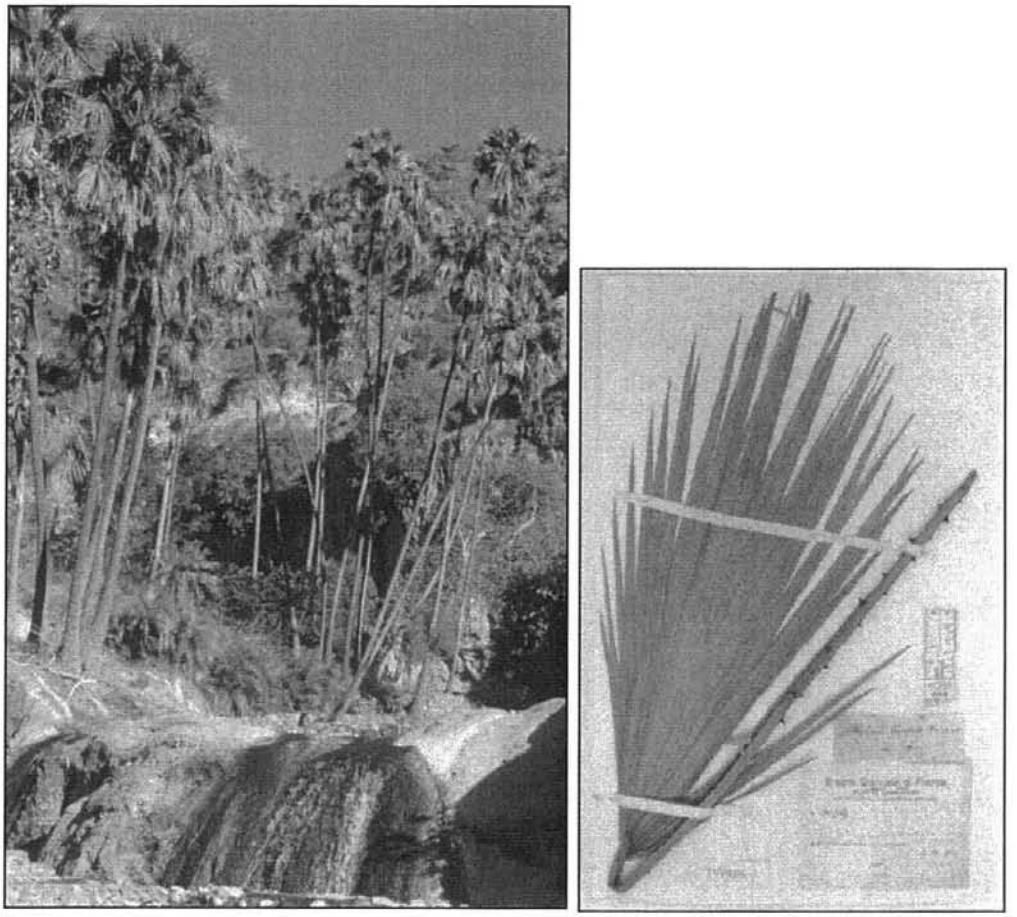


Figure 2.25. ***Livistona carinensis.*** ***Left:*** Habit, Bankouale, Djibouti. ***Right:*** Type specimen, *Puccioni & Stefanini 1027* [FT], Carin, Somalia, 1924.

SPECIMENS SEEN. SOMALIA: Galgala, 10°58'N, 49°02'E, 7 Dec. 1983, *C. Barbier 972* (K); Galgala, 25 km W of Carin, 10°59'N, 49°02'E, 21 Nov. 1986, *Lavranos & Carter 24835* (K). DJIBOUTI: Bankouale Wadi, Nov. 1985, *S. Coghlan s. n.* (K).

NOTES. The geographic isolation of *Livistona carinensis*, some 4500 km from the nearest *Livistona* species in north-eastern India, raises interesting questions with respect to historical distribution and phylogeny. Morphologically it is closest to *L. alfredii* and *L. victoriae* from western and north-western Australia, but this could be an example of ecological convergence, rather than genetic relatedness.

Livistona carinensis was first described by Chiovenda (1929) as a Borassoid palm and named *Hyphaene carinensis* with the specific name derived from the site of its collection in the Carin region of Somalia. The type specimen, *Puccioni and Stefanini 1027* [FT] was collected in 1924 (Fig. 2.25). The original description was based solely on leaf material as flowers and fruit were not collected. Subsequently, the generic determination was not soundly established, and the species true affinities were open to question. Chevalier (1939) suggested that it was a species of *Medemia*: "*....peut-être M. argun P. G. von Wurtemberg connu seulement en Nubie....*", a genus from north-eastern Africa also in the Borassoid group of palms. However, it was the German palm specialist Burret (1943), in his treatment of the Arabian palms, who correctly recognised it as a Coryphoid palm and assigned it to a new genus, *Wissmannia*, named after the palm's discoverer in Yemen, H. von Wissmann, and thus establishing the name *Wissmannia carinensis* (Chiov.) Burret. Burret only had leaves at his disposal, so there still remained questions about the palm's true affinities that could only have been resolved with examination of flowers and fruit.

The first complete description, including flowers and fruit, was provided by Monod (1955) based on specimens collected in Djibouti by E. Chédeville. Monod noted the similarity of its flowers and fruit to *Livistona*, but did not introduce any taxonomic changes and maintained the species in *Wissmannia*. Tomlinson (1961), in a study based on leaf anatomy, provided data that suggested that there was no single character that could be used to separate *Wissmannia* from *Livistona*, but that by invoking a suite of characters, all of which were otherwise shared with certain

species of *Livistona*, it was a distinct genus. Moore (1973a, 1977) and Langlois (1976), similarly, indicated a close relationship with *Livistona* but maintained taxonomic distinction. Based on this evidence and with further study, Dransfield and Uhl (1983a) provided the formal taxonomic transfer of *Wissmannia* to *Livistona*, and established the name *Livistona carinensis*.

Livistona carinensis is listed as a critically endangered species. Welch and Welch (1998, 1999) provided biodiversity reports on the palm's ecological status. Surveys of 15 locations in Djibouti, Somalia and Yemen, resulted in the mapping of 1753 adult palms. Compared to reports on population numbers taken 10-20 years previously, there had been a decline in numbers of 23-59% across all locations. The primary causes of such rapid decline are the cutting down of the palms for timber, or the clearance of land for agriculture. There is no active program to conserve this species in either Somalia or Yemen, but the Government of Djibouti has shown an interest in developing a conservation plan.

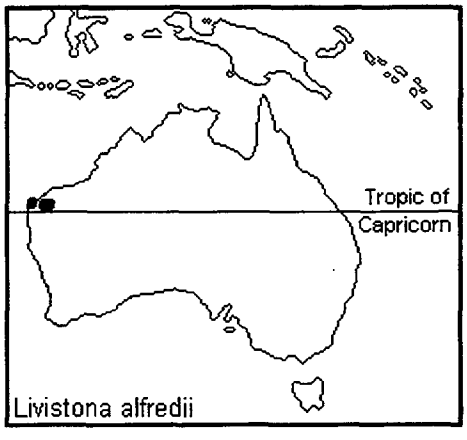
26. *Livistona alfredii* F. Muell., Victorian Naturalist 9: 112 (1892) [as *L. Alfredi*]; Bot. Centralbl. 53: 28 (1893) (*verbatim exemplar*). Type: Australia. Western Australia, Hamersley Range, Millstream, June 1878, *J. Forrest s. n.* (holotype MEL).

[*Livistona mariae auct. non* F. Muell., F. Muell., *Fragm.* 11: 54 (1878); C. A. Gardner, Forest Depart. Bull. Western Australia 32: 36 (1923)].

Functionally dioecious palm. **Trunk** to 12 m tall, 20-50 cm dbh, pale grey, nodes prominent, internodes congested, petiole stubs persistent in basal 1 m, otherwise deciduous. **Leaves** 25-30 in a dense globose crown; petiole 90-130 cm long, 25-30 mm wide, adaxially flat, abaxially rounded, margins with curved single black spines congested in the proximal portion; leaf-base fibres prominent, coarse, persistent; lamina subcircular, 90-140 cm long, rigid, adaxially pale green-grey to glaucous, waxy, dull; abaxially light green-grey, waxy; segments regular, 50-66, rigid, free for 60-70% of their length, apex deeply cleft for 60-75% of the length of the free segment, apices rigid, lobes attenuate; parallel veins very prominent, 6-8 each side of midrib; transverse veinlets inconspicuous, very thin, continuous

across 2-5 parallel veins; transverse veinlet density c. 14 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 180-270 cm long, shorter than the leaves; partial inflorescences 5-7, branched to 3 orders; prophyll not seen; single peduncular bract; rachis bracts sparsely to moderately scaly; rachillae white pruinose, minutely warty, to c. 13 cm long, to c. 2 mm thick. **Flowers** solitary or in pairs, cylindrical in bud; sepals triangular, 0.8-1 mm long, acute, cream to yellowish; petals triangular, 2-3 mm long, acute to mucronate, cream to yellowish; stamens c. 2 mm long. **Fruit** globose, 36-40 mm diam., dark brown to black; epicarp with scattered lenticellular pores; suture line to about ½ way to base; pedicel to c. 3 mm long. **Seed** globose, 17-20 mm diam. **Eophyll** 3-ribbed. *Millstream palm.* Fig. 2.26.

DISTRIBUTION. Australia. Western Australia. In the Hamersley Region mainly in the upper reaches of the Fortescue, Robe and Ashburton Rivers. A small disjunct population occurs in the Cape Range, North West Cape Peninsula, on the western side of Exmouth Gulf [21-22°S]. The dots on the map represent 13 collections.



HABITAT AND ECOLOGY. Grows adjacent to watercourses and along drainage lines in well-drained sites. Flowers Sept.–Jan.; fruits Dec.-May.

Figure 2.26. ***Livistona alfredii***. ***Left:*** Habit, Millstream NP, Fortescue River, Western Australia. ***Right:*** Type specimen, *Forrest s. n.* [MEL], Hamersley Range, Western Australia, 1878.

SPECIMENS SEEN. AUSTRALIA: Western Australia. Pilbara, Millstream-Chichester NP, Fortescue R., Crossing Pool, 20°50'S, 116°35'E, 150 m alt., 3 May 1996, *J. L. Dowe 354* (BRI); Millstream-Chichester NP, 28 July 1990, *E. Leyland s. n.* (PERTH); Millstream-Chichester NP, Fortescue River, below lookout overlooking Crossing Pool, 21°33'12"S, 116°58'5"E, 18 Nov. 1998, *R. N. Bromilow LA2, LA5* (BRI, PERTH); Millstream Station, 21°35'S, 117°04'E, 300 m alt., 20 Oct. 1974, *A. N. Rodd 2847* (K); Fortescue River, Millstream, Aug. 1974, *A. C. Beauglehole s. n.* (PERTH); Fortescue River, Millstream, 2 Mar. 1962, *A. S. George 3523* (PERTH); Fortescue River, Crossing Pool near Millstream Homestead, 13 Aug. 1974, *J. H. Willis s. n.* (MEL); Millstream River, 24 Nov. 1969, *M. I. H. Brooker 2064* (PERTH); Millstream/Yarraloola Rd crossing the Fortescue River, 21°37'58"S, 117°07'08"E, 19 Nov. 1998, *R. N. Bromilow LA1* (BRI, PERTH); Fortescue River, 400 m E of Robe River iron rail bridge, 21°28'35"S, 116°49'14"E, 18 Nov. 1998, *R. N. Bromilow LA6* (BRI, PERTH); Hamersley Ra., *J. Forrest 1879* (MEL); Nichol Bay, 1879, *McRae s. n.* (MEL); Cape Range, North West Cape, 22°22'09"S, 113°54'03"E, 29 Sept. 1988, *J. M. Waldock s. n.* (PERTH).

NOTES. Mueller (1878) first cited specimens relating to *L. alfredii* as part of the distribution of *L. mariae*. The original description of *L. alfredii* (Mueller, 1892) was an informal account in Victorian Naturalist. It included some manner of distinguishing it from *L. mariae*, and discussed leaf colour and fruit size. The type, *Forrest s. n.* [MEL] (Fig. 2.26) is mentioned in the account of *L. mariae*. Drude (1893) found *L. alfredii* distinct enough to place it in its own section, *Gregorya*. Beccari (1931) provided a complete description based on the Forrest specimen and also one by McRae.

Livistona alfredii relationships are obscure, although morphologically it lies closest to *L. victoriae* and *L. carinensis*. From *L. victoriae* it is distinguished by its much more robust trunk, its dense rather than open crown; much longer inflorescence; partial inflorescences branching to three rather than four orders; and in its much larger fruit to 40 mm diam. rather than 15 mm diam. From *L. carinensis* it is distinguished by its shorter stature, an inflorescence that is about the same length as the leaves, rather than longer, and by the rachillae and flowers that are glabrous and not covered in long hairs.

27. *Livistona humilis* R. Br., Prodr. 268 (1810). *Saribus humilis* (R. Br.) Kuntze, Revis. gen. pl. 2: 736 (1891). Type: Lectotype (*fide* Moore, 1963a). Australia. Northern Territory, Gulf of Carpentaria, Blue Mud Bay, Morgans Is., 20 Jan.1803, *R. Brown* (lectotype BM; isolectotypes FI, K).

Livistona leichhardtii F. Muell., Fragm. 8: 221 (1874); Fragm. 5: 49 (1865). Type: Lectotype (*fide* Rodd, 1998). Australia. Northern Territory, McAdam Range, 1855, *F. Mueller s. n.* (lectotype MEL).

[*Livistona humilis* var. *minutiflora* Becc., Ann. Roy. Bot. Gard. (Calcutta) 13: pl. 7, fig. 3a (1931)].

Functionally dioecious palm. **Trunk** to 7 m tall, 5-8 cm dbh, grey, nodes raised, internodes congested, petiole stubs persistent or deciduous with age. **Leaves** 8-15 in an open crown; petiole 40-70 cm long, 6-14 mm wide, triangular in cross section, margins with small, single curved dark red spines; leaf-base fibres not prominent, coarse, persistent; lamina circular, 30-50 cm long, chartaceous, dark green adaxially, lighter green abaxially, glossy; segments regular, 30-44, rigid, free for 60-87% of their length, apical cleft 35-89% of the length of the free segment, apex of lobes acuminate; parallel veins very prominent, c. 6 each side of midrib; transverse veins very thin, extending across 2-3 parallel veins, density c. 29 per unit area of 15x10 mm. **Inflorescences** not branched at the base, sexually dimorphic; those on fruiting plants (functionally female) erect, to 230 cm long, with a single distal partial inflorescence branched to 3 orders; peduncular bracts 5-8, scurfy pubescent; inflorescences on non-fruiting plants (functionally male) arcuate, to 180 cm long, peduncular bracts lacking; partial inflorescences 4-7, branched to 3 orders; rachis bracts scurfy pubescent; rachillae bristly pubescent, 3-12 mm long. **Flowers** in clusters of 2-4, globose, 1.5-1.8 mm long, yellow; sepals broadly ovate, 1-1.3 mm long, membranous, cuspidate; petals broadly ovate, 1.5-1.8 mm long, fleshy, acute; stamens c. 1.3 mm long; pollen symmetrically ellipsoid; aperture symmetrical monosulcate, sulcus as long as the long axis; apices of sulcus acute; long axis (19-) 21.6 (-24) μm; wall thickness c. 1.5 μm; tectum tectate; ornamentation the same over the entire grain; tectum surface psilate; ornamentation perforate. **Fruit** ellipsoid, pyriform or obovoid, 11-

19 mm long, 8-10 mm diam., shiny, purple-black; epicarp with scattered lenticellular pores; suture line extends for full length of the fruit, marked with lip-like structures; mesocarp fleshy; endocarp thin; pedicel 0.5-1 mm long. **Seed** ellipsoid, 7-9 mm long. **Eophyll** 3-ribbed. *Sand palm*. Fig. 2.27.

DISTRIBUTION. Australia. Northern Territory. From near Fitzmaurice River across the Top End to Cape Arnhem and islands in north-western Gulf of Carpentaria, and as far inland as Katherine [11-15°S]. The dots on the map represent 36 collections.

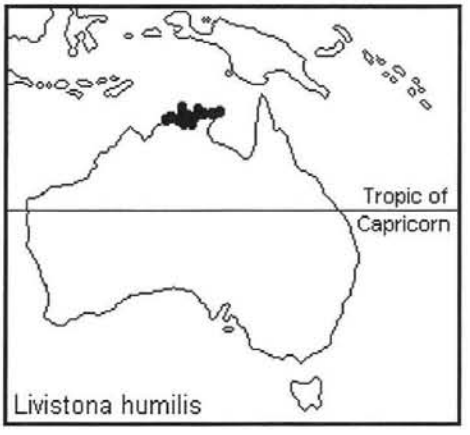


Figure 2.27. ***Livistona humilis.*** ***Left:*** Habit, near Darwin, Northern Territory, Australia. ***Right:*** Type specimen, *R. Brown s. n.* [BM], Morgans Island, Gulf of Carpentaria, 1803.

HABITAT AND ECOLOGY. In open forest and woodland growing in deep sandy soils, at low elevation. Usually occurs in extensive populations. Flowers May-Dec.; fruits Nov.-May.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Coburg Peninsula, 13.5 miles S of Danger Point, 19 July 1961, *G. Chippendale 8220* (MEL); c. 2 miles NW of Caiman Creek, 11°12'S, 132°12'E, 27 Sept. 1968, *N. Byrnes 1014* (LAE, PERTH); Arnhemland, 10.5 NNE of Murgenella, 11°26'S, 132°58'E, 28 Aug. 1987, *J. H. Ross 3306* (MEL); Arnhemland, undated, *Schultz 7* (MEL); 5 km S of Gove Airport, 12°19'S, 136°48'E, 16 July 1978, *J. & J. Eurell 78714* (L); Yirrkala, 12°12'S, 136°47'E, 16 Aug. 1948, *R. L. Specht 901* (A, L, MEL, PERTH, US); Oenpelli, 12°18'S, 133°40'E, 19 Oct. 1948, *R. L. Specht 1221* (L, LAE, US); c. 80 km E of Oenpelli, 12°20'S, 133°56'E, 28 June 1972, *J. R. Maconochie 1598* (PERTH); Palmerston Escarpment Reserve, 12°29'09"S, 130°59'24"E, 16 Sept. 1997, *N. M. Smith 4334* (DNA, JCT); Palmerston, Stapleton, Nov. 1915, *G. F. Hill s. n.* (BM); Palmerston, 10 June 1886, *T. S. Lea s. n.* (BM); 30 km W of Jabiru on Kakadu Hwy, Kakadu NP, *J. L. Dowe 203* (BRI, FTG); Kakadu NP, 18 May 1980, *L. A. Craven 5572* (L, MEL); Kakadu NP, 30 May 1980, *M. Lazarides 9090* (MEL); 3 km S of Kakadu NP Headquarters, 12°40'S, 132°43'E, 13 May 1988, *A. A. Munir 5590* (NY); 4 miles E of Lake Evella turnoff, 12°45'S, 135°51'E, 18 June 1972, *J. R. Maconochie 1513* (MEL, NY, PERTH); Dorisvale Rd, 41 km W of Stuart Hwy, *J. L. Dowe 213* (BRI, DNA); Macdonnell Airstrip, 67 miles N of Katherine, 12 July 1971, *J. R. Maconochie 1300* (B, L, K); 21 miles NW of Katherine, 10 July 1961, *M. Lazarides 6627* (B, L); 16 miles NE of Tipperary Homestead, 27 July 1961, *M. Lazarides 6687* (US); near Grove Hill, 13°28'S, 131°35'E, 6 July 1946, *S. T. Blake 16347* (A, L); Daly River Road, 30 km SSW of Adelaide River township, 13°30'S, 131°01'E, 150 m alt., 15 Apr. 1989, *H. Streimann 8956 with J. A. Curnow* (L); Stuart Highway, 11 km NW of Pine Creek, 13°46'S, 131°45'E, 240 m alt., 15 Apr. 1989, *H. Streimann 8955 with J. A. Curnow* (L); 36 miles N of Wilton River – Bumen Crossing, 13°55'S, 134°35'E, 15 June 1972, *J. R. Maconochie 1457* (L, NY); Cannon Hill Airstrip, 30 Jan. 1973, *Martensz & Schodde AE617* (L); Liverpool River, undated, *B. Gulliver s. n.* (MEL); Castlereagh Bay, undated, *B. Gulliver s. n.* (MEL); [Darwin], Leanyar, *C. Bosshart 1* (QRS); [Port Darwin], 1855, *F. Mueller s. n.* (BO); Wood Island, 1855, *F. Mueller s. n.* (BO, MEL); Liverpool River, 1855, *F. Mueller s. n.* (BO); McAdams Range, 1855, *F. Mueller s. n.* (MEL); Strauss Airstrip, 28 miles S of Darwin, 8 Mar. 1972, *J. Must 957* (L); Port Darwin, undated, *Schultz 373* (MEL); Woodah Island, Apr. 1922, *N. B. Tindale* (US); N of Pine Creek on Stuart Highway, 31 Oct. 1958, *H. & E. Walter 3494* (B); [Northern Territory], 1892, *N. Holtze s. n.* (MEL); [Port Darwin], undated, *N. Holtze 332* (MEL).

NOTES. *Livistona humilis* was one of two species described by Brown (1810) when establishing *Livistona*. Moore (1963a) chose it as the lectotype for the genus. The type specimen, *Brown s. n.* [BM] is presented in Figure 2.27. Although Brown only provided a meagre description, Martius (1838) clearly

established its identity, albeit the illustrations accompanying his description appear to be based on *L. inermis* or a combination of the two taxa.

Bentham (1878) included a specimen of *L. rigida* [*Mueller s. n.*, Albert River] as the one on which he based his amended description of *L. humilis*, but his description is certainly that of *L. humilis*. Beccari (1931) provided a very thorough appraisal of the species, but however described two varieties, *L. humilis* var. *sclerophylla* from north-eastern Queensland and *L. humilis* var. *novoguineensis* from Merauke, Indonesia, that are attributable to *L. muelleri* (see Notes under that species).

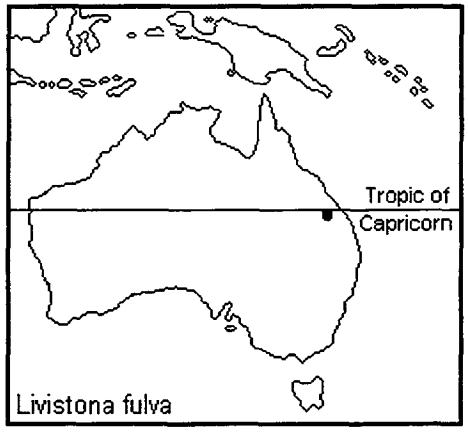
Mueller (1874) described *L. leichhardtii* based on a collection made by himself from McAdam Range, *Mueller s. n.* [MEL], Northern Territory, but this is attributable to *L. humilis*. Beccari (1931) provided an illustration labelled as *L. humilis* var. *minutiflora*, supposedly a typographic error, but did not provide a taxonomic reference. Kuntze (1891) provided the combination of *Saribus humilis*.

Along with *L. exigua* [to which it is not related] from Brunei, *L. humilis* is the smallest species in the genus growing to a maximum of 7 m tall. The closest relationship of *L. humilis* appears to be with *L. eastonii*. However, *L. humilis* is very distinctive due to is smaller stature and smaller leaves; and inflorescences that are strongly sexually dimorphic: the female with a single partial inflorescence at the apex and the male with several partial inflorescences.

28. *Livistona fulva* A. N. Rodd, Telopea 8: 103 (1998). Type: Australia. Queensland, Blackdown Tableland, 11 May 1976, *A. N. Rodd 3062 & S. Jacobs* (holotype NSW; isotypes: BH, BRI, K).

Functionally dioecious palm. **Trunk** to 13 m tall, 20-25 cm dbh, grey or brown, nodes raised, internodes congested, petiole stubs deciduous. **Leaves** 25-35 in an open globose crown; petiole 150-250 cm long, 12-15 mm wide, triangular in cross section, adaxially moderately ridged, abaxially rounded; basal margins armed with single, curved black spines; leaf-base fibres moderately prominent, fine,

persistent; lamina circular, 90-100 cm long, coriaceous, greyish green to glaucous adaxially, coppery brown floccose tomentum abaxially; segments regular, 60-66, rigid, free for 50-55% of their length, apical cleft 3-5% of the length of the free segment, lobes acute to acuminate; parallel veins very prominent, 8-9 each side of midrib; transverse veins thin, extending across 2-5 parallel veins, density of c. 16 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 100-230 cm long; partial inflorescences 7-9, branched to 4 orders; peduncular bract 1, with orange-brown scales; rachis bracts with orange-brown scales; rachillae densely granular to papillose, 5-16 mm long. **Flowers** solitary or in clusters of 2-3, funnel-shaped, yellow, 1.6-2 mm long; sepals narrowly triangular, 1-1.3 mm long, membranous, acute; petals broadly ovate, 1.6-2 mm long, thick, acute; stamens c. 1.6 mm long. **Fruit** globose, 12-16 mm diam., dull black, pruinose; epicarp smooth; suture line not obvious; mesocarp thin, fibrous; endocarp thin, crustaceous. **Seed** globose, 10-13 mm long. **Eophyll** 5-ribbed. *Blackdown fan palm.* Fig. 2.28.



DISTRIBUTION. Australia. Queensland. Endemic to Blackdown Tableland [23°S]. The dot on the map represents four collections.

HABITAT AND ECOLOGY. Grows in moist sites in open forest and woodland, in gullies and gorges near streams and waterfalls at cliff bases. Confined to sandstone areas. Flowers Sept.– Feb.; fruits Dec.–May.

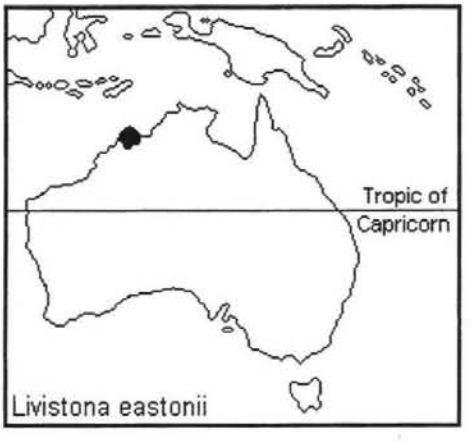
Figure 2.28. ***Livistona fulva.*** Habit, Blackdown Tableland, Queensland, Australia.

SPECIMENS SEEN. AUSTRALIA: Queensland. Blackdown Tableland, *A. K. Irvine 1903* (QRS); N escarpment, *D. L. Jones 6338 & B. E. Jones* (CANB); 23°05'S, 149°00'E, 14 Sept. 1971, *R. J. Henderson 1180* (K); c. 35 km SE of Blackwater, 23°05'S, 149°00'E, 14 Sept. 1971, *L. Durrington & P. Sharpe 1180* (MEL).

NOTES. The relationships of *L. fulva* are unclear. It is similar to *L. muelleri* in having a flat rigid lamina, to *L. decora* in inflorescence size and morphology, and to *L. victoriae* in overall size and fruit morphology.

29. *Livistona eastonii* C. A. Gardner, Forest Depart. Bull. Western Australia 32: 36 (1923) [as *L. Eastoni*]. Type: Lectotype (*fide* Rodd, 1998). Australia. Western Australia, Broome Bay, Napier, Lower King Edward River, 22 Aug. 1921, *C. A. Gardner 1544* (lectotype PERTH; isolectotypes B, BH, CANB, K, MEL).

Functionally dioecious palm. **Trunk** to 15 m tall, 10-15 cm dbh, grey, nodes raised, internodes congested, leaf-bases often persistent. **Leaves** 10-20 in an open globose crown; petiole 50-200 cm long, 1.4-2 cm wide, arcuate, margins with single or double curved brown spines throughout its length but largest and closer in the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina sub-circular, 60-90 cm long, coriaceous, pale greyish green adaxially, lighter abaxially, yellowish with age, pruinose, waxy; segments regular, 40-50, rigid, free for 50-90% of their length, apical cleft 49-63% of the length of the free segment, apex of lobes acute; parallel veins 5-9 each side of midrib, more prominent than transverse veins which are thin and extend across 3-6 parallel veins; transverse vein density c. 12 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 100-200 cm long; partial inflorescences 5-6, branched to 4 orders; prophyll not seen; peduncular bract 1, tubular; rachis bracts tubular with scattered scales; rachillae glabrous, 1-9 cm long. **Flowers** solitary or in clusters of 2-4, 1.6-1.9 mm long, campanulate, cream to yellow; sepals broadly ovate, 0.2-1 mm long, fleshy, acute; petals narrowly ovate, 0.5-1.9 mm long, thick, acute; stamens c. 1.5 mm long; pollen symmetrical–asymmetrically ellipsoid; aperture symmetrical, as long as long axis; apices of sulcus acute; long axis (22-) 25.1 (-27) μm; wall thickness c. 1.5 μm; tectum tectate; ornamentation perforate. **Fruit** ellipsoid to obovoid, 12-16 mm long, 8-9 mm diam., glossy, purple black; epicarp smooth; pedicel 0.5-2 mm long. **Seed** ellipsoid, 10-13 mm long. Fig. 2.29.



DISTRIBUTION. Australia. Western Australia. In the Kimberley Region confined to the Mitchell Plateau to as far south as Doongan Station [14-16°S]. The dots on the map represent 13 collections.

Figure 2.29. ***Livistona eastonii*** ***Left:*** Habit, near Doongan Station, Kimberleys, Western Australia. ***Right:*** Type specimen, *Gardner 1544* [PERTH], Lower King Edward River, Western Australia, 1921.

HABITAT AND ECOLOGY. Grows in a strongly monsoonal climate in open woodland, usually on flat sites or depressions and forms extensive colonies. Soils are lateritic in origin. Flowers Apr.– Sept.; fruits Dec.-June.

SPECIMENS SEEN. AUSTRALIA: Western Australia. 15 miles S of mouth of Mitchell R., 20 Jan. 1973, *J. Schultze s. n.* (PERTH); Mitchell Plateau, 15 miles [c.23 km] N of Amax Bauxite Camp, 1 June 1971, *J. R. Maconochie 1281* (BRI, K, L, PERTH); Mitchell Plateau Airfield, 14°47'S, 125°48'E, 13 June 1976, *R. J. Hnatiuk MP28 & MP36* (PERTH); 2.9 km SE of Mitchell Plateau mining camp, 14°50'S, 125°51'E, 23 Apr. 1977, *A. S. George 14503* (PERTH); 10 km SE of mining camp on track to Mitchell Falls Homestead, 14°53'S, 125°55'E, 11 May 1983, *P. A. Fryxell & L. A. Craven 4044* (MEL, PERTH, UC); 11 km N of Doongan Homestead, 15°21'S, 126°13'E, 25 June 1978, *A. S. George 15220* (PERTH); 8 km N of Doongan Homestead, 15°22'S, 126°13'E, 25 June 1978, *A. S. George 15221* (PERTH); Doongan Station, Crosland Creek at Gibb

River, 15°23'S, 126°17'E, 380 m alt., 24 July 1977, *I. R. Telford 6096 with G. Butler* (PERTH); 15 km S of Doongan Station, 34 km N of Drysdale River Crossing, 15°25'S, 126°18'E, 7 June 1984, *S. J. Forbes 2293* (L, MEL, PERTH); 25 miles N of new Drysdale Station, 28 May 1971, *J. R. Maconochie 1228* (LAE, NY, PERTH); 40 km N of Drysdale HS on Kalumburu Rd, *J. L. Dowe 360* (BRI); 40 km N of Drysdale Station crossing, 15°25'S, 126°18'E, 7 June 1984, *J. H. Willis s. n.* (MEL, PERTH); Kimberley District, 4 May 1922, *S. L. Kessell s. n.* (MEL).

NOTES. Gardner (1923) described *Livistona eastonii* from Lower King Edward River in Western Australia, and named the species for William R. Easton, who commanded the Kimberley Exploration Expedition in 1912 of which Gardner was the botanist. Gardner cited no specimens in the protologue, and Rodd (1998) chose *Gardner 1544* [PERTH] (Fig. 2.29), a specimen collected from the Lower King Edward River in Western Australia, as the lectotype.

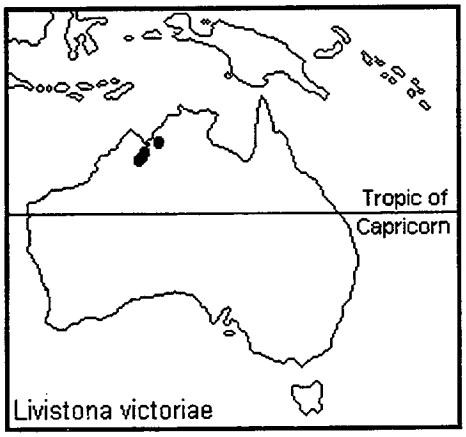
The relationships of *L. eastonii* lie with *L. humilis*, but it is distinguished by its larger size, and by not having sexually dimorphic inflorescences. Wilson (1992) described *L. eastonii* as dioecious, but provided only a description of 'male flowers', and noting that the 'female flowers' were not seen.

30. *Livistona victoriae* A. N. Rodd, Telopea 8: 123 (1998). *Livistona* sp. 'B', Wilson, Fl. Kimberley Region 1250 (1992). Type: Australia. Northern Territory, Victoria River Crossing, Katherine-Kununurra Rd, 3 Nov. 1974, *A. N. Rodd 2934* (holotype NSW *n. v.*).

Functionally dioecious palm. **Trunk** to 17 m tall, 15-30 cm dbh, grey, smooth, nodes and internodes obscure, petiole stubs not persistent. **Leaves** 25-40 in an open globose crown, rigid, arcuate to drooping; petiole 80-200 cm long, pruinose, triangular in cross section, adaxially flat, abaxially rounded, margins with scattered, single, curved, blunt, black thorns, confined to the proximal portion; leaf-base fibres moderately prominent, fine, persistent; lamina sub-circular, 80-110 cm long, coriaceous, adaxially grey green or bluish green, strongly pruinose, dull, abaxially similar; segments regular, 40-56, rigid, free for 55-65% of their length, apical cleft 55-70% of the length of the free segment, apical lobes attenuate; parallel veins 9-11 each side of midrib, more prominent than transverse

veins which are very thin, extend across 2-4 parallel veins, density of c. 20 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 50-150 cm long; partial inflorescences 5-9, branched to 4 orders; prophyll not seen; peduncular bract 1; rachis bracts loosely sheathing, fibrous with age, densely tomentose; rachillae 1-3 cm long, glabrous, striate. **Flowers** solitary or paired, funnel shaped, 2-4 mm long, cream to pale yellow; sepals triangular, 0.7-0.8 mm long, membranous, acute; petals narrowly ovate, 1.2-1.5 mm long, acute; stamens c. 0.9 mm long. **Fruit** globose to ellipsoid, 8-15 mm long, c. 10 mm diam., dark reddish brown to black, dull; epicarp smooth; suture line for most of the length of the fruit; mesocarp thin, fibrous; endocarp thin, brittle; pedicel 0.5-1 mm long. **Seed** globose, c. 9 mm diam. **Eophyll** 3-ribbed. *Victoria River fan palm.* Fig. 2.30.

Figure 2.30. ***Livistona victoriae.*** Habit, Jasper Gorge, Northern Territory, Australia.



DISTRIBUTION. Australia. Northern Territory and Western Australia. In the region between the Victoria River basin and the Bungle Bungle Ranges [15-17°S]. The dots on the map represent seven collections.

HABITAT AND ECOLOGY. Grows in open forest in sandstone gorges, at escarpment bases and along streams and intermittent watercourses. Flowers Mar.-Dec.; fruits Dec.-July.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Jasper Gorge, 2 km S of Charles Crossing, *J. L. Dowe 208* (BRI, FTG); Victoria R., *C. R. Dunlop 3158* (DNA). Western Australia. Kimberleys, 16 km NE of Bungle Bungle Outcamp, 17°13'S, 128°26'E, 5 July 1984, *K. F. Kenneally 9212* (PERTH); between Njitparriya and Dilmariyu, 3 km SE of Bungle Bungle Outcamp, 17°21'30"S, 128°21'30"E, 9 July 1984, *S. J. Forbes 2587* (BRI, MEL); between Njitparriya and Dilmariyu, 3 km SE of Bungle Bungle Outcamp, 17°21'30"S, 128°21'30"E, 9 July 1984, 320 m alt., *N. H. Scarlett 315* (MEL); Kimberleys, 15 km SE of Bungle Bungle Outcamp, Piccaninny Creek Gorge, 17°27'S, 128°25'E, 6 Apr. 1985, *M. I. Blackwell BB419* (PERTH); 7 miles E of Denham River Station, 19 July 1949, *R. A. Perry 2529* (MEL, US).

NOTES. *Livistona victoriae* was described by Rodd (1998) based on a collection from Victoria River Crossing, *Rodd 2934* [NSW], and named with reference to the species occurrence in the vicinity of the Victoria River and also to complete the trio of names of *L. alfredii* and *L. mariae,* species named for Queen Victoria's son and daughter-in-law respectively. Previously the palm had informally been known as '*Livistona* sp. Victoria River' (Jones, 1996).

Relationships of *L. victoriae* are with *L. alfredii* but is distinguished by its smaller stature, open rather than dense crown, shorter inflorescence, partial inflorescences branched to four rather than three orders, and by its smaller fruit. Morphologically it is also closely related to *L. carinensis.*

31. ***Livistona drudei*** F. Muell. ex Drude, Bot. Jahrb. Syst. 39: 12 (1893); Mueller, Fragm. 11: 55 (1878), *nom. provis.*; Fragm. 11: 147 (1878), *nom. in index*; Beccari in Webbia 5: 15, 19 (1921). Type: Lectotype (*fide* Rodd, 1998). Australia. Queensland, Rockingham Bay, Sept. 1865, *Dallachy s. n.* (lectotype MEL).

[*Livistona inermis auct. non* R. Br., Wendland and Drude, Linnaea 39: 229 (1875) *pro. parte*].

Functionally dioecious palm. **Trunk** to 28 m tall, 15-20 cm dbh, pale grey, smooth; internodes 2-10 cm long; nodes 1-2 cm wide. **Leaves** 30-60 in an open globose or inverted-conical crown; petiole 150-230 cm long, 15-25 mm wide, adaxially ridged, abaxially rounded, purple in basal portion, green distally, margins with single, curved reddish spines largest and closer in the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina ± circular, 100-150 cm long, coriaceous, adaxially dark green, abaxially lighter green, glossy; segments regular, 60-84, distally pendulous, free for 60-70% of length, apical cleft c. 60% of the length of the free segment, lobes attenuate; parallel veins c. 7 each side of midrib, more prominent than transverse veins which are thin and extend across 2 parallel veins; density of transverse veins c. 14 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 150-300 cm long; 7-8 partial inflorescences, branched to 3 orders; peduncle subterete, 15-25 mm diam.; prophyll glabrous; peduncular bract 1; rachis bracts tightly tubular, glabrous, apices with acuminate lobes; rachillae minutely pubescent, 1-8 cm long; **Flowers** solitary or in clusters of 2-5, funnel-shaped, 1.7-2.2 mm long, cream to yellow; sepals narrowly triangular, 1.3-1.5 mm long, fleshy, subacute; petals broadly ovate, 1.7-2 mm long, fleshy, apex thickened; stamens c. 1.5 mm long; pollen symmetrically ellipsoid; aperture as long as the long axis; apices of sulcus acute; long axis (23) 26.6 (-34) μm; wall thickness 1-1.5 μm; tectum tectate; ornamentation similar over entire grain; tectum surface psilate; ornamentation microchanneled and of small diameter. **Fruit** globose to pyriform, 10-12 mm long, 10-11 mm diam., semi-glossy purple-black; epicarp with scattered lenticellular pores; suture line extends for about ½ length of fruit, marked with lip-like structures; mesocarp thin, fibrous; endocarp thin, brittle; pedicel 1-2 mm long. **Seed** ellipsoid, 8-9 mm long. **Eophyll** 5-ribbed. Fig. 2.31.

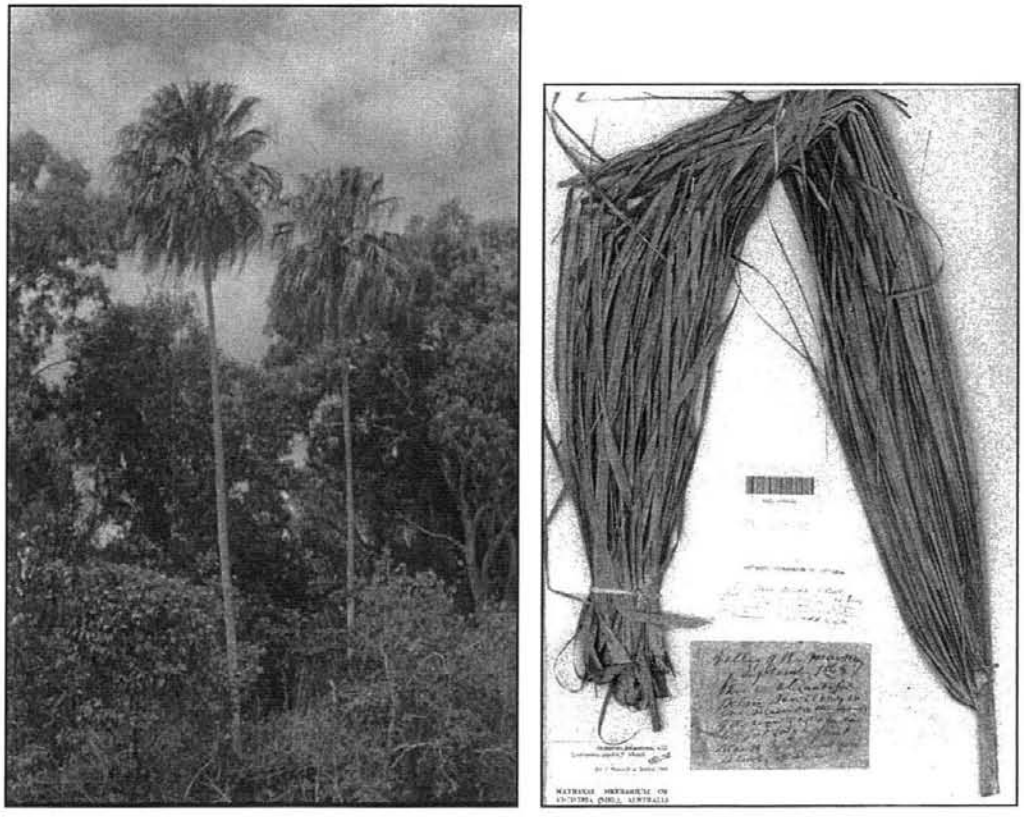
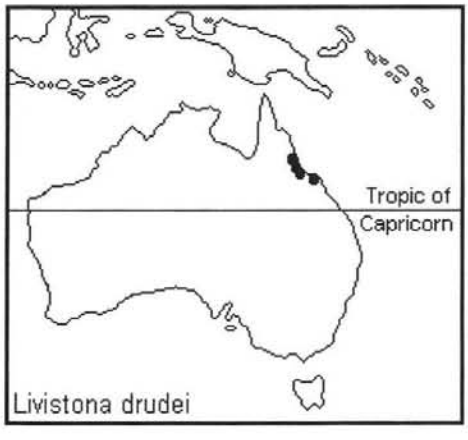


Figure 2.31. ***Livistona drudei.*** ***Left:*** Habit, Hen Camp Creek, Queensland, Australia. ***Right:*** Type specimen, *Dallachy s. n.* [MEL], Rockingham Bay. Queensland, 1865.



DISTRIBUTION. Australia. Queensland. Between Kurrimine Beach and Conway Range [18-20°S]. The dots on the map represent four collections.

HABITAT AND ECOLOGY. Grows in coastal and near-coastal regions on the landward side of mangroves, open forest and swamp forest on coastal plains and along the margins of streams and estuaries at low elevations. Flowers Aug.-Dec.; fruits Dec.-June.

SPECIMENS SEEN. AUSTRALIA: Queensland. Kurrimine Beach, 1 km N of Maria Ck, *J. L. Dowe 281* (BRI, FTG); Halifax, 2 km on road to Lucinda, *A. K. Irvine 1832* (QRS); Conway Beach, 20 km from Proserpine, *J. L. Dowe 329* (BRI, FTG); Herbert R., 1886, *Dittrich s. n.* (MEL).

NOTES. *Livistona drudei* was first mentioned informally by Mueller (1878) as "*....palme nunc pro speciei vel varietatis distictione nomen Doctoris Oscaris Drude impono....*", followed by the use of the name *L. drudei* in the index of the same volume. Drude (1893) reviewed this taxon and applied a brief description, thus validating the name. However, no specimens were directly linked to either Mueller's or Drude's treatments, although Mueller (1878) mentioned a specimen from 'Rockingham's Bay' that Wendland and Drude (1875) had used, incorrectly, as reference in their treatment of *L. inermis*. The lectotype chosen by Rodd (1998) is the 'Rockingham's Bay' specimen *Dallachy s. n.* [MEL] (Fig. 2.31).

Beccari (1931) provided a thorough description based on additional specimens, but did not cite the Dallachy specimen. Rodd (1998) interpreted Beccari's (1931) description as formalising the name, but the fact that Beccari did not mention the Dallachy specimen weakens this assessment, and therefore I have chosen Drude's (1893) treatment as the valid place of publication of the name.

Although of gross similar appearance to *L. decora*, with which it shares deeply segmented laminae with pendulous segment apices, its relationships appear to lie elsewhere. Closest relationships appear to be with *L. concinna* and *L. benthamii*, with which it shares a moderate sized inflorescence and smallish fruit. However, it does not display the sexually dimorphic inflorescences of the former or the retained petiole stubs of the latter.

32. *Livistona lorophylla* Becc., Webbia 5: 18 (1921) [as *L. loriphylla*]. Type: Australia. Western Australia, Cambridge Gulf, 1885, *Johnston s. n.* (holotype FI *n. v.*; isotypes NSW, MEL).

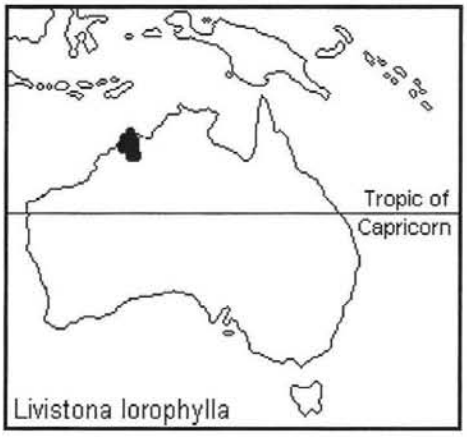
Livistona kimberleyana A. N. Rodd, Telopea 8: 121 (1998) ***syn. nov.*** *Livistona* sp.

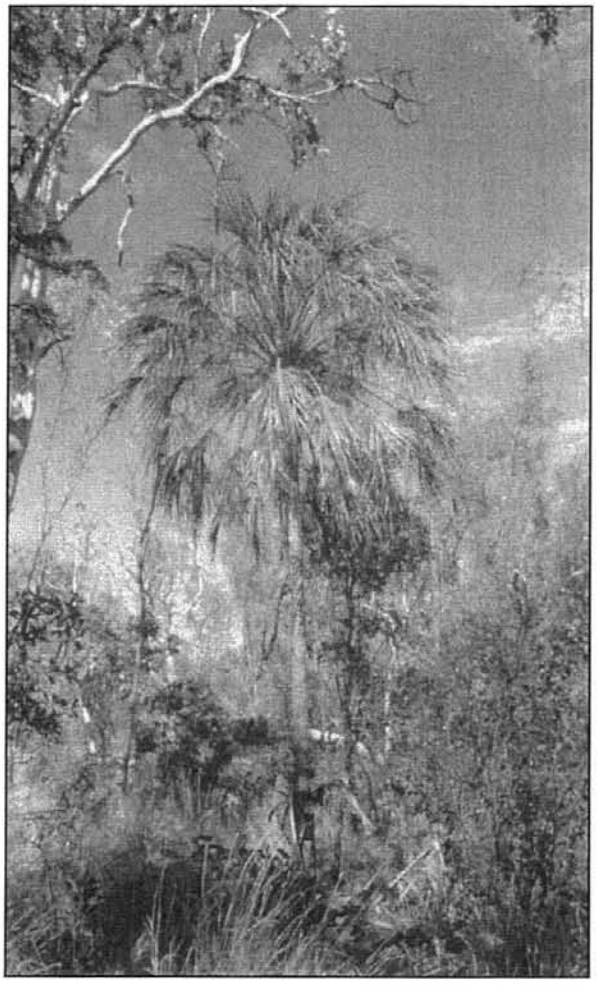
'A', Wilson, Fl. Kimberley Region 1250 (1992). Type: Australia. Western Australia, Kimberley Region, Durack Ra., Mt King, 24 Oct. 1974, *A. N. Rodd 2866* (holotype NSW *n. v.*; isotypes CANB, K, PERTH).

[*Livistona alfredii auct. non* F. Muell., W.V. Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3: 24 (1918); C. A. Gardner, Forest Depart. Bull. Western Australia 32: 36 (1923)].

Functionally dioecious palm. **Trunk** to 15 m tall, 8-20 cm dbh, grey, nodes raised, internodes congested, base with persistent petiole stubs. **Leaves** 25-40 in an open globose crown, arcuate to drooping; petiole 70-200 cm long, 10-17 mm wide, base green, triangular in cross section, adaxially flat, abaxially rounded, margins with small scattered single curved black spines; leaf-base fibres moderately prominent, coarse, persistent; lamina circular, 60-100 cm long, coriaceous, glossy mid green to pruinose grey on both surfaces; segments regular, 34-50, rigid, free for 85-98% of their length, apical cleft 55-78% of the length of the free segment; apices semi-pendulous, lobes acuminate to filiform; parallel veins 8-10 each side of midrib, very prominent; transverse veins thin, extending across 2-3 parallel veins, density c. 10 per unit area of 15x10 mm. **Inflorescence** not branched at the base, 20-160 cm long; partial inflorescences 4-8, branched to 3 orders; prophyll not seen; peduncular bract 1; rachis bracts sparsely tomentose; rachillae glabrous, 1-6 cm long. **Flowers** solitary or in clusters of 2-4, broadly funnel-shaped, 1.2-3 mm long, cream; sepals triangular, 0.7-1.8 mm long, membranous, acute; petals triangular to broadly ovate, 1.2-3 mm long, acute to cuspidate; stamens c. 1.6 mm long; pollen ellipsoid, c. 23 μm long, c. 18 μm wide. **Fruit** obovoid-pyriform, 8-14 mm long, 6-9 mm diam., dull black pruinose; epicarp with scattered lenticellular pores; mesocarp thin, fibrous; endocarp thin, crustaceous. **Seed** ellipsoid, 7-9 mm long. Fig. 2.32.

DISTRIBUTION. Australia. Kimberley region of Western Australia, from Sir Graham Moore Island to Cambridge Gulf, and inland to the King Leopold and Durack Ranges [14-18°S]. The dots on the map represent 33 collections.
HABITAT AND ECOLOGY. Grows in open forest and woodlands, and on sandstone outcrops and gorges. Flowers Aug.-Dec.; fruits Dec.-July.





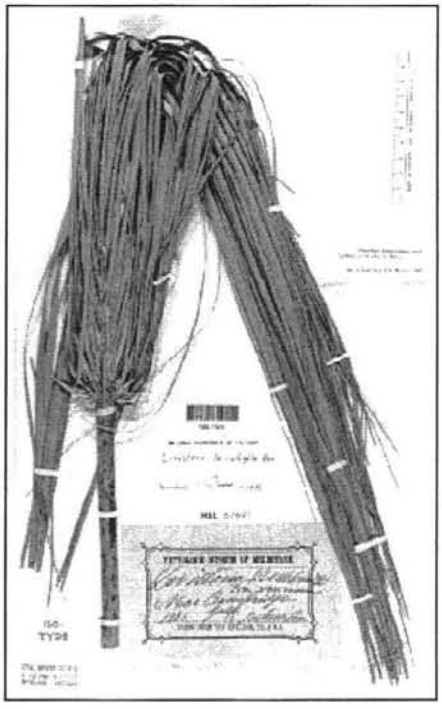


Figure 2.32. ***Livistona lorophylla.*** ***Left:*** Habit, near Pentecost River, Western Australia. ***Right:*** Type specimen, *Johnston s. n.* [FI], Cambridge Gulf, Western Australia, 1885.

SPECIMENS SEEN. AUSTRALIA: Western Australia. S slopes of Sir Graham Moore Island facing the Geranium Islands, 3 Apr. 1991, *T. Willing 293* (PERTH); Sir Graham Moore Island, 13°56'S, 126°33'E, 30 June 1973, *P. G. Wilson 11222* (PERTH); North Kimberley, Sept. 1954, *N. H. Speck 4916* (PERTH); Kalumburu, 6 Jan. 1974, *I. Crawford 58* (PERTH); 19 km W of Cape Rulhiers, 13°56'05"S, 127°11'10"E, 4 June 1987, *K. F. Kenneally 10145* (PERTH); Kalumburu, 18 Jan. 1975, *F. Lullfitz s. n.* (PERTH); Kalumburu, 3 July 1960, *Douglas & Mees s. n.* (PERTH); 190 km W of Wyndham, Gibb River-Kalumburu Mission Road, 1.5 km S of Doongan River, 31 May 1976, *A. C. Beauglehole 51787* (PERTH); Mitchell Plateau, N of mining camp, 24 Aug. 1978, *A. C. Beauglehole 59046 with E. G. Errey 2746* (PERTH); Drysdale River NP, Fern Gulley, 14°39'S, 126°57'E, 20 Aug. 1975, *K. F. Kenneally 4557* (PERTH); Drysdale River NP, 14°40'S, 123°00'E, 12 Aug. 1975, *A. S. George 13758* (PERTH); Drysdale River NP, Planigale Creek, 14°43'S, 126°54'E, 19 Aug. 1975, *K. F. Kenneally 4447* (PERTH); Drysdale River NP, Cracticus Falls, 14°47'S, 127°05'E, 9 Aug. 1975, *K. F. Kenneally 4153* (PERTH); Drysdale River NP, Carson Escarpment Plateau, 2 km N of Face Point (at Laryoo), 14°50'30"S, 126°48'30", 240 m alt., 11 June 1984, *S. J. Forbes 2341S* (MEL); Brunswick Bay, Unwins Island, 15°08'S, 124°48'E, 8 July 1973, *P. G. Wilson 11450* (PERTH); West Kimberleys, upper reaches of Roe River, 15°12'S, 125°32'E, 27 May 1987, *K. F. Kenneally 9991* (PERTH); Prince Regent River Reserve, Marigui Promontory, 15°20'S, 124°56'E, 27 Aug. 1974, *K. F. Kenneally 2162* (PERTH); King Leopold Ranges, Sale River 29.2 km WSW of Mt French, 15°59'15"S, 124°38'30"E, 25 June 1987, *J. J. Alford 1402* (PERTH); Chamberlain River Gorge, 7 km W of El Questro Station Homestead, 16°00'S, 127°55'E, 30 June 1989, *K. F. Kenneally 10978* (PERTH); El Questro Station, Cambridge Gulf, 100 m E of Pentecost R, *J. L. Dowe 362* (BRI, FTG); Sale River, 15.5 W of Mt Lochee, 16°04'00"S, 124°45'45'E, 80 m alt., 19 June 1987, *K. F. Kenneally 10464* (PERTH); West Kimberleys, gorge of unnamed creek running W of Sale River 30 km ESE of mountain, 15 May 1984, *K. F. Kenneally 9652* (PERTH); West Kimberleys, 6.5 km NW of Kimbolton Homestead on mid Stewart River, 16°41'S, 123°50'E, 21 Aug. 1983, *B. Hastings B2* (PERTH); West Kimberley, 1910, *F. M. House s. n.* (PERTH); Kimberleys, 54.7 km SW of turnoff to Beverley Springs Homestead, Gibb River road, 2 June 1986, *K. F. Kenneally 9793A* (PERTH); King Leopold Ranges, 2 km W of March Fly Glen towards Derby on Gibb River road near Mt Bell, 17°10'S, 125°17'E, 20 Aug. 1983, *B. B. Hastings 1* (PERTH); King Leopold Ranges, 26 km NE of Inglis Gap, *J. L. Dowe 356* (BRI); S base of Mt King, Durack Ra., *A. N. Rodd 2868* (QRS); King Leopold Ranges, Lenard River Gorge, c. 130 km ENE of Derby, undated, *G. W. Carr 3978 & Beauglehole 47756* (PERTH); King Leopold Ranges, Mt Herbert, May 1905, *Fitzgerald s. n.* (PERTH); King Leopold Ranges, 11 miles NE of Inglis Gap, 3 June 1971, *J. R. Maconochie 1296* (L); Mt Broome, May 1905, *Fitzgerald s. n.* (PERTH); Mt Leake, July 1905, *Fitzgerald s. n.* (PERTH).

NOTES. *Livistona lorophylla* was described by Beccari (1921) based on *Johnson s. n.* [FI] (Fig. 2.32) collected at Cambridge Gulf, Western Australia, and named for the resemblance of the leaf segments to leather straps.

Livistona kimberleyana was described by Rodd (1998) based on *Rodd 2866* [NSW] collected from Mt King, Western Australia. This taxon was distinguished from *L. lorophylla* primarily by grey pruinose rather than glossy green leaves. However, in some populations individuals exhibit intermediate leaf colour. As noted by Rodd: "....It is possible even that further study may show it to represent an arid race of *L. lorophylla*, but for the meantime it seems preferable to treat it as a distinct species." Other than leaf colour, there are no other characters to distinguish the taxa and *L. kimberleyana* is therefore placed as a synonym of *L. lorophylla*. The original spelling provided by Beccari (1921) was *L. loriphylla*. This was corrected to *L. lorophylla* by Rodd (1998).

Some populations now regarded as *L. lorophylla* had previously been assigned to other taxa. Fitzgerald (1918) misidentified it as *L. alfredii*, occurring in the King Leopold and Durack Ranges [= Rodd's *L. kimberleyana*], while Gardner (1923) noted it at the same locations, also under *L. alfredii*, as well as throughout the presently known distribution of *L. lorophylla* throughout the Kimberleys. Gardner (1930) also referred to *L. lorophylla* as *L. inermis* in a later systematic account. Conversely, populations of *L. inermis* in the Northern Territory have been incorrectly named as *L. lorophylla* (Chippendale, 1972).

Livistona lorophylla is most closely related to *L. inermis* but can be distinguished by its overall larger size, including greater height, stem diameter and leaf dimensions. The inflorescence of *L. lorophylla* has up to eight partial inflorescences but only three in *L. inermis*; and it possesses a single peduncular bract whereas it is absent in *L. inermis*. The fruit are semi-glossy in *L. lorophylla*, whereas they are glossy in *L. inermis*.

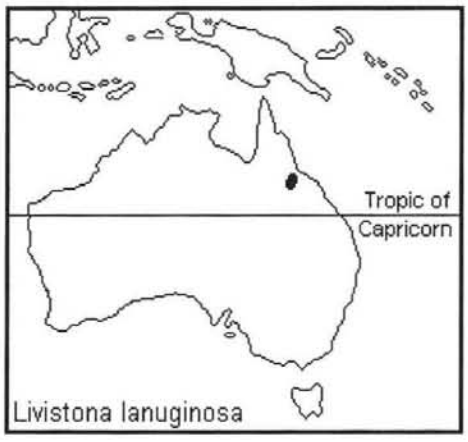
33. *Livistona lanuginosa* A. N. Rodd, Telopea 8: 82 (1998). Type: Australia. Queensland, S of Ravenswood, Glenroy Creek, 20°35'S, 147°10E, 25 Aug. 1978, *A. K. Irvine 1912* (holotype NSW *n. v.*; isotypes BH, BRI, MEL, QRS).

[*Livistona mariae auct. non* F. Muell., F. M. Bailey, Queensl. fl. 5: 1684 (1902)].

Functionally dioecious palm. **Trunk** to 18 m tall, 25-35 cm dbh, grey-brown, nodes raised, internodes 2-12 cm long, base with persistent petiole stubs; internodes raised; nodes short, compressed. **Leaves** 35-45 in an open rounded crown; petiole 150-200 cm long, 30-35 mm wide, densely floccose, triangular in cross section, adaxially flat, abaxially rounded, margins with small single, curved black spines confined to the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina circular, 130-190 cm long, coriaceous, pale grey-green adaxially, lighter grey-green abaxially, waxy, strongly pruinose; segments regular, 70-92, free for c. 34% of their length, apical clefts c. 24% of the length of the free portion; apices semi-pendulous, lobes acuminate-attenuate; parallel veins c. 8 each side of midrib, very prominent; transverse veins very thin, extending across 2-4 parallel veins, density c. 6 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 140-220 cm long; partial inflorescences 8-12, branched to 4 orders; prophyll densely tomentose; peduncular bracts 1-2, densely tomentose/lanuginose; rachis bracts loosely sheathing, not disintegrating, densely lanuginose; rachillae glabrous, 3-12 cm long. **Flowers** solitary or in pairs, funnel-shaped, 2.8-3 mm long, cream to yellow; sepals narrowly triangular, c. 1.5 mm long, fleshy, acuminate to aristate; petals triangular, 2.8-3 mm long, thick, acute; stamens c. 2 mm long; pollen ellipsoid, c. 15.3 μm long, c. 9.5 μm wide. **Fruit** globose, 25-35 mm diam., purple-brown to black with white flecks; epicarp with large lenticellular pores; suture line extends for about ½ the length of the fruit, marked with lip-like structures; mesocarp fibrous, dry; endocarp 2-3 mm thick; pedicel to 1 mm long. **Seed** globose, 18-22 mm long. **Eophyll** 5-ribbed. *Cape River Livistona*, *Burdekin Livistona*. Fig. 2.33.

DISTRIBUTION. Australia. Queensland. Restricted to tributaries of the middle Burdekin River [20°S]. The dots on the map represent three collections.

HABITAT AND ECOLOGY. Grows along the margins of streams and in gullies that flow seasonally, at low elevations. Flowers Mar.-Nov.; fruits Nov.-Jan.



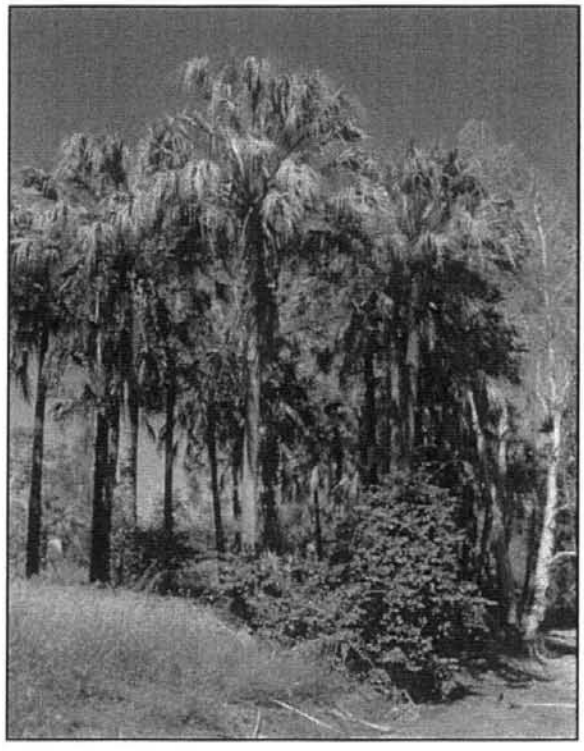


Figure 2.33. ***Livistona lanuginosa.*** Habit, Glenroy Creek, Queensland, Australia.

SPECIMENS SEEN. AUSTRALIA: Queensland. Glenroy Ck, 1 km N of junction with Stoney Ck, 15 km N of Burdekin Falls, *J. L. Dowe 292* (BRI, FTG); Nosnillor Stn, on Clermont Rd, 112 km S of Charters Towers, *A. K. Irvine 1914* (QRS); Amelia Creek, 9.8 km NW of Cape R. crossing on Pentland road, *J. L. Dowe 705 with N. Pettit* (JCT).

NOTES. *Livistona lanuginosa* was described by Rodd (1998) based on *Irvine 1912* [NSW] collected from Glenroy Creek, near Ravenswood, Queensland, and named for the densely lanuginose inflorescence bracts. Bailey (1902) had

previously determined the population to be *L. mariae*: "....I have received a portion of a leaf from *F. L. Berney*, of Hellenslie, Campaspe River, which in all probability belongs to this inland palm". Recently, the species was informally known as '*Livistona* sp. Cape River' (Jones, 1996). Most closely related to *L. mariae* and *L. rigida*, *L. lanuginosa* is readily distinguished by its much larger fruit and the densely lanuginose inflorescence bracts.

An historical account was provided by Leichhardt (1847) who noted this palm in the diary of his transcontinental expedition of 1846: "....(in the Burdekin River valley on 25 March 1846)....at the junction of the creek, a great number of small *Corypha* palms were growing, and my companions observed the dead stems of some very high ones, whose tops had been cut off by the natives, probably to obtain the growing shoot".

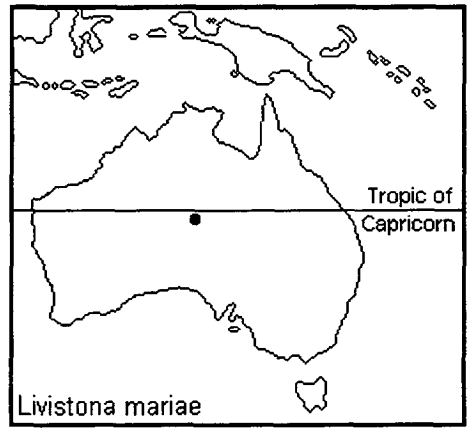
Livistona lanuginosa is one of Australia's most endangered palms. The population is very small, possibly only a few hundred individuals, all of which presently occur on private property in the middle tributaries of the Burdekin River. A primary threat is the consumption of seedlings by cattle, which is preventing regeneration.

34. *Livistona mariae* F. Muell., Fragm. 8: 283 (1874), *nom. provis.*; Giles, Geo. trav. central austral. 222 (1875), *nom. ined.*; Fragm. 11: 54 (1878). *Saribus mariae* (F. Muell.) Kuntze, Revis. gen. pl. 2: 736 (1891). *Livistona mariae* F. Muell. subsp. *mariae,* in A. N. Rodd, Telopea 8: 80 (1998). Type: Lectotype (*fide* Rodd, 1998). Australia. Northern Territory, Macdonnell Ranges, *E. Giles s. n.* (lectotype MEL).

Functionally dioecious palm. **Trunk** to 30 m tall, 30-40 cm dbh, grey, nodes stepped, raised, internodes 4-12 cm long, petiole stubs persistent only in the basal 1 m or so. **Leaves** 30-50 in a dense globose crown, obliquely erect to drooping; petiole 150-250 cm long, 20-45 mm wide, triangular in cross section, adaxially ridged, abaxially rounded, margins with small, single, curved, black spines in the proximal portion, smooth distally; leaf-base fibres moderately prominent, coarse,

persistent; lamina moderately folded, circular, 100-220 cm diam, rigidly coriaceous, adaxially grey green, glossy, abaxially lighter grey green, waxy pruinose; segments regular, 50-86, distally pendulous, proximal margins of outer segments with small spines; segments free for 45-55% of their length, apical cleft 45-65% of the length of the free segment, apex lobes attenuate; parallel veins 7-9 each side of the midrib, very prominent; transverse veins thin, extending across 2-3 parallel veins, density c. 5 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 125-250 cm long; partial inflorescences 10-14, branched to 4 orders; peduncular bracts 1, loosely sheathing with dense white-grey scales as are the rachis bracts; rachillae glabrous, 3-8 cm long. **Flowers** in clusters of 3-6, campanulate, 1-1.8 mm long, greenish cream to yellow; sepals ovate, 0.8-1 mm long, membranous, bluntly acute; petals broadly oblong, 1.2-1.5 mm long, acute; stamens c. 1.2 mm long. **Fruit** globose, 12-18 mm diam., black, semi-glossy; epicarp with scattered lenticellular pores; suture line extends for about ¾ the length of the fruit, marked with lip-like structures; mesocarp fibrous; endocarp thin, crustaceous. **Seed** globose, 8-12 mm long. **Eophyll** 3-ribbed. *Central Australian fan palm, Central Australian cabbage palm, Palm Valley Livistona.* Fig. 2.34.

DISTRIBUTION. Australia. Northern Territory. Endemic to the Finke River in the Macdonnell Ranges [24°S]. The dot on the map represents three collections.



HABITAT AND ECOLOGY. Grows along creek lines and watercourses with a permanent shallow water supply, and in sandstone gorges. The total population includes about 2000 mature individuals in Palm Valley and Little Palm Creek. Flowers July-Dec.; fruits Nov.-Feb.

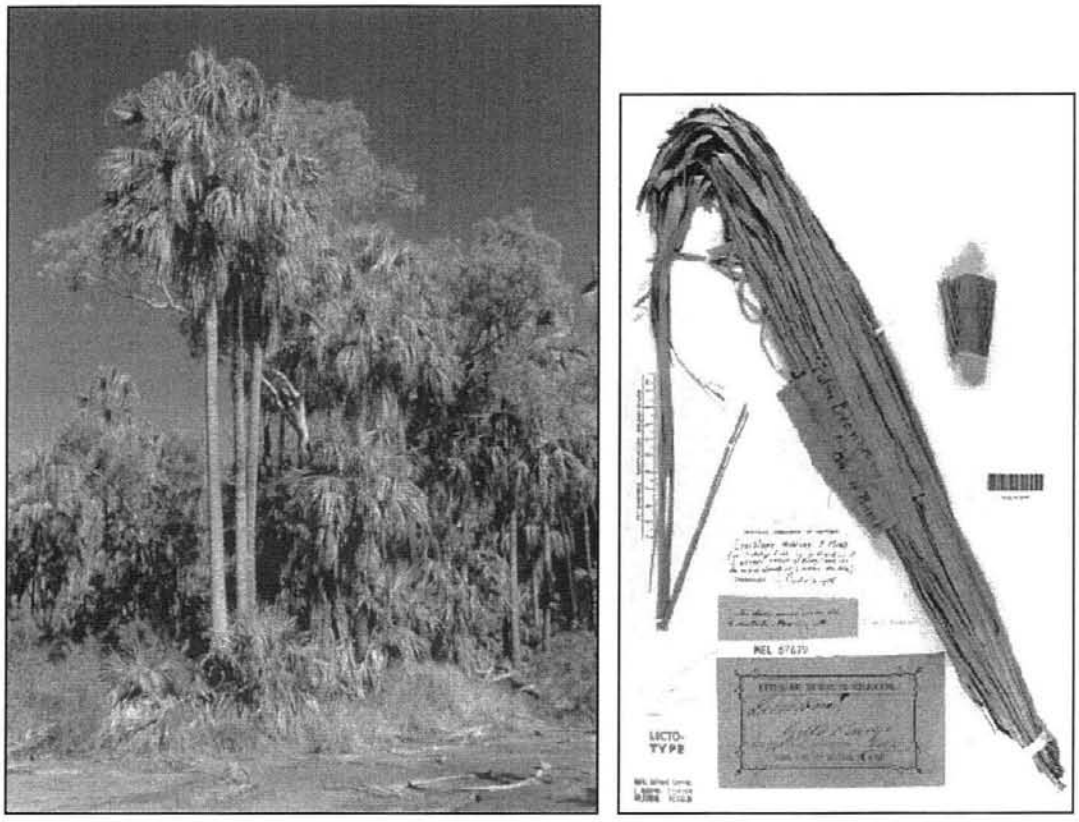


Figure 2.34. ***Livistona mariae***. ***Left:*** Habit, Finke River, Northern Territory, Australia. ***Right:*** Type specimen, *Giles s. n.* [MEL], Macdonnell Ranges, Northern Territory, undated.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Palm Valley, *A. N. Rodd 3215* (QRS); Finke Gorge NP, Palm Creek, 2 km W of carpark, *J. L. Dowe 352* (DNA); Palm Valley, c. 8 miles SSW of Hermannsburg Mission, 16 Sept. 1965, *J. H. Willis s. n.* (MEL).

NOTES. The name *Livistona mariae* was first used by Mueller (1874a) in notes under *L. leichhardtii*, with which he considered it may be conspecific. Previously, Mueller (1874a) had mentioned it only as the palm from the 'Glen of Palms' collected by Giles. These instances had no descriptions and in the former was considered as a provisional name only. A complete description in Mueller (1878) provided validation of the name. He named it in honour of the "*....Grandi-principi Mariae, Ducissae Edinensi, cultus hortorum nobilioris tam in Russia quam nunc in Brittania patronae imperiali*". However, Mueller's description included elements of another species ["*....Mill-stream fluminis Fortescue-River satis numerosa, F. Gregory, J. Forrest...*"], later described as *L. alfredii* from

Western Australia (Mueller, 1892). Although Mueller's description was based on specimens of more than one species, the name is validly published according to the rules of nomenclature (Chapman, 1991; Rodd, 1998).

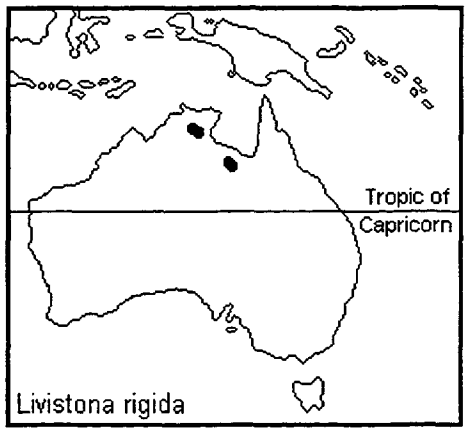
However, the identities of *L. mariae* and *L. alfredii* remained unclear to some botanists, with Gardner (1923) referring to the Millstream palm as *L. mariae* and applying *L. alfredii* to yet another as-of-then undescribed species in the Kimberleys. Other taxonomists (Drude, 1893; Beccari, 1931), however, were able to distinguish the two species.

The close relationship of *L. mariae* to *L. rigida* has been recognised by some authors. Johnson (1981) wrote of the relationship of *L. rigida*: "....very closely related to the Fan-Leaved palm (*L. mariae*) of central Australia and may even be conspecific....". Rodd (1998) resolved this by placing it as a subspecies of *L. mariae*, but noting his action as a temporary measure pending a thorough investigation. Considering the above, and while acknowledging that *L. mariae* and *L. rigida* are closely related, I have reinstated the latter to specific status. The leaves of *L. rigida* are comparatively smaller, the folding into a 'v' along the axis of the costa is considerably more pronounced and the segment apices are most often rigid rather than semi-pendulous. The fruit are also comparatively smaller, although occasionally *L. mariae* produces smaller than average fruits and *L. rigida* larger than average fruits.

35. *Livistona rigida* Becc., Webbia 5: 19 (1921). *Livistona mariae* subsp. *rigida* A. N. Rodd, Telopea 8: 80 (1998). Type: Australia. Queensland, Gulf of Carpentaria, Albert River, Aug. 1855, *F. Mueller s. n.* (holotype K).

Functionally dioecious palm. **Trunk** to 28 m tall, 30-40 cm dbh, grey, nodes raised, internodes congested, petiole stubs persistent in the basal 1 m or so, otherwise deciduous. **Leaves** 30-50 in a dense globose crown; petiole 150-250 cm long, 20-35 mm wide, triangular in cross section, adaxially channelled, abaxially rounded, margins with single curved reddish-black spines to 6 mm long in the proximal portion, otherwise smooth; leaf-base fibres moderately prominent,

coarse, persistent; lamina strongly folded, circular, 125-170 cm long, 100-150 cm diam., rigidly coriaceous, adaxially grey to glaucous, mid-green, semi-glossy, abaxially lighter; segments regular, 50-78, distally rigid or semi-pendulous, free for 50-55% of their length, apical cleft 30-63% of the length of the free segment, apex of lobes acuminate; parallel veins 5-7 each side of midrib, more prominent than transverse veins which are thin, extending across 2-3 parallel veins, density c. 15 per unit area of 15x10 mm. **Inflorescences** not branched at the base, 100-250 cm long; partial inflorescences 9-14, branched to 4 orders; prophyl 25-38 cm long, 8-9 cm wide; peduncular bract 1, densely to moderately scaled; rachis bracts loosely tubular with sparse white scales; rachillae glabrous, 3-8 cm long. **Flowers** in clusters of 3-8, globose, c. 1.8 mm long, cream to yellow; sepals broadly ovate, c. 2 mm long, thin, acute; petals triangular, 1.0-1.4 mm long, obtuse; stamens c. 1.2 mm long; pollen ellipsoid, c. 19 μm long, c. 9 μm wide. **Fruit** globose, 12-14 mm diam., black, semi-glossy; epicarp with scattered lenticellular pores; suture line extends for about ½ the length of the fruit, marked with lip-like structures; mesocarp fibrous; endocarp thin; pedicel c. 2 mm long. **Seed** globose, 9-11 mm long. **Eophyll** 5-ribbed. *Mataranka palm.* Fig. 2.35.



DISTRIBUTION. Australia. Queensland and Northern Territory [15-20°S]. In north-western Queensland on the Gregory, Leichhardt, Nicolson and Albert Rivers, and in the Northern Territory on the Roper and South Alligator Rivers. The dots on the map represent five collections.

HABITAT AND ECOLOGY. Grows along streams, on seasonally inundated banks, in creek lines and watercourses, sometimes with intermittent flow, but with a permanent shallow water supply. Flowers June– Dec.; fruits Nov.-May.

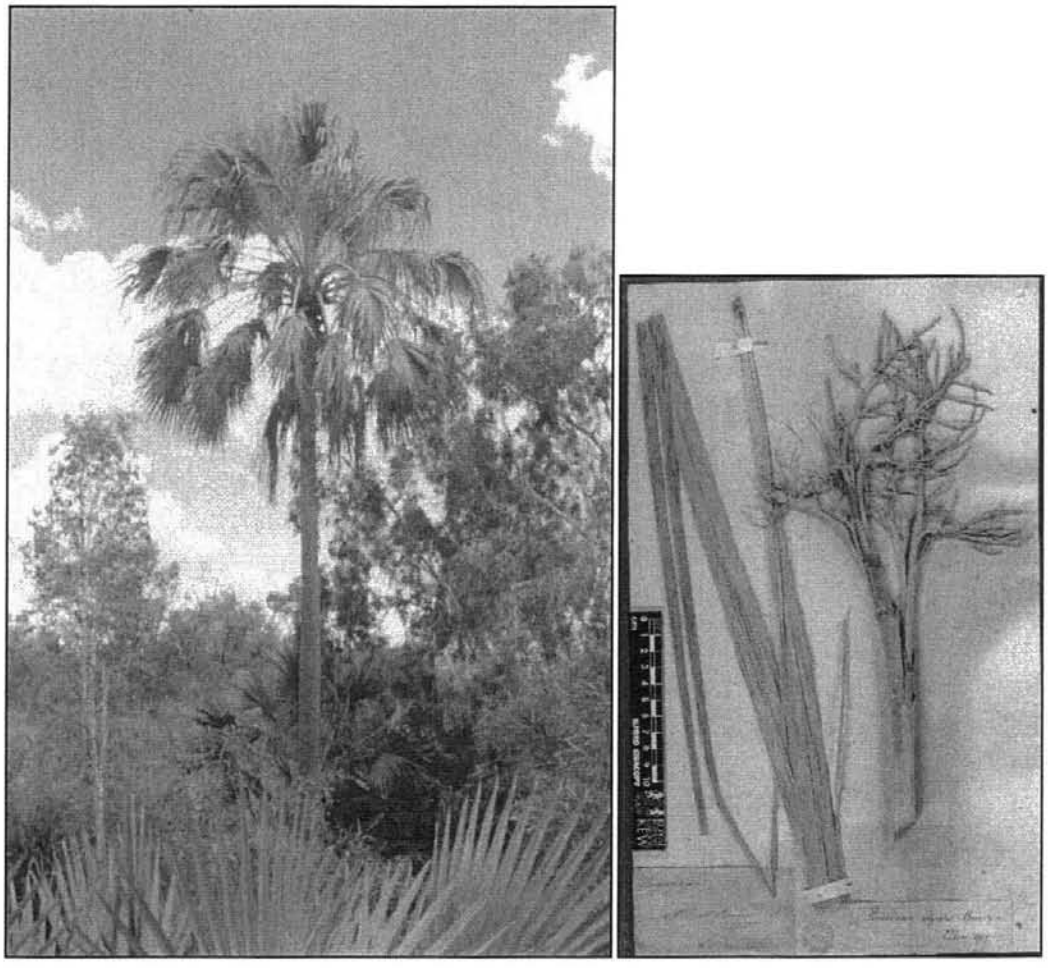


Figure 2.35. ***Livistona rigida.*** ***Left:*** Habit, Mataranka, Northern Territory, Australia. ***Right:*** Type specimen, *Mueller s. n.* [K], Albert River, Queensland, Australia, 1855.

SPECIMENS SEEN. AUSTRALIA: Northern Territory. Mataranka, *J. Must 1499* (DNA); Roper River, road crossing 1.5 km W of Mataranka Homestead, 14°55'S, 133°06'E, 120 m alt., 12 Jan. 1996, *J. L. Dowe 212* (JCT). Queensland. Gregory R., 10 km N of Gregory Downs, *A. K. Irvine 1856* (QRS); Lawn Hill Creek, 3 km above Lawn Hill Homestead, *A. N. Rodd 2937* (QRS); Adels Grove, Lawn Hill Creek, 500 m W of camping grounds, 18°41"55'S, 138°31"06'E, *J. L. Dowe 630 with A. Kazandjian* (BRI, JCT).

NOTES. *Livistona rigida* was described by Beccari (1921), based on a collection of which the collector was then not known (Fig. 2.35), from Albert River in the Gulf of Carpentaria, and named for the "....*spadix rigidus*". This specimen, deposited at K, is most probably one that was collected by Mueller during the 1855 North-Australian Expedition and sent to Kew. Mueller (1858) reported on the expedition, in which he noted: "....*Livistona inermis* and an allied species

supplied us occasionally with palm cabbage....", but whether the 'allied species' relates to *L. rigida* cannot be determined. But it is known that in August 1855 Mueller traversed the area in which *L. rigida* is now known to occur and collected extensively (Elsley, 1857; Mueller, 1857). Bentham (1878) included this same specimen as one of his reference specimens in his description of *L. humilis*, citing Mueller as the collector. However, his description certainly does not account for the size of the leaf in the Mueller specimen, as his description placed the radius of the leaf at "about 1½ ft." [c. 45 cm] whereas the leaf of *L. rigida* is 150-170 cm long. Beccari (1931), not knowing the size or habit of *L. rigida* as he described it on the unannotated Mueller specimen, suggested that Plate 145, fig. 4 and Plate 146 in Martius (1838) could belong to *L. rigida* based on the apparent large size of the leaf. Beccari argued that the leaf of *L. inermis*, the species that the illustrations were supposed to represent, were much smaller that those illustrated.

Livistona rigida is most closely related to *L. mariae* but is distinguished by smaller leaves, rigid or semi-pendulous segment apices and smaller fruits. See Notes under *L. mariae* for further discussion.

2.7 Excluded and uncertain names

Livistona subgen. *Livistonella* Becc., Ann. Roy. Bot. Gard. (Calcutta) 13: 53 (1931). Type: *Livistona rupicola* Ridley. = ***Maxburretia rupicola*** (Ridley) Furt.

Livistona ? bissula Mart., Hist. nat. palm. 3: 319 (1850). *Bissula* Rumph. Herb. Amboin. 1: 85 (1741). *Licuala ? bissula* Miq., Fl. Ned. Ind. 3: 57 (1855). *Saribus bissula* Bl. ex Pfister, Beitr. vergl. anat. Sabaleenblät. 25 (1892). Type: not designated. *Bissula* was the name applied by Rumphius (1741) to a fan palm collected in the Celebes. Rumphius' description does not allow for a positive identification, and therefore its identity and taxonomic position has been variously interpreted. Blume (1838) was the first to discuss the name, including it in his account of *Saribus*, and suggesting a possible relationship with *Licuala excelsa* Zipp. Martius (1838) similarly included it initially only in the mononomial form and placed it somewhat tentatively at the conclusion of his account, but was later (Martius, 1849) to combine it with *Livistona*, though with a question mark.

Miquel (1855) used it in combination with *Licuala*, including Martius' *Livistona bissula* as a synonym. Pfister (1892) used the name '*Saribus bissula* Bl.' in his study of the anatomy of the *Sabal* alliance, and concluded that it was near *Livistona*. Merrill (1917) noted that it "....may be neither a *Livistona* nor a *Licuala*; the description of the fruits is suggestive of *Pholidocarpus*...", while Beccari (1921, 1931) tentatively placed it as a synonym of ***Licuala celebica*** Miq. However, Miquel (1868) in his protologue of that species did not mention any relationship to Rumphius' *Bissula*, but rather placed it under *Livistona* with the suggestion that "*forsan ad L. rotundifoliam referenda*". As *Bissula* is a pre-Linnaean mononomial, the name is otherwise inadmissible under the ICBN.

Livistona diepenhorstii Hassk., Bonplandia 6: 180 (1858). Basionym of *Pholidocarpus diepenhorstii* (Hassk.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 15: 327 (1941). = ***Pholidocarpus ihur*** Miquel, Fl. Ned. Ind. 3: 47 (1855).

Livistona dournowiana Hort. ex Taylor, Bailey Stand. cycl. hort. 1896 (1943), *nom. nud.* A name without a description that appeared in a list of cultivated palms. However, Taylor (1943) provided a comparison with *L. chinensis*: "....is 'a new palm with lvs. resembling those of *Latania borbonica*', which is *Livistona chinensis*. Hab. (?)".

Livistona enervis Hort. ex Ill. Gart.-Zeitung 16: 346 (1891), *nom. nud.* This name was applied to a palm from the nursery collection of William Bull. The leaves were described as delicately textured and with narrow segments. The description is inadequate for correct identification.

Livistona eocenica Ettingsh. & J. S. Gardner, Proc. roy. soc. London 29: 393 (1879). A fossil taxon described from Sheppey, United Kingdom. Reid and Chandler (1933) synonymised it under *Hightea elliptica* Bowerb. (Myrtaceae?) *pro parte* and genus?, Cornaceae sect. Mastixioideae *pro parte*, but apparently not a palm. Type: not designated.

Livistona erecta (*fide* Moore, 1963b), *nom. nud.* Moore listed this name in his annotated list of cultivated plants as 'a name without botanical standing'.

Livistona filamentosa Hort. Petrop. ex R. Pfister, Beitr. vergl. anat. Sabaleenblät. 25 (1892). = ***Washingtonia filifera*** Wendl. ex Watts (Beccari, 1921). A name applied to *Washingtonia filifera.*

Livistona filifera Hort. ex Wendl., Kerchove, Palmiers 250 (1878), *nom. nud.* A name that appeared in a list of palms published by Kerchove. The lack of a description makes it unable to be identified or placed as a synonym, although in the list was appended with "vide *L. inermis* R. Br.".

Livistona (?) gaudichaudii Mart., Hist. nat. palm. 3: 242 (1849). Type: Hawaii. 1836, *Gaudichaud-Beaupré s. n.* [FI, P] = *Pritchardia gaudichaudii* (Mart.) H. Wendl. (Read and Hodel, 1990). = ***Pritchardia martii*** (Gaudichaud) H. Wendl., Bonplandia 10: 199 (1862).

Livistona kingiana Becc., Malesia 3: 199 (1889). Type: Malaysia. Perak, *Dr King s. n.* [holo FI *n. v.*] = ***Pholidocarpus kingianus*** (Becc.) Ridley, Mat. Fl. Malay. Penins. 2: 167 (1907) (*fide* Dransfield and Uhl, 1983b).

Livistona macrophylla Bruder, Lotos. Jahrbuch für Naturwissenschaften 10: 39 (1890); Bot. Centralbl. 41: 297 (1890). A fossil taxon described by G. Bruder from the Tertiary deposits of freshwater sandstone from Tuchorschitz, Sasser Region in Böhmen (present-day south-eastern Germany), collected by Carl Ihl prior to 1888. Location of the type specimen is not known.

Livistona macrophylla Roster in Bull. soc. Tosc. Ort. 29: 82 (1904), *nom. nud.* This is a name that appeared in a list of cultivated plants, and appears to be a name not associated with *L. macrophylla* Bruder (see previous entry).

Livistona martii Gaudichaud, Voy. Bonité, Atlas t. 58, 59 (1842). *Livistona (?) martiana* Gaudichaud ex Mart., Hist. nat. palm. 3: 242 (1849) *ortho. var.* Type: Lectotype. Illustrations in Gaudichaud, Voy. Bonité, Atlas t. 58, 59 (1842). = ***Pritchardia martii*** (Gaudich.) H. Wendl., Bonplandia 10: 199 (1862).

Livistona minima Reid and Chandler, London clay fl. 109 (1933). A fossil taxon described on a single seed from southern England. Type: United Kingdom. Sheppey, *Bowerbank V. 22021* [BM].

Livistona moluccana Hort. Petrop. ex. H. Wendl. in Kerchove, Palmiers 250 (1878), *nom. nud.* (*fide* Beccari, 1921). A name that appeared in a list of palms

published by Kerchove. The lack of a description makes it unable to be identified or placed as a synonym.

Livistona mülleri H. Wendl. ex Kerch., Kerchove, Palmiers 68 (1878), *nom. nud.* A name without a description that appeared in a list of palms.

Livistona occidentalis Hort. ex Hook. f., Report on the progress and condition of the Royal Gardens at Kew 1882: 64 (1884). = ***Brahea dulcis*** (Kunth) Mart. This name was used by Hooker in a list of palms cultivated in the Royal Gardens, Kew. He listed both *L. occidentalis* and *Thrinax tunicata* Hort. ex Verschaff. as synonyms of *Brahea dulcis.*

Livistona okinawensis Hort. ex L. H. Bailey, Hortus third 674 (1976), *nom. nud.* A name without a description that appeared in a list of cultivated palms.

Livistona ramsayi F. Muell., Fragm. 7: 221 (1874) Type: Australia. Queensland, Rockingham's Bay, *Ramsay s. n.* (holo MEL). = ***Licuala ramsayi*** (F. Muell.) Domin.

Livistona rupicola Ridley, Jour. Straits Branch Roy. Asiat. Soc. 41: 41 (1904). Type. Lectotype (*fide* Burret 1941). Malaysia. Selangor, Gua Batu, *Ridley 8285* (lectotype SING). = ***Maxburretia rupicola*** (Ridley) Furt.

Livistona saribus (Rumph.) Devansaye, Rev. Hort. 47: 34 (1875), *nom. illeg.* A combination published in a list of cultivated plants.

Livistona ternatensis Hort. ex Salomon, Palmen 174 (1887), *nom. nud.* A name without a description that appeared in a list of palms.

Livistona vidalii Becc., Webbia 1: 343 (1905). Type: Philippines. Luzon, Pampanga, Arayat, 27 Feb 1903, *R. Garcia 63* (holotype PNH, isotype FI) = *Corypha elata* Roxb. = ***Corypha utan*** Lam. (Beccari, 1919b). Beccari (1919b) related the illustration, T. 93 in Vidal (1883) as this taxon. Although the leaves somewhat resemble those of *L. saribus*, the flowers and fruits are of *C. utan.*

Livistona vogamii H. Sander ex Becc., Webbia 5: 22 (1921) (also as '*voganii*'), *nom. nud.* A name without a description, but suggested to be a possible synonym of "*L. cochinchinensis* Mart. ?" by Beccari (1921).