

## A Taxonomic Account of *Livistona* R.Br. (Arecaceae)

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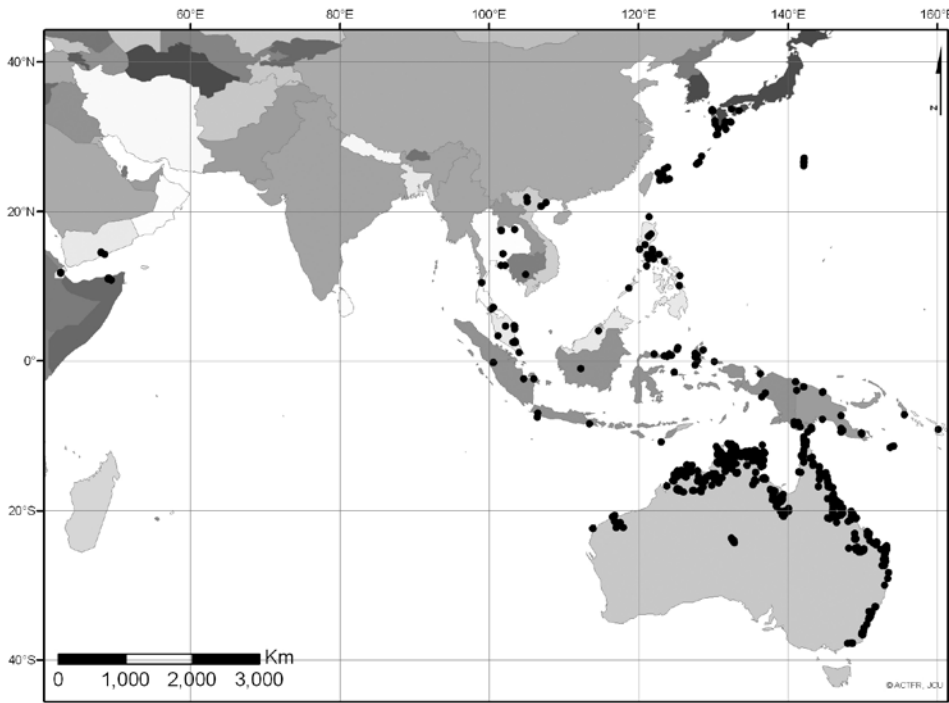
### Abstract

A taxonomic account of the palm genus *Livistona* is presented. Thirty-six species are recognised. Taxonomic and nomenclatural changes are applied to a number of species. *Livistona rotundifolia* (Lam.) Mart. is treated as a highly variable species, with *L. rotundifolia* var. *luzonensis* Becc., *L. rotundifolia* var. *microcarpa* (Becc.) Becc., *L. rotundifolia* var. *mindorensis* (Becc.) Becc. and *L. robinsoniana* Becc. placed as synonyms; *L. fengkaiensis* X.W.Wei & M.Y.Xiao is placed under *L. speciosa* Kurz; *Livistona chinensis* var. *subglobosa* (Hassk.) Becc. is placed under *L. chinensis* (Jacq.) R.Br. ex Mart.; *Livistona tonkinensis* Magalon is placed under *L. saribus* (Lour.) Merr. ex A.Chev.; and *Livistona kimberleyana* A.N.Rodd is placed under *L. lorophylla* Becc. A neotype is proposed for *L. saribus*, and lectotypes are chosen for *L. altissima* Zoll., *L. beccariana* Burret, *L. hoogendorpii* Hort. ex Teysm. & Binn. ex Miq., *L. olivaeformis* (Hassk.) Mart., *L. subglobosa* (Hassk.) Mart., *L. tonkinensis* Magalon, *L. woodfordii* Ridl., and *Chamaerops biroo* Siebold.

### Introduction

*Livistona* R.Br. is one of the most ecologically diverse and widespread genera of palms. It is distributed in the Horn of Africa and southern Arabia, throughout southeastern and eastern Asia, Malesia and Australia (Fig. 1). Because of this extensive distribution, the genus has received uneven taxonomic attention at the species level. In southeastern and eastern Asia, and Malesia, there appeared to be an over-description of species, with a number of taxa based on political boundaries (Dransfield, 1999). Considering that the genus is of major horticultural and economic importance, as well as ecologically diverse, it is timely to provide a revision of the genus over its entire distributional range.

*Livistona* is included in the subfamily Coryphoideae, within the tribe Trachycarpeae, and is one of five genera in the subtribe Livistoninae (Dransfield *et al.*, 2008). Genera in the Livistoninae possess the unique



**Figure 1.** Distribution of *Livistona*, based on herbarium specimen data.

character of three basally free carpels that are united by their styles. As circumscribed by Uhl and Dransfield (1987, p. 192), *Livistona* 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 related genus, *Pholidocarpus* Blume, is distinguished by a thick conspicuous androecial ring that is almost free at the base (in *Livistona* the androecial ring is scalloped apically and epipetalous), a top-shaped gynoecium (in *Livistona* it is widest above the locules), and large fruit to 6 cm diameter at maturity (in *Livistona* usually 1-4 cm) usually with a corky-warted epicarp (in *Livistona* it is always smooth). With regard to other closely related genera, *Livistona* is distinguished from *Licuala* Wurm by lanceolate, apically tapered rather than wedge-shaped apically broad leaf segments, while *Johannesteijsmannia* H.E.Moore has unsegmented diamond-shaped leaves, an inflorescence with several inflated peduncular bracts (in *Livistona* they are tightly tubular to loosely sheathing) and a warty epicarp on the fruit (in *Livistona* it is always smooth). The generic

boundaries of *Livistona* based on morphological characteristics are well defined (Tomlinson, 1990; Rodd, 1998). However, relationships inferred from molecular data, of some genera within the Livistoninae and with related groups, are not congruent with traditional classification (Asmussen and Chase, 2001), and are presently unresolved (Dransfield *et al.*, 2008).

### **Taxonomic history**

*Livistona* was established by Robert Brown (1810), and named for Patrick Murray (born 1634?, died 1671), Baron Livingston, whose plant collection at Livingston Estate near Edinburgh, was incorporated into the founding collection of the present-day Royal Botanic Gardens, Edinburgh, established in 1670 (Hyam and Pankhurst, 1995). The genus was first described with two species, *L. humilis* R.Br. and *L. inermis* R.Br., from northern Australia. *Livistona humilis* was subsequently chosen as the lectotype for the genus (Moore, 1963a) and the specimen collected by Brown from Morgans Is., in the Gulf of Carpentaria, was designated as the type specimen for that species.

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. Although Brown's broad circumscription of *Livistona* can be applied to other genera in the Livistoninae, *Livistona*, as it is presently understood, is readily distinguished from related genera (Uhl and Dransfield, 1987).

Prior to establishment of *Livistona* in 1810, other species that would eventually be included in *Livistona* had been named. The first was a pre-Linnaean monomial *Saribus*, described by Rumphius (1741), and which was later to be recognised as *Livistona rotundifolia* (Lam.) Mart. The first name in the Linnaean system was that provided by Lamarck (1786) who described *Corypha rotundifolia* Lam. This species was transferred to *Livistona* by Martius (1838). *Corypha saribus* Lour., described by Loureiro (1790), was to become *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) amended the description of *Livistona*, subsumed Brown's *Corypha* species, and Blume's *Saribus* species as well as some *Corypha* species of other authors. Subsequently

Martius (1849) also included the *Livistona* species described by Griffith (1845) from India and Malaysia. The circumscription provided by Martius firmly established the identity of *Livistona*, and was accepted by most taxonomists (Miquel, 1855; Wendland and Drude, 1875; Hooker, 1883). Treatments that proposed taxonomic changes were provided by Devansaye (1875), Kuntze (1891) and Drude (1893).

Odoardo Beccari made a significant contribution to *Livistona* taxonomy by describing many species in Australia, southeastern Asia and Malesia. Beccari's (1931) most detailed treatment of *Livistona* appeared in *Asiatic Palms - Coryphea*.

A unique chapter in *Livistona* taxonomy was provided by herbarium-based palm specialist, Max Burret (b.1883-d.1964), who described most specimens received by him in Berlin as new taxa (Henderson, 1999), and many of which have since been synonymised (Potztl, 1958), as they were narrowly described on limited materials. 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 in *Livistona* (Dransfield and Uhl, 1983a), thus providing an extension of the genus both in geographical range and morphological diversity.

More recently, Rodd (1998), in his revision of the genus in Australia, described five new species. One species was described for Vietnam (Nguyen and Kiew, 2000), and four species for New Guinea and one for Australia (Dowe and Barfod, 2001; Dowe and Moge, 2004). Dowe and Jones (2004) have recently applied nomenclatural changes to some Australian species.

### **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 widespread 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 southeastern

Asia and Malesia, various species have received conservation ratings and protection plans (Basu, 1991; Kiew, 1991; Madulid, 1991; Mogea, 1991; Lim, 2002, 2004; Lim and Chan, 2002). For Malaysia, Kiew (1989) applied a vulnerable/endangered status to *L. saribus* and rare but not threatened to other *Livistona* species for that area. 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), Welch and Welch (1998, 1999), and Ford and Bealy (2004).

A conservation status is herein applied to all species based on IUCN categories (IUCN, 2006). Some species of *Livistona* have been included in the most recent *Red List of Threatened Species*, and these are appropriately referenced. Established ratings have been reviewed and where necessary, a revised status has been suggested.

## Materials and Methods

The morphological species concept by Stuessy (1990) and Kanis *et al.* (1999) was used in this treatment to define species limits. Although systematists differ as to the precise definition of this concept, here 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 as in Greuter *et al.* (2000) were followed. In the taxonomic citations, pre-Linnaean names are placed in square brackets.

About 840 specimens were examined from the following herbaria: A, AD, 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 incorporated into the species descriptions. To obtain data that were not available from herbarium specimens, fieldwork was undertaken in Australia, Papua New Guinea, the Philippines and Thailand. To further expand the descriptive database, reference was also made to species descriptions in the available literature. Distribution maps and ranges were based on the localities recorded on the labels of the specimens that were examined and other localities reported in literature, but this excluded cultivated specimens.

## Morphology

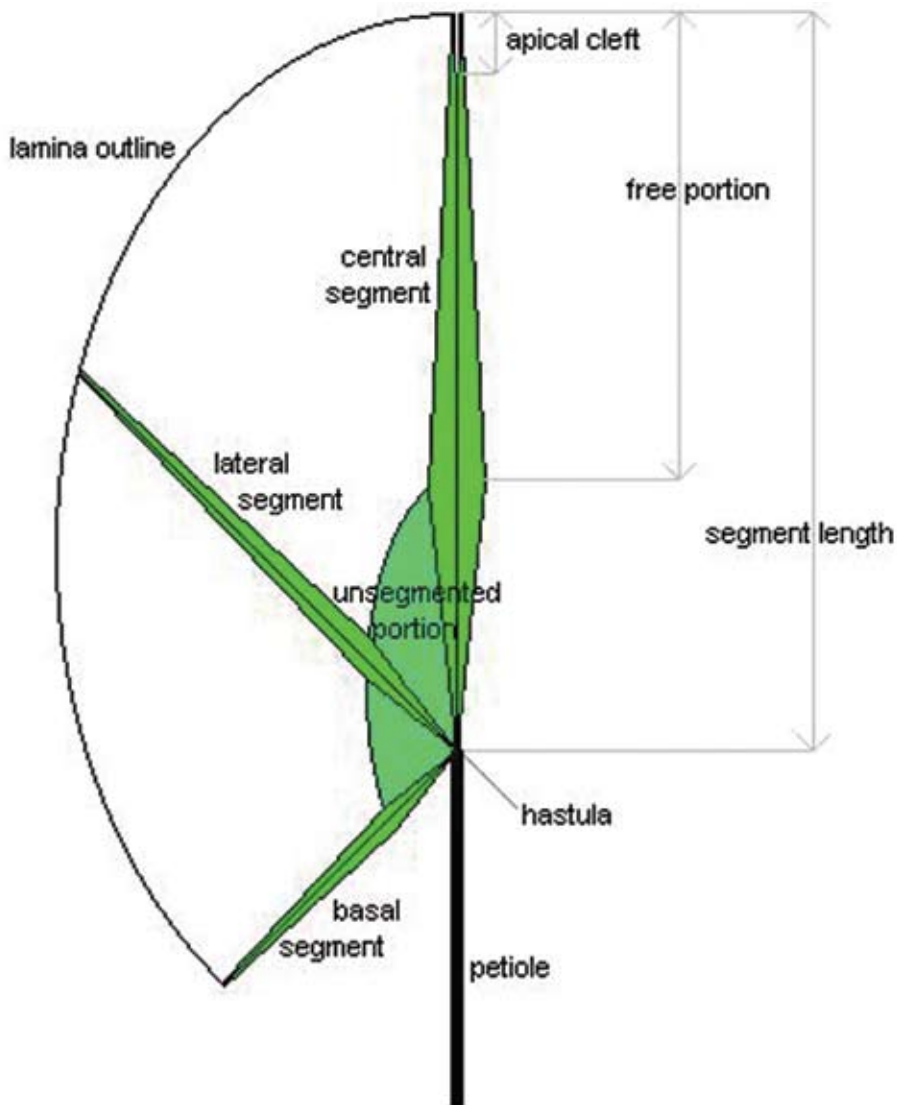
### *Stem*

All *Livistona* species have a single, more or less, erect stem, except where damage has induced either aerial branching or basal branching. Rodd (1998) suggested that at least one species, *L. inermis*, had basally clustered stems, but field observations indicate that this situation is caused by damage, possibly from fire, and is not the natural condition for that species. Stem heights range from 5 m tall in *L. exigua* (Plate 2a) to 45 m tall in *L. rotundifolia* (Plate 3a) and with a diameter at breast height of from 2.5 cm in *L. exigua* to ca. 60 cm in *L. nasmophila* and *L. saribus*. Stem surfaces may be smooth, as in *L. rotundifolia* (Plate 3b), or have longitudinal fissures of varying width and depth, as in *L. australis* (Plate 21a) and *L. chinensis* (Plate 9c). Leaf scars, where leaves were formerly attached to the stem, are annular around the stem, usually of irregular width, and may be close together and appearing contiguous, as in *L. fulva* (Plate 22d), or up to 30 cm apart, as in *L. decora* (Plate 20a). Leaf scars may be raised, or flush with the internodes. In some species such as *L. chinensis*, *L. humilis* and *L. muelleri* (Plate 15a), the leaf scars are roughened, retaining some leaf-base tissue. In some species, such as *L. humilis* (Plate 14a), *L. muelleri* (Plate 15a) and *L. tahanensis* (Plate 11a), the petiole base can be retained as a stub. This is very pronounced in *L. benthamii* (Plate 18b), where the petiole base and the proximal half of the petiole is retained on the stem, only to be removed by weathering, fire or old age. In many species, the petiole stubs remain persistent on the stem up to the position that flowering commences, and from that point upward the stubs are not retained and the stem is more or less smooth.

### *Leaf*

Leaves are produced in globose, hemispherical, elongate, vertically extended or compact crowns. Leaves have a clasping leaf-base, a long petiole and a segmented blade radiating from a hastula (Fig. 2). Leaf-bases are not split at the base, as in some other Coryphoid palms such as *Corypha*, but are entire. Fibres of various textures and thickness form ligule-like appendages on either side of the leaf-base. These fibres can be diagnostic in some species, whereas in many they are undifferentiated and/or variable and of little diagnostic value.

The petiole, up to 300 cm long in *L. concinna* (Plate 18e, 18f), and as less as 40 cm long in *L. exigua* (Plate 2b, 2c), narrows toward the leaf blade, is either convex or concave on the abaxial surface, and convex on the adaxial surface. In some species there may be a stripe extending along the abaxial surface, this being yellowish-green in *L. australis* (Plate 21b)



**Figure 2.** Composite half-leaf of *Livistona*. Three segments are shown – central, lateral and basal - indicating from where on the central segment the length, free portion and apical cleft were measured. Both the depth of the free portion and the depth of the apical cleft are determined, for comparative purposes, as a percentage of the length of the segment.

and reddish-purple in *L. saribus* (Plate 1b). The petiole base in *L. drudei* (Plate 19c) is characteristically purple. The margins are armed with spines in most species. Spines are of varying shapes, but mostly shark-tooth like, or retrorsely recurved. In some species, such as *L. saribus* (Plate 1c) and *L.*

*speciosa* (Plate 12c), the spines resemble the shape of the traditional Thai dagger, the kris. Spines are usually ca 20 mm long, but may reach up to 60 mm long in *L. saribus* (Plate 1c). In *L. inermis*, the spines are reduced to blunted calli up to 5 mm long, but usually only ca 1 mm long (Plate 16e). In some species, such as *L. chocolatina*, only juveniles have spines, but are not produced, or are very reduced, in mature individuals. Spines are most often congested in the proximal portion of the petiole in most species, but may extend for the full length in others, such as *L. rotundifolia*.

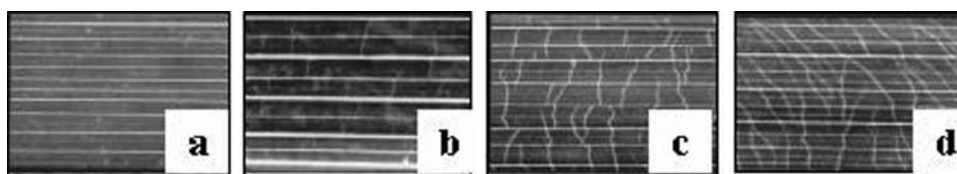
The petiole terminates in a hastula, from which the leaf segments radiate in most species. In some species, such as *L. decora* (Plate 20b) and *L. inermis* (Plate 16e) the segments extend along the costa producing a pseudo-pinnate appearance. The hastula may have a vertically erect flange of tissue, such as in *L. rotundifolia*, or the flange may be rudimentary as in *L. halongensis* (Plate 9b).

The lamina is costapalmate in most species, and is palmate in only *L. exigua* (Plate 2a, 2b). The costa, a much thickened rib that is morphologically an extension of the abaxial surface of the petiole, may be strongly arcuate as in *L. lanuginosa* (Plate 25a), or almost straight as in *L. muelleri* (Plate 15b). The outline of the lamina may be circular, or nearly so, as in *L. rotundifolia* (Plate 3b), to oblong or ovate in most species. The length of the lamina is interpreted here as the length of the midleaf segment when measured from the hastula to the apex of the segment, i.e., in a line extending directly outward from the petiole, and parallel to it. Segments are induplicate. The number of segments ranges from 25 or less in *L. brevifolia* (Plate 4c, 4d), up to 30 in *L. exigua* (Plate 2b), and to 90 or more in *L. australis* (Plate 21b), *L. lanuginosa*, *L. papuana* (Plate 4b) and *L. surru* (Plate 8b) among others. Segments are arranged in either of two ways: firstly in a regular arrangement in which the segments are widest in the mid section and become decreasingly less wide and usually longer or infrequently shorter toward the outer-leaf, and with the point of disjunction, herein termed divisions, between the segments terminating at more or less the same position in the lamina relative to the length of the segments. The second type of arrangement, which occurs in only two species, *L. saribus* (Plate 1b) and *L. exigua* (Plate 2b), has the segments of similar width and dimensions as mentioned above, but the segments are arranged in groups, and there is a deep division between the groups that extends almost to the hastula. In the first mentioned arrangement of segments, divisions between the segments may extend for up to 98% of the lamina length, as in *L. lorophylla* (Plate 17b), and as shallow as 34% in *L. lanuginosa* (Plate 25a). In this revision, the depth of the division between the segments and the depth of the apical cleft are recorded as percentages of the length of the



segment, rather than absolute ranges of measurements, as this allows greater direct comparison between species in what is a good diagnostic character in mature leaves. In leaves that have many deep divisions between segments, the apical portion of the segment may be pendulous, such as in *L. chinensis* (Plate 9d), *L. concinna* (Plate 18d), *L. decora* (Plate 20b) and *L. drudei* (Plate 19b). The segment apex is bifurcate, with the depth of the cleft as shallow as 1% of the segment length as in *L. brevifolia* (Plate 4d), to as deep as 84% in *L. inermis* (Plate 16e). Species that have deep apical clefts tend to have pendulous segment apices, although those in *L. inermis* (Plate 16e) have somewhat rigid apices because of the relatively thick midribs.

Venation of a segment consists of a dominant central midrib, accompanied by a series of parallel veins of more or less equal number each side of the midrib, and transverse veins of various thickness and lengths, that connect, girdle or traverse the parallel veins (Fig. 3). The number of parallel veins is more or less consistent for a species. There are as many as 38 in *L. carinensis* (Fig. 3a), and as few as nine in *L. chinensis* (Fig. 3d). There is a relationship between the number of parallel veins and environment: species in moist, humid environments tend to have fewer parallel veins, whilst species in semi-arid to arid environments have relatively more.



**Figure 3.** Venation patterns in *Livistona*. Example of the variation for the genus present in four species: **a.** *L. carinensis* – a large number of parallel veins and very few transverse veins; **b.** *L. mariae* – a moderate number of parallel veins, though very prominent, and a moderate number of transverse veins; **c.** *L. australis* – less prominent parallel veins and prominent transverse veins; **d.** *L. chinensis* – less prominent parallel veins but numerous transverse veins.

### *Inflorescence*

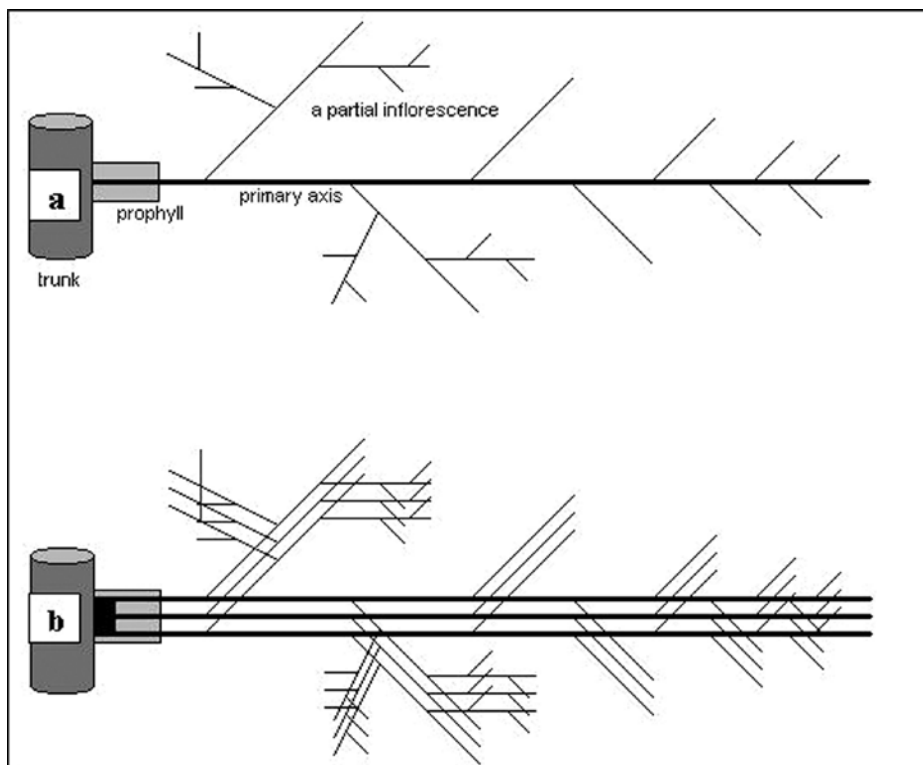
Inflorescences are interfoliar, initiated in the axil of each leaf at the onset of reproductive maturity. Leaves and inflorescence buds are produced more or less regularly throughout the year. Leaf growth is continuous but inflorescence buds remain dormant within the leaf axil until the onset of the flowering season. With the onset, buds that were previously initiated develop rapidly to facilitate more or less synchronised or closely sequential acropetal inflorescence production. From 1 to 15 inflorescences can be produced in

a flowering event, with a period of a few weeks between maturation of the proximal and distal inflorescences. Most species flower seasonally at more or less the same time each year. Some species may flower aseasonally.

There are two types of inflorescences in *Livistona*. Type 1 has a single dominant axis (Fig. 4a), whilst Type 2 is trifurcate, or occasionally bifurcate, with three (or sometimes only two) collateral equi-dominant axes that emerge from a single base and have a common prophyll (Fig. 4b). *Partial inflorescences* are positioned along the length of each axis, at more or less regular intervals. The partial inflorescences may be interpreted as discrete panicles that terminate in flower-bearing rachillae, and reduce in size and complexity toward the inflorescence apex. There are 11 or more partial inflorescences in species such as *L. carinensis* (Plate 13b), *L. decora* (Plate 20a), *L. lanuginosa* (Plate 25a) and *L. mariae*, and with the average number across all species being ca. 6. There is one species, *L. humilis*, which has only a single partial inflorescence, but only in female plants (Plate 14c); male plants have numerous partial inflorescences (Plate 14b). The structure of the partial inflorescences is similar in most species. Inflorescences may be branched up to 5 orders, when the primary axis (Fig. 4a) is considered as '0'. The surfaces of the partial inflorescences may be variously glabrous, papillose, or tomentose. The rachillae of *L. carinensis* (Plate 13d) are unique within the genus as they are covered in sparse long unbranched hairs. In *L. chocolatina*, there is a dense chocolate-brown tomentum in the proximal portion of the partial inflorescence branches.

The prophyll is bicarinate in all species, but of various lengths and widths, and the outer surfaces are furnished with various types and densities of tomentum, or are glabrous. There is a single peduncular bract in 14 species, including *L. boninensis*, *L. carinensis*, *L. eastonii*, *L. fulva* and *L. mariae*, among others; and as many as 4-8 in *L. chocolatina*, *L. halongensis* and *L. humilis*. The peduncular bract may also be lacking, as in 16 species, such as *L. australis*, *L. benthamii*, *L. chinensis* and *L. saribus*, among others. Peduncular bracts do not subtend a partial inflorescence, and are confined to the portion of the peduncle that is proximal to the emergence of the lowest partial inflorescence. Each partial inflorescence is subsequently subtended by a single rachis bract that is, otherwise, morphologically similar to the peduncular bracts. Peduncular bracts are tightly tubular to loosely sheathing, and glabrous or variously tomentose. In *L. lanuginosa* (Plate 25b), the tomentum is very dense and fur-like. Rachis bracts are tightly tubular to loosely sheathing, glabrous or variously tomentose.

Rachillae are straight to moderately flexuose, pliable to rigid, glabrous or variously tomentose, papillose, pubescent or pruinose. They are as short as 1 cm long in *L. inermis* (Plate 16f, 16g), and up to 45 cm



**Figure 4.** Inflorescence types in *Livistona*: a. Type 1 – inflorescence has an unbranched primary axis with partial inflorescences placed at  $\pm$  regular intervals and reducing in size and complexity toward the distal end; b. Type 2 – inflorescence has a trifurcate or infrequently bifurcate axis with  $\pm$  identical collateral axes that share a common prophyll but each axis with an individual peduncular bract. The individual axes otherwise have a Type 1 structure.

long in *L. saribus*, and 2.5 mm diameter in *L. exigua* (Plate 2d) and to 9 mm diameter in *L. chinensis* (Plate 9e, 9f).

#### *Floral morphology*

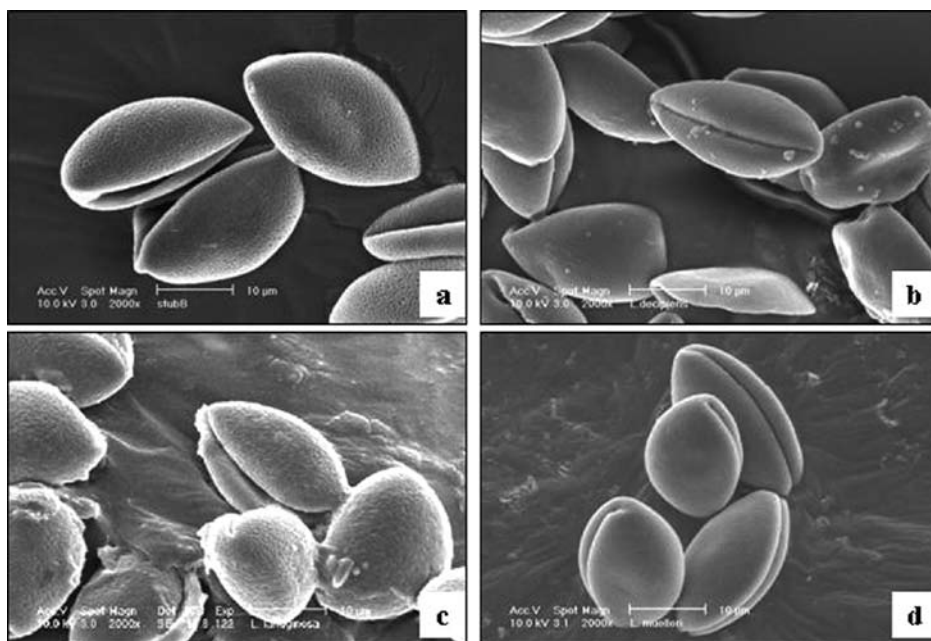
Flowers are arranged spirally on the rachillae, solitary or in pairs, or in sympodial clusters of 3-8, widely spaced or congested, and either sessile or on pedicels. They are bisexual or functionally unisexual with little dimorphism, a situation that will be discussed below under sexuality. There are three triangular sepals fused at the base, glabrous or with long hairs in a single species *L. carinensis* (Plate 13d); three free petals that are longer than the sepals, triangular, valvate, glabrous or hairy as only in *L. carinensis* (Plate 13d). There are six epipetalous stamens that are

shorter than the petals, and are basally connate to form a narrow fleshy ring. Filaments are 'shouldered' and narrow abruptly into the connective. Anthers are didymous, roundish to ovoid, medi-fixed, versatile, and open latrorsely. The gynoecium is tri-carpellate; carpels are wedge-shaped and basally separated, and connate distally to form a common slender style. The style is shorter than the stamens. The stigma is small and 3-lobed. The ovule is basally attached and anatropous.

The colour of sepals and petals in most species is white to cream to yellow; however both sepals and petals can be red, as exclusively in some New Guinea species such as *L. brevifolia* (Plate 4e) *L. chocolatina*, *L. tothur* (Plate 7b) and *L. woodfordii*; sepals can be maroon as in *L. muelleri* (Plate 15c, 15d); and petals can be bright yellow as in *L. merrillii* and *L. muelleri* (Plate 15d). The length of sepals ranges from 0.2 mm to 4 mm, and for petals 0.4 mm to 4 mm.

Septal nectaries have been reported in *L. humilis* (Schmid, 1983). The nectaries are situated at the base of the partitions between the carpels. Nectaries have not been reported in other species.

Pollen is monosulcate, ellipsoidal, and in those species that have been studied, dimensions fall within a range of the long axis of 15µm to



**Figure 5.** Pollen micrographs of *Livistona* species: **a.** *L. chinensis*; **b.** *L. decora*; **c.** *L. lanuginosa*; **d.** *L. muelleri*. Scale bar = 10µm.

44 $\mu$ m, and the short axis of 9 $\mu$ m to 37 $\mu$ m (Dowe, 2001) (Fig. 5). Tectum ranges from finely perforate to reticulate. *Livistona* pollen is binucleate at the time of shedding (Mahabalé, 1967).

### *Fruit*

The fruits contain a single seed, and are globose, subglobose, ellipsoidal, depressed-globose, obovoid, reniform, pyriform, or obpyriform. The fruit may be as small as ca 9 mm long, as in *L. benthamii*, *L. exigua* (Plate 2d), *L. victoriae* (Plate 17d) and *L. woodfordii* (Plate 5f); to 40 mm long in *L. alfredii*; 36 mm in *L. lanuginosa* (Plate 25e), 43 mm in *L. tothur* (Plate 7d); and the largest to 65 mm in *L. surru* (Plate 8e). The epicarp is thin or thick, smooth or with scattered pores or mildly rugose. The stigmatic remains are apical to subapical and there is a suture line extending longitudinally from the stigmatic remains toward the base in most species or sometimes this is not readily visible. Colour at maturity can be shades of green, orange, red, blue, purple, brown or black. The mesocarp is dry or fleshy, and with or without embedded fibres.

### *Seed*

The seed is globose, subglobose, ovoid, ellipsoid or reniform. The endosperm is homogeneous, and is intruded by the testa from one side with spongy/crystalline tissue to displace a moderate or large proportion of the endosperm. The hilum is broad, circular to elongate, and the raphe branches are few or lacking. The embryo is small, and positioned supra- to sublateral.

### *Sexuality*

Sexual expression in *Livistona* is not well understood. Uhl and Dransfield (1987, pp. 190, 191) described the genus as “*hermaphroditic (rarely dioecious)*” and “*where dioecious, anthers or ovules not developing but otherwise as in the hermaphroditic*”. In a review of pollination in palms, Henderson (1986) reported that *Livistona* flowers possessed septal nectaries and that bee pollination was possible. Rodd (1998, pp. 72, 73) stated that “*Some of the Australian species display clear signs of sexual differentiation among the palms of a population, although the nature of this sexuality is still unclear*”, and that “*it is possible, indeed, that this is a feature of all the Australian species, or even of the genus as a whole. It remains an interesting area for further study*”.

Dowe (2001) concluded that there was a range of sexual functionality in the genus, from hermaphroditic species such as *L. rotundifolia* and *L. chinensis*, to functional dioecy, such as in *L. decora* and *L. lanuginosa*, and

dioecy, such as in *L. concinna* and *L. humilis*. Where there is reasonable evidence available of sexuality, it is noted in the species descriptions, but pending further study sexuality is otherwise noted as hermaphroditic.

#### *Phylogeny and species relationships*

Based on phenetic similarity, Rodd (1998) proposed four informal groups for the Australian species of *Livistona*:

- Mariae Group: *L. lanuginosa*, *L. mariae*, *L. nasmophila* and *L. rigida*: palms of alluvial flood-plains in semi-arid environments.
- East Coast Group: *L. australis*, *L. benthamii*, *L. decora*, *L. drudei*, *L. fulva* and *L. nitida*: mesomorphic palms of moist habitats.
- Arafura Group: *L. eastonii*, *L. humilis* and *L. muelleri*: smallish palms of monsoonal climates.
- Northwestern Group: *L. alfredii*, *L. inermis*, *L. lorophylla* and *L. victoriae*: small to moderate palms in semi-arid environments.

Dowe (2001) performed cladistic analyses of all *Livistona* species based on morphological characters. In summary, three moderately supported lineages within the genus were identified:

- *L. exigua*/*L. saribus* Group
- Asian/Malesian Group (with two sublineages)
  - *L. chinensis* subgroup (*L. boninensis*, *L. chinensis*, *L. endauensis*, *L. halongensis*, *L. jenkinsiana*, *L. tahanensis*)
  - *L. rotundifolia* subgroup (*L. chocolatina*, *L. merrillii*, *L. papuana*, *L. rotundifolia*, *L. surru*, *L. tothur*, *L. woodfordii*)
- African/Australian Group (with two sublineages)
  - *L. mariae* subgroup (*L. alfredii*, *L. australis*, *L. carinensis*, *L. decora*, *L. lanuginosa*, *L. mariae*, *L. nasmophila*, *L. nitida*, *L. rigida*, *L. victoriae*)
  - *L. humilis* subgroup (*L. benthamii*, *L. concinna*, *L. drudei*, *L. eastonii*, *L. fulva*, *L. inermis*, *L. humilis*, *L. lorophylla*, *L. muelleri*)

More recently, Isagi (pers. comm. and unpublished data, 2008) established a molecular phylogeny of the Australian species and a small number of extra-Australian species using AFLPs, cpDNA sequences and nuclear DNA sequences. Preliminary results indicated that the Australian species form a well-supported monophyletic group in all analyses, and the extra-Australian species a less well-supported group. Some of the

arrangements based on phenetic and morphological analyses as noted above were in most part confirmed by molecular studies, such as Rodd's (1998) *Mariae* and Northwestern groups, and Dowe's (2001) *L. mariae* and *L. humilis* groups. In addition, the closest relationship of *L. carinensis* was variously with extra-Australian species rather than the *L. mariae* group as predicted by Dowe (2001).

## Taxonomy

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

–*Saribus* Blume, Rumphia 2 (1838) 48. –Type: *S. rotundifolius* (Lam.) Blume.

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

–*Corypha* L., Juss., Gen. Pl. (1789) 39, *pro parte*.

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

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

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

Solitary, short to tall, erect, pleonanthic, hermaphroditic or dioecious or functionally dioecious palms. **Trunk** slender to robust, cylindrical, broader at the base, ringed with leaf scars; internodes narrow to broad. **Leaves** palmate or costapalmate, when senescent leaves sometimes forming a persistent skirt; leaf-bases forming a fibrous network, sometimes forming an appendage either side of the petiole base; petioles long, adaxially concave, flat or ridged, abaxially rounded, margins smooth or spiny; adaxial hastula present; lamina regularly segmented, or irregularly segmented with segments grouped and divisions between each group deeper into the lamina than the divisions between individual segments; segments induplicate, narrow, lanceolate, single-fold, tapered to the apex, apices shallowly or deeply cleft, rigid or pendulous; segment with a prominent midrib, few to many parallel veins each side of midrib; transverse veins equal thickness or thinner than parallel veins. **Inflorescences** interfoliar, usually held within the limits of the crown, infrequently extending beyond the crown,

either a single axis not branched at the base but with partial inflorescences positioned along its length, or basally trifurcate or occasionally bifurcate with  $\pm$  similar collateral axes, which have a common prophyll, and with partial inflorescences positioned along the length of each axis; partial inflorescences 1 (*L. humilis* only) or numerous per axis; inflorescences branched 2 to 5 orders when the primary axis of the inflorescence is regarded as '0'; prophyll 2-keeled; peduncular bracts lacking or if present then loosely or tightly tubular; rachis bracts loosely or tightly tubular, subtending each partial inflorescence, secondary rachis bracts that subtend subsequent branches of the partial inflorescence may be lacking or present; rachillae straight or flexuose, glabrous or tomentose, papillose, pubescent or pruinose. **Flowers** bisexual, or unisexual with little dimorphism, solitary or in sympodial pairs or clusters, spirally arranged, variously coloured; sepals triangular, fused at the base with 3 apical lobes, glabrous, or hairy (*L. carinensis* only); petals 3, free, longer than the sepals, triangular, valvate, glabrous, or hairy (*L. carinensis* only); stamens 6, epipetalous, shorter than the petals; anthers didymous, globose to ovoid, medi-fixed, versatile, latrorse; pollen monosulcate, ellipsoidal; tectum finely perforate to reticulate; carpels wedged-shaped, basally separated; styles united distally, slender, shorter than the stamens; stigma 3-lobed. **Fruit** globose, subglobose, ellipsoid, depressed-globose, obovoid, reniform, pyriform, or obpyriform, 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 sometimes not readily visible; mesocarp dry or fleshy, with or without embedded fibres. **Seed** globose, subglobose, ovoid, ellipsoid or reniform; endosperm homogeneous, intruded by the testa from one side with spongy/crystalline tissue to displace a moderate or large proportion of the endosperm; hilum broad, circular to elongate; raphe branches few or lacking; embryo small, supra- to sublateral. **Eophyll** simple, with longitudinal ribs.  $n = 18$  (Sharma and Sarkar, 1956).

A genus of 36 accepted species distributed in Djibouti, Somalia, Yemen, NE India, Assam, Sikkim, Bangladesh, Myanmar, Thailand, Malaysia, Taiwan, China, Ryukyu Islands, southern Japan, Bonin Islands, Vietnam, Kampuchea, Laos, the Philippines, Brunei Darussalam, Indonesia, Papua New Guinea, Solomon Islands, and Australia; grows in rainforest, montane forest, swamp forest, monsoon forest, coastal forest, semi-closed to open woodlands and savanna, semi-arid woodlands, and riparian and riverine forest, 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 where subsurface moisture is seasonally available.



**Key to *Livistona* species**

- 1a. Lamina with the segments grouped, with divisions between each group of segments deeper into the lamina than the divisions between individual segments ..... 2
- 1b. Lamina with leaf segments not grouped, with divisions between adjacent segments to more or less the same depth into the lamina ..... 3
- 2a. Large canopy palms to 40 m tall; lamina costapalmate; mid-leaf segments to 200 cm long; partial inflorescences 4-9; fruit blue to purple at maturity ..... 1. *L. saribus*
- 2b. Small understorey palms to 5 m tall; lamina palmate; mid-leaf segments to 50 cm long; partial inflorescences 3-4; fruit purplish-green at maturity ..... 2. *L. exigua*
- 3a. Inflorescences trifurcate, or very infrequently bifurcate, branched at the base, with the 3 (or 2) collateral axes more or less similar and all sharing a common prophyll but with each axis bearing its own peduncular bract(s) (if present) ..... 4
- 3b. Inflorescences not branched at the base and composed of a single axis ..... 11
- 4a. Lamina with 25 or less segments; depth of apical cleft 1-4% of the length of the segment ..... 5. *L. brevifolia*
- 4b. Lamina with 45 or more segments; depth of apical cleft 4-40% of the length of the segment ..... 5
- 5a. Fruit > 35 mm long ..... 6
- 5b. Fruit < 35 mm long ..... 7
- 6a. Lamina with abaxial surface silvery glaucous; segment apices rigid; rachillae 6-12 cm long, glabrous; flowers solitary; fruit 35-43 mm long ..... 9. *L. tothur*
- 6b. Lamina with abaxial surface green; segment apices pendulous, hanging  $\pm$  vertically; rachillae 14-24 cm long, pubescent; flowers in clusters of 2-4; fruit 50-65 mm long ..... 10. *L. surru*
- 7a. Inflorescences branched to 4 orders ..... 3. *L. rotundifolia*
- 7b. Inflorescences branched to 3 orders ..... 8
- 8a. Sepals and petals yellow ..... 9

- 8b. Sepals and petals red ..... **10**
- 9a. Petiole usually lacking spines, or if present then confined to the very proximal part; depth of apical cleft 30-40% of the length of the segment; flowers 3.0-4.5 mm long; fruit dark red ..... 6. *L. merrillii*
- 9b. Petiole armed throughout, or with spines infrequently confined to proximal portion or very infrequently lacking; depth of apical cleft 5-11% of the length of the segment; flowers to 1.2 mm long; fruit orange-red ..... 4. *L. papuana*
- 10a. Segment apices semi-pendulous, hanging ca. 45° or more to the vertical; lamina deeply undulate, angles of undulations 90° or less; rachillae 4-6 cm long, 1 mm thick, basally with brown-purple tomentum, distally glabrous ..... 7. *L. woodfordii*
- 10b. Segment apices rigid; lamina moderately undulate, angles of undulations 91° or more, usually much greater; rachillae 8-12 cm long, 2-3 mm thick, basally with chocolate brown tomentum, distally with cream-green tomentum ..... 8. *L. chocolatina*
- 11a. Inflorescences held vertically above the crown, with at least 30% of their length extending beyond the limit of the crown ..... **12**
- 11b. Inflorescences held obliquely, horizontally, or below the horizontal, confined to within the crown, or if extending beyond the crown then by no more than 10% of their length ..... **13**
- 12a. Fruit globose, glossy dark green at maturity; plants hermaphroditic; inflorescences with 6-7 partial inflorescences ..... 11. *L. halongensis*
- 12b. Fruit ellipsoidal or pyriform to obovoid, shiny purple-black at maturity; plants dioecious; inflorescences on male plants with 4-7 partial inflorescences and the female plants with a single terminal partial inflorescence ..... 19. *L. humilis*
- 13a. Inflorescences extending beyond the limit of the crown by no more than 10% of their length; rachillae, sepals and petals with scattered long hairs ..... 18. *L. carinensis*
- 13b. Inflorescences not extending beyond the limit of the crown; rachillae, sepals and petals lacking long hairs ..... **14**
- 14a. Inflorescences lacking peduncular bracts ..... **15**
- 14b. Inflorescences with 1 or more peduncular bracts ..... **27**

- 15a. Segments with rigid apices ..... 16
- 15b. Segments with pendulous apices ..... 22
- 16a. Flowers with maroon sepals, yellow petals, and pink to maroon carpels ..... 20. *L. muelleri*
- 16b. Flowers with sepals, petals and carpels of a single similar colour, white to cream or yellow ..... 17
- 17a. Fruit green at maturity ..... 18
- 17b. Fruit not green at maturity ..... 19
- 18a. Lamina with 60-70 segments; abaxial surface green; stems with persistent petiole stubs only at the base; inflorescences to 150 cm long; fruit obovoid to pyriform ..... 14. *L. endauensis*
- 18b. Lamina with 40-50 segments; abaxial surface grey-green; stems with persistent petiole stubs for most of its length; inflorescences to 91 cm long; fruit globose to depressed-globose ..... 15. *L. tahanensis*
- 19a. Mid-leaf segments no more than 70 cm long; lamina with divisions between segments more than 80% of the length of the lamina; apical cleft in the segment more than 70 % of the length of the segment; fruit glossy black at maturity ..... 22. *L. inermis*
- 19b. Mid-leaf segments not less than 110 cm long; lamina with divisions between segments less than 75% of the length of the lamina; apical cleft in the segment less than 48% of the length of the segment; fruit purple-black or leaden blue to dark bluish-purple or greenish-blue to blue at maturity ..... 20
- 20a. Fruit purple-black; lamina with less than 60 segments; depth of apical cleft in the segment more than 40% of the length of the segment ..... 33. *L. nasmophila*
- 20b. Fruit leaden blue to dark bluish-purple or greenish-blue to blue at maturity; lamina with more than 70 segments; depth of apical cleft in the segment less than 10% the length of the segment ..... 21
- 21a. Lamina adaxially shiny green, abaxially subglaucous grey or bluish; inflorescence branched to 3 orders; rachillae puberulous; fruit globose to reniform, leaden blue to dark bluish-purple ..... 16. *L. jenkinsiana*
- 21b. Lamina adaxially green, abaxially glaucous grey; inflorescence branched to 4 orders; rachillae glabrous; fruit obovate, obpyriform to ovoid, greenish-blue to light-blue at maturity ..... 17. *L. speciosa*

- 22a. Petiole stubs long due to the abscission of leaves occurring in about the middle of the petiole; stubs persistent on the trunk for most of its length, unless decayed by age or fire ..... 25. *L. benthamii*
- 22b. Petioles stubs lacking the persistent remnant portion of petiole; stubs persistent on the trunk only in the basal portion ..... 23
- 23a. Rachis bracts glabrous, tightly tubular, not disintegrating into open fibres but remaining intact with age ..... 26. *L. concinna*
- 23b. Rachis bracts tomentose or scaly, loosely tubular, disintegrating into open fibres with age ..... 24
- 24a. Fruit blue-green to bright green, glossy, epicarp ceramic-like at maturity ..... 12. *L. chinensis*
- 24b. Fruit reddish-brown to black, variously dull, glaucous, glossy or shiny but not ceramic-like at maturity ..... 25
- 25a. Lamina with divisions between segments more than 82% of the length of the segment; fruit shiny black ..... 28. *L. decora*
- 25b. Lamina with divisions between segments less than 70% of the length of the segment ..... 26
- 26a. Inflorescences branched to 5 orders; fruit dull, reddish-brown to dull black, or occasionally glaucous ..... 29. *L. australis*
- 26b. Inflorescences branched to 4 orders; fruit glossy jet black ..... 30. *L. nitida*
- 27a. Lamina with coppery brown floccose tomentum on the abaxial surface ..... 31. *L. fulva*
- 27b. Lamina not with coppery brown floccose tomentum on abaxial surface, but variously green or grey ..... 28
- 28a. Inflorescences branched to 3 orders ..... 29
- 28b. Inflorescences branched to 4 orders ..... 32
- 29a. Fruit bright green at maturity ..... 13. *L. boninensis*
- 29b. Fruit not green at maturity, but variously brown to black ..... 30
- 30a. Petiole purple in basal portion ..... 27. *L. drudei*
- 30b. Petiole green in basal portion ..... 31

- 31a. Fruit 25 mm or greater in length, globose; lamina segments 50-66; divisions between segments less than 70% of the length of the segment; rachillae white pruinose, papillose ..... 32. *L. alfredii*
- 31b. Fruit 14 mm or less in length, obovoid-pyriform; lamina segments 34-50; divisions between segments more than 85% of the length of the segment; rachillae glabrous ..... 23. *L. lorophylla*
- 32a. Fruit diameter 25 mm or greater ..... 36. *L. lanuginosa*
- 32b. Fruit diameter 18 mm or less ..... 33
- 33a. Moderate palms to 15 m tall, dbh less than 15 cm; less than 20 leaves in the crown; fruit obovoid ..... 21. *L. eastonii*
- 33b. Tall palms more than 15 m tall; dbh more than 15 cm; more than 25 leaves in the crown; fruit globose to ellipsoidal ..... 34
- 34a. Lamina not more than 100 cm long; divisions between segments more than 55% of the length of the segment; rachillae not more than 3 cm long; flowers solitary or in pairs ..... 24. *L. victoriae*
- 34b. Lamina more than 100 cm long; divisions between segments less than 55% of the length of the segment; rachillae more than 3 cm long; flowers in clusters of 3 or more flowers ..... 35
- 35a. Lamina to 220 cm long, moderately undulate with undulations  $> 91^\circ$ ; segment apices .... pendulous hanging  $\pm$  parallel to the vertical; peduncular bracts with dense white-grey scales; rachis bracts with dense white scales; rachillae pliable to flexuose ..... 34. *L. mariae*
- 35b. Lamina to 170 cm long, strongly undulate with undulations  $< 90^\circ$ ; segment apices rigid or semi-pendulous; peduncular bracts with moderate to dense white-grey scales; rachis bracts with sparse white scales; rachillae rigid ..... 35. *L. rigida*

### Descriptions of species \*

[\* In the following species descriptions, species are arranged informally in morphological groupings. This arrangement does not suggest phylogenetic relationships, but rather that similar species are placed close to each other.]

1. ***Livistona saribus*** (Lour.) Merr. ex. A.Chev., Bull. Écon. Indo-Chine. ser. 2, 22 (1919) 501. -*Corypha saribus* Lour., Fl. Cochinch. 1 (1790) 212; Gmelin, Syst. Nat. 2 (1791) 569. – **Type:** not designated. Neotype

here designated: *Pierre 4837*, Cay Ki, Vietnam, July 1866 (neotype, L; isoneotypes, A, BO, K, P, UC). **Plate 1a-e.**

-*Livistona spectabilis* Griff., Calcutta J. Nat. Hist. 5 (1845) 336; Palms Brit. E. Ind. (1850) 130, pl. 226C; Miquel, Fl. van Ned. Ind. 3 (1855) 58 (as *L. rotundifolia*); Wendland, in Kerchove, Palmiers (1878) 250, *prop. syn.*, *L. rotundifolia*; Beccari, Webbia 5 (1921) 21, *prop. syn.*, *L. chinensis*. – **Type:** Malaysia. Malacca, 1843, *Lewis s.n.* (holotype, BR).

-*Livistona cochinchinensis* (Blume) Mart., Hist. Nat. Palm. 3 (1849) 242; Beccari & Hooker, Fl. Brit. India 6 (1892) 434. -*Saribus cochinchinensis* Blume, Rumphia 2 (1838) 49. Type not designated.

-*Livistona hoogendorpii* Hort. ex Teysm. & Binn. ex Miq., Palm. Archip. Ind. (1868) 14 (as *L. hoogendorpi*); Teysmann & Binnendijk, Cat. 'slands Plant. Buitenzorg (1866) 71, *nomem*; André, Ill. Hort. 21 (1874) 108, 121, t. 174; Kerchove, Palmiers (1878) t. 33. -*Saribus hoogendorpii* (Hort. ex Teysm. & Binn. ex Miq.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** Lectotype here chosen. Indonesia. Cultivation, Bogor Botanic Gardens, May 1878, *Beccari s.n.* (lectotype, FI, Beccari collection, sheets 11330 & 11330-B).

-*Livistona hasseltii* (Hassk.) Miq., Palm. Archip. Ind. (1868) 14 (as *L. hasselti*); Wendland, in Kerchove, Palmiers (1878) 250; Backer & Bakhuizen van den Brink, Fl. Java 3 (1968) 174. -*Saribus hasseltii* Hassk., Flora 25 (Beibl. 2) (1842) 16. – **Type:** Indonesia. Batam Prov., Tjikoi and Tjilakatan, 1820-23, *van Hasselt s.n.* (type not located at either L or U (N. Sol pers. comm.)).

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

-*Livistona tonkinensis* Magalon, Contr. étude Palmiers Indoch. (1930) 54; Feddes Repert. Spec. Nov. Regni Veg. 28 (1930) 239; Feddes Repert. Spec. Nov. Regni Veg. 29 (1931) 23; Gagnepain, Fl. Indo-Chine 6 (1937) 983. – **Type:** Lectotype, here chosen. Vietnam. Rivière Noire and the middle region of the Tonkin R., 25 Jan. 1930, *Magalon s.n.* (lectotype, P).

Hermaphroditic palm. **Trunk** to 40 m tall, 15-65 cm dbh, leaf scars raised, internodes broad, petiole stubs persistent in the basal 2 m or so. **Leaves** 25-30 in a ± 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, glabrous, green to green-purple to green-red, glossy, frequently with a reddish-purple longitudinal stripe; margins with large, single, retrorsely recurved, green to brown spines 10-60 mm long, largest and closer in the proximal portion; leaf-base fibres moderately fibrous, coarse, persistent;

lamina costapalmate, irregularly segmented, with segments grouped and with divisions between each group of segments deeper into the lamina than the divisions between individual segments, subcircular, 80-200 cm long, 150-170 cm wide, adaxially green, abaxially a similar green; lamina divided into groups of 2-12 segments separated from adjacent groups by a deep split that almost reaches the hastula; lamina divided for 37-78% of its length, with 80-90 segments, depth of apical cleft 19-50% of the segment length, apical lobes pendulous; parallel veins 6-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, 60-230 cm long, not extending beyond the limit of the crown, curving, branched to 4 orders; partial inflorescences 4-9, 45-60 cm long; prophyll not seen; peduncular bract(s) lacking; rachis bracts loosely sheathing, glabrous; rachillae 15-45 cm long, drooping, yellow, glabrous. **Flowers** in clusters of 3-5, 1.5-1.75 mm long, yellow; sepals suborbicular; petals broadly triangular, obtuse. **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, 1.0-1.5 mm thick; endocarp crustaceous; pedicel 1-3 mm long, ca. 3 mm wide. **Seed** globose to ellipsoid, 9-24 mm long, 9-10 mm diam., apically pointed; endosperm intruded for ca half its width; embryo lateral. **Eophyll** 6-8-ribbed.

*Specimens examined:* VIETNAM: West Tonkin. *Bonn 6184* (P); Cay Ki, *Pierre 4837* (A, BO, K, L (neotype), P, UC); Cay Ki, *Poilane 1222* (BO, P); Tonkin. *Balansa 4366* (K); Tonkin. Rivière Noire, 25 Jan 1930, *Magalon s.n.* (P); Location not specified, 3 Oct. 1936, *Poilane s.n.* (K); Location not specified, Jun 1918, *Lecomte s.n.* (P). KAMPUCHEA: Foret de Phnom Penh, 16 Feb 1934, *Bejaud s.n.* (K, P). THAILAND: Chiang Mai Prov. Road to Doi Chang Dao, 19°21'N, 98°47'E, 900-1100 m alt., *Barfod 45208 with Pooma & Burholt* (AAU, K, NY); Phitsanulok, 7 km E of Tung Salaeng Luang, 600 m alt., *Larsen 792 with Smitinand & Warncke* (AAU, BKF); Loei, 10 km W of Loei, *Dowe 561 & 562* (JCT); Kabin Buri, 45 km N of Kabin Buri, Ban Numklae village, *Dowe 564* (JCT); Prachinburi, Krabin, Bupram, 500 m alt., *Kerr 9836* (AAU, BK, K, NY); 1 km NW of Wang Chan, 30 km from Klaeng, *Dowe 570* (JCT); Chumphon, Bang Son, 100 m alt., *Kerr 11342* (AAU, BM, K); Chumphon, 20 km N of Thai Sae, *Dowe 567 & 568* (JCT); Ranong, Bang Mon Kapur, Klong Na Kha Wildlife Sanctuary, *Smith 46 with Sumawong* (K); Ranong, Klaeng, Nam Groi (outside N. P.), farmland on boundary of park, *Smith 126 & 132 with Sumawong* (AAU, K); Ranong. Pluak Daeng, Sukhaphiban Rd No.

9, 100 yards, *Smith 144 with Sumawong* (K); Trang, Muang, Tran Airport, *Smith 78 with Sumawong* (K); Songkhla, Kha Kok Hng, Hatyai, 07°00'N, 100°20'E, 150-250 m alt., *Larsen 41280* (AAU); Nakhon Si Thammarat, Ta Sumet, less than 50 m alt., *Kerr 14313* (BK, BM, K, NY). MALAYSIA: Malacca, 1843, *Lewis s.n.* (BR); Sabah. Abai, Kinabatangan, *Keith 3429* (K); Perak. Gunong Pondok, ca. 700 ft alt., 7 Jun 1930, *Henderson s.n.* (BO, SING); Selangor. Tanjong Karang, Sungai Tingi, low alt., *Nur 34149* (A, BM, L, K, SING, US); Selangor. 5 Jul 1902, *Burn-Murdoch s.n.* (K); Selangor. Jugua, *Burn-Murdoch 11352* (BM). INDONESIA: Kalimantan. Djaro Dam, Muara Uja, 100 m alt., *Dransfield & Sauerudin 2141 & 2145* (BO, K); South Sumatra. Rasau, Waikambas Reserve, 10 m alt., *Dransfield 1254* (BO); Java. Track to Tjibunar, Udjang Kulai, *Dransfield 1459* (BO); Java. Bantam, Tjimura, *Koorders 6123/3* (BO); Java. *Koorders 35163* (BO). PHILIPPINES: Luzon. Nueva Vizcaya Prov., ca 350 m alt., *Fernando 7286* (K); Luzon. Nueva Vizcaya Prov., Diadi, Magat, 350 m alt., *Fernando EF671* (LBC); Luzon. Tarlac Prov., *Vidal 1951* (K); Luzon. Zambales Prov., Pannubuan, hills between San Marcelino and Mt Pinatubo, *Bartlett 14236* (K); Luzon. Zambales Prov., Dinahyihan, *Loher 1390* (K); Luzon. Laguna Prov., Santa Maria Mavitae, *Curran 10079* (PNH); Luzon. Laguna Prov., Tical, Cavinti, *Loher 7508* (K).

*CULTIVATION*: BRAZIL: Gardens, Piracicaba, *anon. s.n.* (K); CHINA: Yunnan Institute of Tropical Botany, *Chen San-yang 18831* (K); Dominican Republic: Location not known, *anon. 13* (K); INDONESIA: Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI); Mauritius. Botanic Gardens, 1881, *Horne s.n.* (K); PHILIPPINES: Luzon, Laguna Prov., Los Baños Forestry Campus, *Fernando 7359* (LBC); SINGAPORE: Singapore Botanic Gardens, Lawn K, 22 Jun 1929, *Nur s.n.* (K); Singapore Botanic Gardens. *Furtado 34149* (US); SRI LANKA: Royal Botanic Gardens, Peradeniya, S-16, *Rutherford 54 with Bandara* (K); THAILAND: Trang, Khao Chong Gardens, *Whitmore 3153* (K); Trang, Khao Chong, ca 15 km E of Trang, Peninsula Botanic Garden, *Barfod 41588 with Ueachirakan* (AAU, PSU); Trang, Khao Chong, Peninsula Botanic Garden, *Barfod 737 with Pongsattayapipat* (AAU); VIETNAM: Saigon Botanic Garden, 3 Oct 1936, *Poillane s.n.* (P, PNH, UC).

*Local and vernacular names*: Serdang, Sar (Trengganu), Tarao (Cagayan Prov., Philippines).

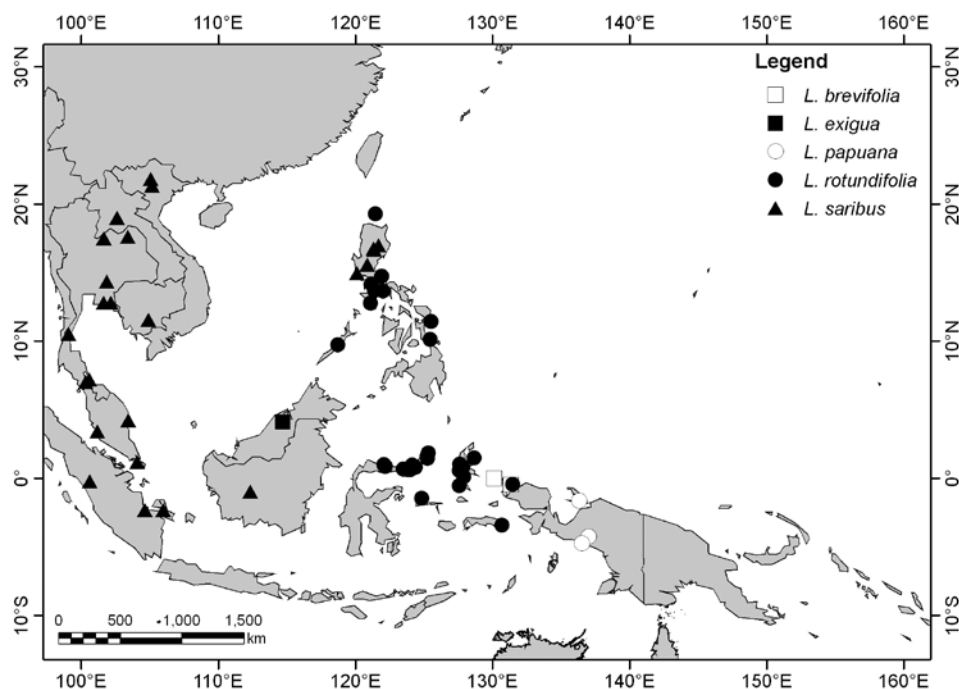
*Habitat and ecology*: In rainforest or swampforest as scattered individuals or in small to very large colonies, and occasionally in watercourses and



adjacent slopes, at 0-600 m alt. Occurs in peatforest and mangroves in central Sumatra (Dransfield, 1974; Laumonier, 1997). Flowers Mar.-July; fruits June-Sept.

*Conservation status:* Vulnerable.

*Distribution:* Laos, Vietnam, Kampuchea, Thailand, Malaysia, Indonesia and the Philippines. Widespread, but rare in Laos, Vietnam, Kampuchea, Thailand and Malaysia because of forest clearance. In Indonesia confined to Batam, Sumatra and Kalimantan, and in the Philippines on Luzon Is., in Cagayan, Nueva Vizcaya, Tarlac, Zambales and Laguna Provinces (Fig. 6).



**Figure 6.** Distribution of *Livistona saribus* (▲), *L. exigua* (■), *L. rotundifolia* (●), *L. papuana* (○), and *L. brevifolia* (□).

*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 on that basis. Dransfield (1999) noted the over-description of palm taxa based on political boundaries, with particular

reference to *L. saribus* and its former 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 species of *Livistona*. There is also a paucity of type specimens, with only four of the eight names applied to the species having been typified.

The monomial *Saribus* was attributed by Rumphius (1741) to the vernacular name used by the Macassans of eastern Indonesia. *Livistona saribus* was first named as *Corypha saribus* (Loureiro, 1790) for plants collected in Vietnam, based on the specimen *Loureiro s.n.* but not able to be located and presumed lost (M. Pignal, pers. comm.). Because of the loss of the holotype, the neotype *Pierre 4837* has been chosen.

*Livistona cochinchinensis* was first named as *Saribus cochinchinensis* by Blume (1838), who based it in part on Loureiro's *Corypha 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 conspecificity 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.*" This scheme was continued by Beccari (1921, 1931), despite the formalisation of *Livistona saribus* (Chevalier, 1919; Merrill, 1925). However, most taxonomists have recently listed it as a synonym (Burret, 1936, 1941; Moore, 1963b; Pei *et al.*, 1991).

*Livistona spectabilis* was described by Griffith (1845) for plants collected from Malacca, Malaysia, possibly with the name referring to the remarkable height attained by the palm. The specimen cited by Griffith, "*Mr. Lewes*", correctly W.T. Lewis, is extant in BR. Wendland (1878) included the name as a synonym under *L. rotundifolia*; subsequently, Beccari (1886) included it as a synonym of *L. cochinchinensis* (= *L. saribus*); but later as a synonym of *L. chinensis* (Beccari, 1921). The protologue, the illustration included in Griffith (1850) and the specimens in BR confirm its correct synonymy under *L. saribus*.

The name *L. hoogendorpii* was first used by Teysmann & Binnendijk (1866) 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 & Binnendijk established the name, and those specimens, sheets 11330 and 11330-B in FI are here chosen as the lectotype. Although the origin 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.*, from Batam Province 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 & 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*. *Livistona tonkinensis* was applied to a population in the Tonkin region of Vietnam by Magalon (1930) based on his own collection now in P, and is synonymised under *L. saribus*.

*Livistona saribus* is a canopy palm to 40 m tall; leaves are large with grouped segments and deep divisions between the groups; segment apices are pendulous; there are long prominent spines on the petiole; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 9 partial inflorescences; flowers are yellow; and fruit are globose to ellipsoid to reniform, to 25 mm long, to 18 mm diam., often bilobed, and glossy blue to purple at maturity.

2. ***Livistona exigua*** J.Dransf., Kew Bull. 31 (1977) 760, fig. 2. – **Type:** Brunei. Belait District, Ulu Ingei, ca. 60 m alt., Aug 1959, *Ashton BRUN 5513* (holotype, K; isotypes, BH, BO, L, NY, SAR). **Plate 2a-d.**

Hermaphroditic palm. **Trunk** to 5 m tall, 1.5-2.5 cm dbh, leaf scars raised, irregular in width, internodes narrow, irregular in length, pale brown, petiole stubs not persistent. **Leaves** 16-20 in a vertically ovoid crown; petiole 40-60 cm long, slightly arching, proximally ca. 6 mm wide, tapered to ca 3 mm wide distally, adaxially flat, armed on the margins in the lower one-third, upper margins sharp, slightly winged; petiole surface with scattered caducous pseudo-parenchymatous peltate scales on both surfaces; spines retrorsely recurved, brown, to 4 mm long, bases swollen, regularly placed at ca 5 mm apart; leaf-base fibres

prominent, coarse, closely woven, dull dark brown, persistent; appendage to ca 30 cm long; lamina palmate, irregularly segmented, with segments grouped and with divisions between each group of segments deeper into the lamina than the divisions between individual segments, circular, ca 50 cm wide, adaxially midgreen, abaxially lighter green, adaxially glabrous, scattered brown scales abaxially; lamina divided for ca 42% of its length, with 16-30 segments that are single or grouped into 2-6 segments, depth of apical cleft ca 8% of the segment length; segments to 25 cm long, widest at mid segment, 1.0-1.5 cm wide, acuminate toward both apex and base, apical lobes rigid, finely toothed; parallel veins 5-6 each side of midrib; transverse veins  $\pm$  same thickness as parallel veins; hastula conspicuous, to 5 mm wide and 2-3 mm high. **Inflorescences** unbranched at the base, 15-40 cm long, not extending beyond the limit of the crown, straight to slightly curving, branched to 2 orders; partial inflorescences 3-4; 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, the apices acute; peduncular bract(s) lacking; rachis bracts loosely tubular; partial inflorescence axes covered densely with indumentum and papillae; rachillae 6-10 cm long, rigid, to ca 2.5 mm diameter. **Flowers** solitary or paired, sessile, purplish, subtended by a fimbriate bract ca 0.2 mm high, ca 1 mm diam.; sepals fused for ca half their length to form a short tube ca 0.3 mm high, lobes ca 0.2 mm high, rounded, fimbriate, abaxially densely covered with indumentum; petals broadly triangular, glabrous, ca 0.4 mm high, basally fused for ca one-quarter their length; stamens ca 2 mm high, basally fused, swollen; carpels glabrous, style ca 0.2 mm high. **Fruit** globose, ca 9 mm diam., purplish-green; epicarp smooth; suture line extending the full length of the fruit; mesocarp ca 1.5 mm thick with numerous tannin cells; endocarp crustaceous, ca 0.3 mm thick; pedicel 1-2 mm long. **Seed** globose. **Eophyll** not seen.

*Specimens examined:* BRUNEI DARUSSALAM: Belait District, Ulu Ingei, ca 60 m alt., *Ashton BRUN 5513* (BH, BO, L, K holotype, NY, SAR); Ulu Ingei, Bukit Batu Patam, 04°5'N, 114°42'E, 200 m alt., ridge top kerangas forest, transitional to mixed Dipterocarp forest, abundant miniature serdang forming thickets on ridge tops, *Dransfield JD6568 with Wong Khoon Meng, Dransfield & Boyce* (A, K, SING); Ulu Ingei, 150 m alt., Jan 1982, *Morgan s.n.* (K, SING).

*Habitat and ecology:* In forest transitional between lowland Dipterocarp forest and kerangas (heath forest) on sandstone, at 60-260 m alt.

*Conservation status:* Near threatened.

*Distribution:* Brunei. Belait District, Ulu Ingei (Fig. 6).

*Notes:* *Livistona exigua* was described by Dransfield (1977) based on the collection *Ashton BRUN5513* collected from the Belait District, Brunei, in 1959, and named with reference to the palm's small stature. This collection had remained as unidentified material in Kew, but with examination by Dransfield was recognised as a new species. It has provided a considerable ecological extension for the genus, as a rainforest understorey palm in kerangas heath, which was previously not recorded in *Livistona*.

*Livistona exigua* is an understorey palm to 5 m tall; leaves are small, and have grouped segments and deep divisions between the groups; segment apices are rigid; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to four partial inflorescences; flowers are purplish; fruit are globose, to 9 mm diam., and purplish green at maturity.

3. *Livistona rotundifolia* (Lam.) Mart., Hist. Nat. Palm. 3 (1838) 241; Miquel, Fl. Ned. Ind. 3 (1855) 58; Palm. Archip. Ind. (1868) 12; Beccari, Ann. Roy. Bot. Gard. (Calcutta) 13 (1931) 74. -*Corypha rotundifolia* Lam., Encycl. 2 (1786) 131; Willdenow, Sp. pl. 2 (1797) 201; Hayne, Term. Bot. tab. 11, fig. 1 (1807); Sprengel, Syst. Veg. 2 (1825) 138; Schultes, Syst. Veg. 7 (2) (1830) 1309. -*Saribus rotundifolius* (Lam.) Blume, Rumphia 2 (1838) 49, pl. 95, 96. – **Type:** Illustration in Rumphius, Herb. Amboin. 1 (1741) t. 8 (lectotype, *fide* Merrill, 1917). **Plate 3a-d.**

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

-*Corypha umbraculifera* auct. non L., Sp. Pl. (1753) 1187.

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

-*Livistona altissima* Zoll., Nat. Tijdschr. Ned. Indië 14 (1857) 150. *Saribus* sp. n. ? 'Sadjeng', Zollinger, Syst. Verz. (1854) 78; Miquel, Palm. Archip. Ind. (1868) 14. - Type: Lectotype here chosen. Indonesia. Cultivation. Bogor Botanic Gardens, undated, *Zollinger 2684* (lectotype, BM).

-*Livistona robinsoniana* Becc., Philipp. J. Sci. 6C (1911) 230; Philipp. J. Sci. 14 (1919) 341. -Type: Philippines. Polillo Is., Quezon Prov., Aug. 1909, *Robinson 9265* (holotype, FI; isotypes, K, US).

-*Livistona rotundifolia* var. *microcarpa* (Becc.) Becc., Philipp. J. Sci. 14 (1919) 341; Leaflet Philipp. Bot. 8 (Aug. 25) (1919) 3024. -*Livistona microcarpa* Becc., Philipp. J. Sci. 2 (1907) 231. -Type: Philippines. Palawan, Carañugan R., 28 Feb. 1906, *Curran 3784* (holotype, FI; isotypes, BM, NY, P).

-*Livistona rotundifolia* var. *mindorensis* (Becc.) Becc., Philipp. J. Sci. 14 (1919) 341. -*Livistona mindorensis* Becc., Philipp. J. Sci. 4 (1909) 615. - Type: Philippines. East Mindoro Prov., Mindoro, Bongabong R., May 1906, Merritt 4108 (holotype, FI).  
 -*Livistona rotundifolia* var. *luzonensis* Becc., Leaflet Philipp. Bot. 8 (Aug. 25) (1919) 3025; Philipp. J. Sci. 14 (1919) 340; as *Livistona rotundifolia* (Lam.) Mart., Leaflet Philipp. Bot. 2 (1909) 647; Merrill, Fl. Manila (1912) 122. - Type: Philippines. Luzon. Quezon (Tayabas) Prov., Lucban, Mt Banahao, May 1907, Elmer 9293 (holotype, FI; isotypes, BM, BO, K, L, NY, US).

Hermaphroditic palm. **Trunk** to 45 m tall, 15-25 cm dbh, leaf scars obscure to prominent, light green to white, internodes broad, green to grey, smooth or infrequently with longitudinal fissures, petiole stubs not persistent. **Leaves** 20-50 in a globose crown; petiole slightly arching, 90-210 cm long, 15 cm wide proximally, ca 2 cm wide distally, adaxially flat or moderately ridged, margins with retrorsely recurved black spines 1-20 mm long throughout or proximally only, with largest proximally, distally becoming smaller and more widely spaced, or very infrequently with spines lacking in mature plants; leaf-base fibres moderately prominent, coarse, in a criss-cross pattern, brown, persistent, appendage triangular; hastula very prominent, 2 cm high; lamina costapalmate, circular to subcircular, regularly segmented, 75-150 cm long, adaxially semi-glossy dark green, abaxially lighter subglaucous green; lamina divided for 38-62% of its length, with 60-90 segments, depth of apical cleft 4-25% of the segment length, apical lobes usually erect, but pendulous in segments with deeper clefts; mid-leaf segments ca 5 cm wide where the segments diverge; parallel veins 6-9 each side of midrib; transverse veins equal thickness or thinner than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes, branched to 4 orders, 90-150 cm long, not extending beyond the limit of the crown, arching; partial inflorescences ca 10, longest to ca 30 cm; prophyll to 30 cm long, glabrous, straw coloured; peduncular bracts lacking or 1, and then tightly tubular; rachis bracts tightly tubular, reddish brown, glabrous, apically truncate, remaining intact with age; rachillae 3-20 cm long, 1-1.5 mm thick, straight, yellowish, glabrous. **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 less obtuse, yellowish; ovary glabrous; style subulate, acute, very short. **Fruit** globose to subglobose, 11-25 mm diam., at first yellow, ripening though to orange-red 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 ca 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, 2-2.4 mm long. **Eophyll** 5 ribbed.

*Specimens examined:* INDONESIA: *anon. s.n.* (BO); Ternate and Sulawesi (Woka), *Reinwardt* 60 (L); North Maluku. Halmahera Is., Jailol District, Kampung Pasir Putih, *Taylor* 605 (US); Maluku. Halmahera, Ekor, Bukit Dowora Ina, *de Vogel* 3236 (BO, K, L); Maluku. Halmahera, Akelamo Oba, 00°34'N, 127°36'E, ca 50 m alt., *de Vogel* 4436 (K, LAE); North Sulawesi, Amoerang, undated, *collector unknown* (BO); North Sulawesi, Manado, *Koorders* 18424 (BO); North Sulawesi, *Koorders* 18425 (BO); Sulawesi, near Manado, *Forman* 409 (A, BO, LAE, PNH); Sulawesi. Bolaang Mongondow, Dumoga Bone NP, Toraut Dam, *de Vogel* 6894 with *Vermeulen* (K); Sulawesi. Bolaang Mongondow, Pindool, Lelak, *Dransfield & Moge* JD 3831 (BO, K); Ceram, undated, *de Vriese & Teysmann s.n.* (L); Papua. Sorong. Raja Ampat Islands, Waigeo Is., Waifo Village, *Maturbongs* 501 (K). PHILIPPINES: Calayan Is. Cagayan Prov., 150 m alt., *Quisumbing & del Rosario* 61-369 (PNH); Luzon. Cagayan Prov., Linao, Tuguegarao, *Rocero* 220 (PNH); Luzon. Cagayan Prov., Claveria, Mt Taggat, *Reynoso* 11903 (K); Luzon. La Union Prov., Contilla, *Loher* 7070 (K); Luzon. Tarlac Prov., *Vidal* 1952 (K); Luzon. Zambales Prov., Mt Pinatubo, Villar, 350 m alt., *Fox* 26 (PNH); Luzon. Quezon (Tayabas) Prov., Lucban, Mt Banahao, *Elmer* 9293 (BM, BO, FI, K, L, NY, US); Polillo Is. Quezon Prov., *Fox* 8996 (A); Polillo Is. Quezon Prov., *Robinson* 9265 (FI, K, US); Polillo Is. Quezon Prov., Barangsay Sibulan, 4 km N of Polillo town, *Dowe* 700 with *Romero* (K, PNH); Polillo Is. Quezon Prov., Karlagan, *Fox* 6b (PNH); Polillo Is. Quezon Prov., Lukutaw, *Fox* 223 (PNH); Luzon. Manila, Paco, *Bartlett* 13203 (K); Luzon. Laguna Prov., Mt Makiling, *Gates* 5700 (CAHP); Luzon. Laguna Prov., Mt Makiling, 450 m alt., *Gates* Q93 (CAHP); Luzon. Laguna Prov., Los Baños (Mt Makiling), *Elmer* 18054 (BM, K, L); Luzon. Laguna Prov., Mt Makiling, *Pancho* 3488 (CAHP); Luzon. Laguna Prov., Mt Makiling, 100 m alt., *Fernando* 7115 (LBC); Luzon. Laguna Prov., Mt Makiling, 100 m alt., *Fernando* 7451 (LBC); Luzon. Laguna Prov., Mt Makiling, *Mabesa* 26228 (K, US); Luzon. Batangas Prov., San Jaun, Laiya, *Hernaez* 3625 (CAHP); Luzon. Camarines Prov., *Curran* 10631 (BM, L, US); Luzon. Camarines Sur Prov., Albay, Tabacco, *Hernaez* 3870 (CAHP); Marinduque Is. Marinduque Prov., *Vidal* 1943 (K); Mindoro. Mt Yagaw, 400 m alt., *Conklin* 535 (PNH); Mindoro. Bongabong R., *Merritt* 4108 (FI); Mindanao. District of Davao, Todayo (Mt Apo), *Elmer*

11967 (A, BM, BO, K, L, NY, UC); Samar. Llorente, Mt Apoy, 200-300 m alt., *Guiterrez* 367 (PNH); Palawan. Quezon, Panitian, ca 50 m alt., *Dransfield* JD6208 (K); Palawan. Mt Tagburos, vicinity of Puerto Princesa, *Ebalao* 648 (K); Palawan, Carañugan R., *Curran* 3784 (BM, FI, NY, P); No locality: 1904, carpological collections 1712, *Burck s.n.* (L).

**CULTIVATION:** INDIA: Madras, 26 May 1900, *A.G. Bourne s.n. with Lady Bourne* (K); INDONESIA: Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI); Java. Puger, *Koorders* 6128 (BO); Java, Koeli, *Koorders* 6129 (BO); North Sumatra, *Lörzing* 12131 (BO); Bogor Botanic Gardens, *Zollinger* 2684 (BM). MALAYSIA: Penang Hill, Viaduct Rd, Methodist Centre, *Whitmore* FRI0291 (L); SINGAPORE: Singapore Botanic Gardens, Lawn B near main gate, *Furtado* 29216 (K); Singapore Botanic Gardens, near main gate, B area, introduced as sp. from Negros, *Furtado* 29393 (A, K, SING); Singapore Botanic Gardens, *Furtado* 29394 (A); Singapore Botanic Gardens, near main gate, B area, *Furtado* 40542 (SING); PAPUA NEW GUINEA: Lae Botanic Gardens, *Croft* 71100 (LAE); PHILIPPINES: Luzon, Manila Botanic Gardens, *Loher* 1391 (K); Luzon, Pasay City, Mona Lisa Steiner's garden, *Steiner* 685 (PNH); Luzon, Los Baños, College of Agriculture Campus, University of Philippines, *Pancho* 2405 (CAHP); SRI LANKA: Royal Botanic Gardens Peradeniya, S-7, *Rutherford* 51 with *Bandara* (K); TRINIDAD AND TOBAGO: Trinidad, 1884, *anon. s.n.* (K); UNITED KINGDOM: Royal Botanic Gardens Kew, Palm House, *anon.* 000-73.12587 (K); Royal Botanic Gardens Kew, *anon.* 000-73.1258 (K).

**Local and vernacular names:** Footstool Palm, Balla (Mindanao), Luzon Livistona, Anahao (Tagalog), Bulus (Albay Province), Mindoro Livistona, Panobao (Tagalog), Pilig (Tagalog); Sergand (Sumatra), Woka (North Sulawesi).

**Habitat and ecology:** Locally abundant in swampforest, seasonally dry swampforest, mangrove margins, rainforest, moist evergreen forest, along rivers and secondary forest at 0-300 m alt. Flowers all year; fruits all year.

**Conservation status:** Least concern.

**Distribution:** Indonesia, Malaysia and the Philippines. In Indonesia on Java (though possibly escaped from cultivation only), Kalimantan, Sulawesi, Maluku, and Raja Ampat Islands; in Malaysia, in northern Sabah and nearby islands; and throughout the Philippines (Fig. 6).



*Notes:* *Livistona rotundifolia* is treated here as a variable species. Previous taxonomy, which included a number of taxa that are herein synonymised, is otherwise difficult to support. The morphological diversity within *L. rotundifolia* encompasses both leaf and fruit characteristics; the former with segment apices erect to semi-pendulous, and the latter with size, of 11-25 mm diam., and colour, at first yellow, then ripening though to red or to dark violet or bluish-black. These variable characters appear to occur more or less randomly throughout the entire population.

*Livistona rotundifolia* was the first species in the genus to be taxonomically recognised, and named by Rumphius (1741) in the pre-Linnean publication *Herbarium Amboinense*, as the monomial *Saribus*. Linnaeus (1753) included Rumphius' *Saribus* as part of his broadly circumscribed *Corypha umbraculifera*. Subsequently, 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, p. 111) noted that "*Saribus Rumph. is the whole basis of Corypha rotundifolia Lam., which in turn typifies Livistona rotundifolia Mart.*", and therefore proposed the illustration in *Herbarium Amboinense*, tab. 8 (Rumphius, 1741), to be the lectotype. Moore (1963a) proposed *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 identity of the species, Blume (1838) established the genus *Saribus*, utilising the name of Rumphius' monomial 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* in regards 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* and establishing the disassociation of *C. saribus* from *L. rotundifolia*. See Notes under *L. saribus* for further discussion about this.

*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. *Livistona altissima* was first synonymised under *L. rotundifolia* by Beccari (1931).

*Livistona robinsoniana* was described by Beccari (1911) based on Robinson 9265 from Polillo Is (Robinson, 1911), and named for the collector, Canadian botanist, C. B. Robinson (1871-1913). 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.

Beccari (1919a, 1919b) ultimately recognised three subspecies of *L. rotundifolia* in the Philippines, *L. rotundifolia* var. *microcarpa*, *L. rotundifolia* var. *mindorensis*, and *L. rotundifolia* var. *luzonensis*, all of which cannot be separated from *L. rotundifolia sensu lato*. 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, p. 76) wrote of *L. rotundifolia* that it was “.... a palm of wide geographical distribution and subject, for that reason, to vary more or less, but easily grouped around one well characterised type...”.

Regarding fruit colour in *L. rotundifolia*: it appears that individuals have uniformity in mature fruit colour, and that variation occurs in individuals within and between populations. 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”.

*Livistona rotundifolia* is one of a distinct group of closely related species that has its distribution in Malesia, including the Philippines. The group 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 group consists of *L. rotundifolia* (Indonesia, Philippines), *L. merrillii* (Philippines), *L. brevifolia*, *L. chocolatina*, *L. papuana*, *L. surru*, *L. tothur* (New Guinea), and *L. woodfordii* (New Guinea and Solomon Islands).

*Livistona rotundifolia* is a variable canopy palm to 45 m tall; leaves are large and regularly segmented; segment apices are rigid or pendulous, and with a bifurcate cleft 4-25% of the segment length; the inflorescence is

basally trifurcate or infrequently bifurcate, not extending beyond the limit of the crown, and with up to 10 partial inflorescences; bracts are tightly tubular; flowers are yellowish; fruit are globose, to 25 mm diam., and orange-red to red, dark violet to bluish black at maturity.

4. ***Livistona papuana*** Becc., Malesia 1 (1877) 84. -*Saribus papuanus* (Becc.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** Indonesia. Papua, Miosnom Is., Apr 1875, *Beccari s.n.* (holotype, FI). **Plate 4a-b.**

Hermaphroditic palm. **Trunk** to 30 m (50 m?) tall, 12-30 cm dbh, leaf scars raised, internodes broad, grey. **Leaves** 17-40 in a globose crown; petiole 111-200 cm long, ca 15 mm wide at the apex, whitish with a thin, flakily deciduous waxy coating, adaxially flat to slightly ridged, margins armed throughout, or with spines infrequently confined to proximal portion or very infrequently lacking; margins sharp when unarmed; spines retrorsely recurved, to 20 mm long; leaf-base fibres soft, reddish, partly disintegrating; lamina costapalmate, regularly segmented, subcircular, 90-180 cm long, 100-150 cm wide, adaxially shiny or greyish green, abaxially lighter green, rigid, waxy glaucous; lamina divided for 23-69% of its length, with 45-90 segments, depth of apical cleft 5-11% of the segment length; apical lobes acuminate, rigid; parallel veins 7-8 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** with  $3 \pm$  similar collateral axes, branched to 3 orders, each axis 100-225 cm long, not extending beyond the limit of the crown, arched-nodding, the central axis slightly longer than the laterals; partial inflorescences 5-10; 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, tightly sheathing, margins acute; rachis bracts tubular, subterete or very slightly flattened, mouths truncate, entire or lacerate-fibrous, and extended on one side into bi-toothed tips; rachillae 3-12 cm long, ca 1 mm thick, straight, reddish-brown pubescent, most dense underneath and immediately outside of enclosing bracts, whitish-green on exposed parts. **Flowers** solitary or in clusters of 2-4, ca 1.2 mm long, sessile on superficial pulvinuli, with an inconspicuous bracteole; sepals fused, lobes long, triangular, ca. 1 mm long, apically acute, longitudinally nerved, yellow; petals triangular, obtuse, apically acute, ca 1 mm long, ca 1.2 mm wide at the base, yellow; stamens fused for ca  $\frac{1}{2}$  the length of the petal, shoulders flat, filament very thin, ca 0.5 mm high; anthers ca 0.1 mm long; carpels ca 0.8 mm long; stigma pointed. **Fruit** globose to obovoid-obpyriform, 14-25 mm long, 5-20 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 sublateral. **Eophyll** not seen.

*Specimens examined*: INDONESIA: Papua. Misool Is, Pulalongkakalong, *Heatubun 363 with Iwanggin* (K, MAN); Manokwari District, Bintuni Subdistrict, near Tanah Merah Village, *Maturbongs 730 with Siwana & Kamisopa* (BO, K, MAN); Manokwari District, Bintuni Subdistrict, near Saengga Village, *Maturbongs 731 with Siwana & Areta* (AAU, BO, K, LAE, MAN); Miosnom Is., Apr 1875, *Beccari s.n.* (FI, holotype); Yapen Is, N side, Sewenui village, *Arisoi HA1* (MAN); Yapen Is, N side, Sewenui village, *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., *Baker WJB851* (AAU, BH, BO, BRI, K, MAN).

*Local and vernacular names*: Woka (Papuan name), Wanna (Poparo language).

*Habitat and ecology*: In rainforest at 200-540 m alt.

*Conservation status*: Near threatened.

*Distribution*: Indonesia. In Papua on Miosnom, Biak and Yapen islands, and the Timika area (Fig. 6).

*Notes*: *Livistona papuana* was described by Beccari (1877) from his own collection from Miosnom Is in Cenderawasih Bay, Papua. He suggested some resemblance to *L. rotundifolia*, but from which it was distinct by the lack of armature and obovoid/obpyriform rather than globose fruit. Beccari did not describe flowers or mature fruits. Recent collections from Yapen Is, such as *Arisoi HA1* (MAN), have yellow flowers and orange-red fruits.

*Livistona papuana* is a canopy palm to 30 m tall; leaves are large and regularly segmented; segment apices are rigid, and with a bifurcate cleft 5-11% of the segment length; the inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 10 partial inflorescences; bracts are tightly tubular; flowers are yellow; fruit are globose, to 25 mm diam., and orange-red at maturity.

5. ***Livistona brevifolia*** Dowe & J.P.Mogea, *Palms* 48 (2004) 201, fig. 6.  
– **Type**: Indonesia. Papua, Kepulauan Raja Ampat, West Waigeo, Kawe Is.,

17 Nov. 2002, *Mogea 8171 with Takeuchi, Neville & Liuw* (holotype, BO; isotypes, K, L, MAN, NY). **Plate 4c-e.**

Hermaphroditic palm. **Trunk** to 22 m tall, ca 12 cm dbh, leaf scars slightly raised, light grey, internodes narrow, petiole stubs not persistent. **Leaves** 16-40 in a globose crown; petiole ca 110 cm long, slightly arching, green, proximally 29-42 mm wide, distally 12-13 mm wide, adaxially slightly concave, glabrous, with deciduous white waxy scales on the adaxial surface, abaxially rounded, margins lacking spines; leaf-base fibres coarse, woven in one layer, brown, persistent until leaf fall then deciduous; appendage 12-25 cm long; lamina costapalmate, regularly segmented, semi-circular, moderately undulate, rigid, 55-62 cm long, 45-55 cm wide, adaxially midgreen, abaxially light green; lamina divided for 17-53% of its length, with 22-25 segments, depth of apical cleft 1-4% of the length of the segment, 2-2.5 cm wide where the segments diverge, apical lobes rigid; hastula poorly developed, strongly asymmetric, lobed; parallel veins 5-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes, branched to 3 orders, ca 60 cm long, not extending beyond the limit of the crown, but with central axis slightly longer and slightly more robust than the lateral axes; each axis with 2-3 partial inflorescences; prophyll 35-45 cm long, 2.5-3.5 cm wide, papyraceous, entire at the apex, glabrous; peduncle of central axis subterete to laterally compressed, 18-20 mm diam.; peduncle of lateral axes terete, 8-12 mm diam.; peduncular bract(s) lacking; rachis bracts 15-25 cm long, tightly tubular, papyraceous, remaining intact at the apex with maturity; bases of partial inflorescences with green tomentum; rachillae 4-9 cm long, straight, subterete to angular, ca 0.5 mm thick, pubescent, red at floral anthesis. **Flowers** solitary or in clusters of 2-4; sepals basally fused, red, with lobes to 1.0-1.2 mm long; petals broadly triangular, ca 2 mm long, basally connate for ca half their length, thick, fleshy, red, apical margins recurved; stamens much shorter than petals, basal part fused to petal, shoulders flat; filament very short; anthers 0.2 mm long, pink. **Fruit** globose, 10-12 mm diam.; epicarp thin, smooth, drying minutely tuberculate with scattered lenticels; stigmatic remains apical; mesocarp thin, nonfibrous; endocarp thin, crustaceous; pedicel 2-3 mm, ca 1 mm thick. **Seed** globose, 8-10 mm diam.; endosperm intruded by the testa to about three quarters across the seed, intrusion of soft tissue irregularly shaped with minor intrusions extending to the outer edge of the endosperm; embryo supra-lateral, ca 1 mm long. **Eophyll** not seen.

*Specimens examined*: INDONESIA: Papua, Raja Ampat, Kawe Is., *Mogea*

8171 with Takeuchi, Neville & Liuw (BO holotype, K, L, MAN, NY); Papua. Raja Ampat, Kawe Is., Mogeia 8224 with Takeuchi, Neville & Liuw (BO, K).

*Habitat and ecology*: Forming colonies in open coastal forest on ultrabasic rocks at 10-20 m alt.

*Conservation status*: Near threatened.

*Distribution*: Indonesia. Papua, Raja Ampat, Kawe Island and Gag Island (Fig. 6).

*Notes*: *Livistona brevifolia* was described by Dowe and Mogeia (2004) based on a specimen collected during an ecological survey of the Raja Ampat Islands (Takeuchi, 2003). *Livistona rotundifolia* also occurs on Kawe, but the two species occupy different habitats: *L. brevifolia* on well-drained slopes and low ridges, whilst *L. rotundifolia* occupies moist depressions and swampforest.

*Livistona brevifolia* is a moderate canopy palm to 22 m tall; leaves are smallish and regularly segmented; segment apices are rigid, and with a bifurcate cleft 1-4% of the segment length; the inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 3 partial inflorescences; flowers have all parts red, and the anthers pink; fruit are globose, to 12 mm diam. at maturity.

6. ***Livistona merrillii*** Becc., in Perkins, *Fragm. Fl. Philipp.* 1 (1904) 45; *Webbia* 1 (1905) 339; *Philipp. J. Sci.* 14 (1919) 340. – **Type**: Philippines. Luzon. Tayabas Prov., Guinayangan, Jan. 1903, *Merrill 2071* (holotype, FI). **Plate 5a-c.**

–*Corypha minor* Blanco non Jacq., *Fl. Filip.* (1837) 229.

–*Livistona whitfordii* Becc., *Webbia* 1 (1905) 341; *Philipp. J. Sci.* 4 (1909) 615. –Type: Philippines. Luzon. Quezon Prov., Atimonan, 23 Aug 1904, *Whitford 731* (holotype, FI; isotype, PNH).

–*Livistona blancoi* Merr., *Sp. Blancoan.* (1918) 84. –Type: Philippines. Luzon, Quezon (Tayabas) Prov., Unisan, 11 May 1916, *Merrill 919* (holotype, PNH; isotypes, A, BM, BO, K, L, NY).

Hermaphroditic palm. **Trunk** to 20 m tall, 15-30 cm dbh, leaf scars prominent, light green to grey in the upper portions aging to grey throughout, internodes broad, dark green to purple-green in the upper portion, aging to grey, petiole stubs not persistent. **Leaves** 40-50 in a ± globose crown; petiole

90-200 cm long, slightly arching, proximally ca 15 cm wide, distally ca 2.5 cm wide, adaxially flat, with deciduous tomentum, margins most frequently unarmed in leaves from mature plants or if present the spines confined to the very proximal part with single curved black spines 6-20 mm long, then reduced to scattered rudimentary tubercles 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; appendage long; lamina costapalmate, regularly segmented, circular, 100-150 cm long, adaxially green, abaxially slightly lighter green; lamina divided for ca 34% of its length, with ca. 70 segments, depth of apical cleft 30-40% of the segment length, apical lobes acuminate, rigid when depth of apical cleft is shallow, pendulous when depth of apical cleft is deep; hastula prominent, irregularly curved, lobed; parallel veins 5-6 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes, branched to 3 orders, 100-150 cm long, not extending beyond the limit of the crown; each axis with 5-10 partial inflorescences, longest to 40 cm; prophyll to 45 cm long, 7 cm wide, glabrous, thinly coriaceous, apices acuminate, caudate; peduncle ca 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, straight, glabrous. **Flowers** solitary, sessile, 3-4.5 mm long, ovate-acute in bud, on large raised pulvini; sepals fused basally, fleshy, lobes broadly subtriangular, thick, yellow; petals elongate-triangular, thick, acute, slightly spreading at anthesis, bright yellow; stamens with basally fused filaments, thick and short, contracted into short apices, connective very short, narrow. **Fruit** globose to depressed-globose, 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. **Eophyll** not seen.

*Specimens examined:* PHILIPPINES: Luzon. Zambales Prov., *Curran* 5834 (US); Polillo Is. Quezon Prov., *Hernaez* 3622 (CAHP); Polillo Is. Quezon Prov., Panukulan, Sitio Kitian, *Fernando* 8019 (LBC); Luzon. Laguna Prov., Covinti, *Loher* 7056 (K); Luzon. Quezon (Payabas) Prov., *Curran* 10189 (US); Luzon. Quezon Prov., Atimonan, *Whitford* 731 (FI, PNH); Luzon. Quezon (Tayabas) Prov., Unisan, *Merrill* 919 (A, BM, BO, K, L, NY, PNH); Luzon. Camarines Prov., Paracale, *Ramos & Edano* 33759 (K, US); Luzon. Camarines Prov., *Curran* 10409 (A, UC, US); No location given, *Llanos* 221 (MA).

**CULTIVATION:** Philippines: Luzon, Laguna Prov., Los Baños Forestry Campus, *Fernando 7337* (LBC).

**Local and vernacular names:** Ballang (Cagayan Prov., Luzon), Telsis (Zambales Province).

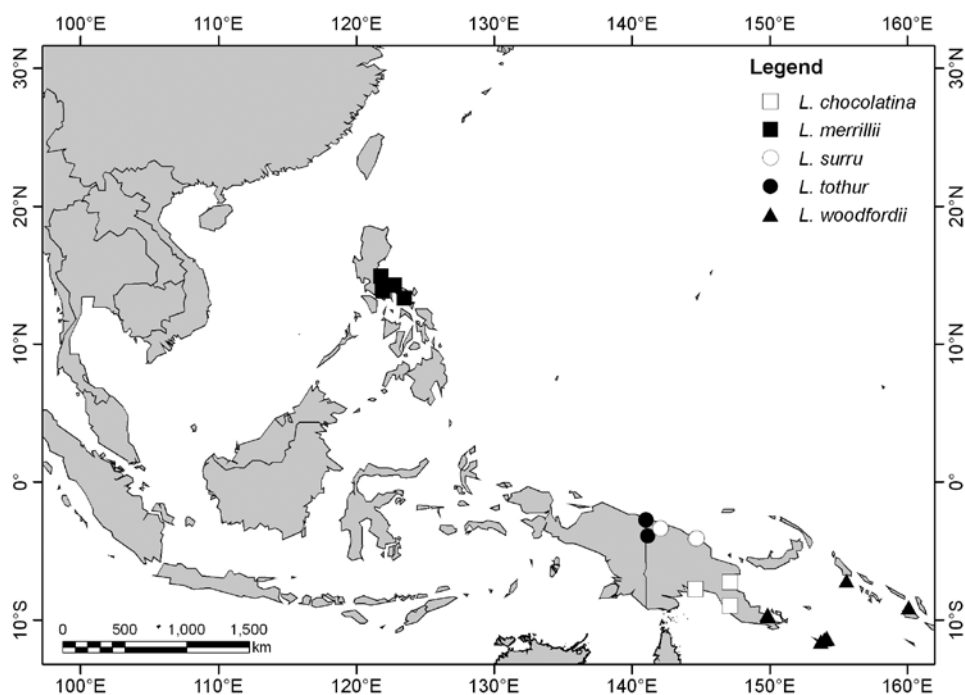
**Habitat and ecology:** Forming colonies in *Shorea* forest and on rocky limestone hills near the seashore at 60-200 m alt.

**Ethnobotany:** Leaves used for thatching and for raincoats, stems for bows and flooring.

**Conservation status:** Vulnerable.

**Distribution:** Philippines. Luzon, in Cagayan, Camarines, Tayabas and Zambales Provinces, and on Polillo Is (Fig. 7).

**Notes:** *Livistona merrillii* was first described by Beccari (1904) based on a



**Figure 7.** Distribution of *Livistona merrillii* (■), *L. woodfordii* (▲), *L. chocolatina* (□), *L. tothur* (●), and *L. surru* (○).



specimen from Guinayangan, Luzon, *Merrill 2071*, 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. Blanco (1837) used the name *Corypha minor* in his treatment of Philippine palms. However, the name *Corypha minor* was first used by Jacquin (1776) and is the basionym of *Sabal minor* (Jacq.) Pers. Blanco's use of the same name for the Filipino palm constituted a misapplication of a name already taken, and Beccari's creation of a new name, *L. merrillii*, was the correct procedure, according to Article 58.1 (Tokyo Code). Confusingly, Blanco's description of *C. minor* clearly differentiated it from *S. minor* 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. Correctly, it should be *C. minor* Blanco *non* Jacq. when used in synonymy.

Beccari (1905), in a subsequent description of *L. merrillii*, 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 segment 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 *L. merrillii*. It is not clear if Merrill considered *L. blancoi* to be a new species or whether it was simply a matter of providing what he considered to be a more appropriate epithet. The taxon was named for the Spanish Augustinian friar, F.M. Blanco (1780-1845), who provided various accounts 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 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 synonymy 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.

*Livistona merrillii* is a moderate canopy palm to 20 m tall; leaves are moderate to large and regularly segmented; segment apices are rigid to pendulous, and with a bifurcate cleft 30-40% of the segment length; the

inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 10 partial inflorescences; bracts are loosely tubular; flowers are yellow; fruit are globose to depressed-globose, to 23 mm diam., and dark red at maturity.

7. ***Livistona woodfordii*** Ridl., Gard. Chron. ser. 3 (1), 23 (1898) 177 (as *L. woodfordi*). – **Type:** Solomon Islands. San Cristobal Is., (1891?) 1898, *Micholitz s.n.* (holotype, B, destroyed. Lectotype here chosen, BM; isoelectotypes, FI, K, SING). **Plate 5d-f.**

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

Hermaphroditic palm. **Trunk** to 16 m tall, 12-20 cm dbh, leaf scars slightly raised, irregular in width, light grey, internodes broad, greyish-brown to grey with age, petiole stubs not persistent. **Leaves** 30-60 in a globose to broadly conical crown; petiole to ca 110 cm long, 13 mm wide in the distal portion, slightly arching, adaxially slightly ridged, flat or slightly concave, 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 costapalmate, regularly segmented, subcircular to circular, 60-170 cm long, 45-90 cm wide, rigid, adaxially shiny midgreen, glaucous, abaxially lighter green with fine powdery wax; lamina divided for 51-75% of its length, with 60-70 segments, depth of apical cleft 5-23% of the segment length, apical lobes acuminate, semi-pendulous, hanging ca 45° or more to the vertical; lamina deeply undulate, angles of undulations 90° or less; hastula raised ca 10 mm; parallel veins 5-7 each side of midrib; transverse veins equal thickness or thinner than parallel veins. **Inflorescences** with ± similar collateral axes, branched to 3 orders, 120-270 cm long, not extending beyond the limit of the crown, slightly curving; partial inflorescences 5-10, longest to 45 cm long; 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, straight, basally with brown-purple tomentum, distally 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 with a very narrow connective; style sharply tapered, ca. 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 ca.  $\frac{1}{2}$  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.; endosperm intruded by the testa for ca  $\frac{3}{4}$  of the way through to form a central cavity filled with brownish tissue; embryo lateral. **Eophyll** not seen.

*Specimens examined*: SOLOMON ISLANDS: Location not given, *anon.* *H840-14* (K); (Solomon Islands), *Woodford 651-14* (K); Tulagi Is., abundant in wet laterite soils, 90-110 m alt., *Dennis BSIP7944* (K, L, LAE, SING); Tulagi Is., *Whitmore's collectors 4427* (K, L, SING, US); Tulagi Is., *Whitmore 18101 & collectors* (K, LAE); Tulagi Is., (N'gela), ca 50 m alt., *Brass 3517* (A, L; photo BRI); Tulagi Is., W end of island, 0-50 m alt., *Zona 661* (K); San Cristobal Is., (1891?) 1898, *Micholitz s.n.* (BM lectotype, FI, K, SING). PAPUA NEW GUINEA: Milne Bay Prov. Cape Vogel Peninsula, Menapi, 120 m alt., *Brass 21809* (CANB, LAE, US); Cape Vogel Peninsula, near Tapio village, 9°38'S, 149°53'E, alt. 10 m, *Hoogland 4284* (A, CANB, L, LAE); Rossel Is., Abeleti, 50 m alt., *Brass 28281* (K, L, LAE, PNH, US); Rossel Is., Abeleti, 11°20'S, 154°10'E, 50 ft alt., *Henty 27041* (L, LAE); Rossel Is., Pambwa area, Yeleamba, 50 m alt., *Banka 2015 with Dowe* (BRI, K, LAE); Sudest Is., ca 5 km NW of East Point, 60-70 m alt., *Banka 2019 with Dowe* (BRI, K, LAE).

*CULTIVATION*: SINGAPORE: Singapore Botanic Gardens, Lawn O, 7 Mar 1930, *Furtado s.n.* (K); Singapore Botanic Gardens, Garden O, *Furtado 21175* (K, SING); Singapore Botanic Gardens, O towards M & Q, probably progeny of the type collection, *Furtado 29223* (SING); Singapore Botanic Gardens, K, near Office, *Furtado 29* (BH, K, L, SING).

*Local and vernacular names*: Boda (Wedau language), Filu (Kakabai language).

*Habitat and ecology*: Coastal forest on limestone or lateritic soils at 0-120 m alt., in high rainfall areas. Flowers Jan-Apr; fruits May-July.

*Conservation status*: Vulnerable (IUCN, 2006).

*Distribution*: Papua New Guinea and Solomon Islands. 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 (Fig. 7).

*Notes:* *Livistona woodfordii* was described by Ridley (1898) from the collection Micholitz *s.n.* from “...*insula Polynesiae*” and annotated as “*S. S. Islands*” on the specimen labels, and 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 discrepancies regarding the collection date of the type specimen. On the type it is written as 1898, but the itinerary of Micholitz shows he was 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 rather than its collection date. An expanded description was provided by Beccari (1931), and was in part based on an inflorescence and fruit collection, *Macgregor s.n.*, in the Louisiade Archipelago, most probably in 1888 (Thomson, 1889; van Steenis-Kruseman, 1950). Beccari (1931) related that the MacGregor specimen was sent to him by Mueller 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 named it *L. beccariana*. As Burret’s description was based on the Macgregor collection, it is the type. 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*.

*Livistona woodfordii* is a moderate canopy palm to 16 m tall; leaves are moderate and regularly segmented; segment apices are semi-pendulous, and with a bifurcate cleft 5-23% of the segment length; the inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 10 partial inflorescences; bracts are tubular; flowers (sepals and petals) are red; fruit are globose, to 12 mm diam., and reddish orange to reddish brown at maturity.

8. ***Livistona chocolatina*** Dowe, Palms 48 (2004) 199, figs 2, 3. – **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 Mar 2000, Barfod 466 with Banka, Dowe & Kjaer (holotype, AAU; isotypes, BRI, CANB, K, LAE). **Plate 6a-c.**

Hermaphroditic palm. **Trunk** to 22 m tall, 16-18 cm dbh, leaf scars slightly raised, internodes narrow, light grey, petiole stubs not retained. **Leaves** 30-40 in a globose crown; petiole 110-155 cm long, slightly arching, green, proximally ca 3 cm wide, distally ca 2 cm wide, adaxially flat, glabrous

with a cover of deciduous white waxy powder, margins usually spineless in mature plants, or with small single spines to 5 mm long only in the very basal portion in juvenile plants; leaf-base fibres course, brown, persistent until leaf fall then readily deciduous; appendage short; hastula ca 1 cm high, 5 cm across with a central division; lamina costapalmate, regularly segmented, subcircular, flat, rigid, 100-120 cm long and wide, adaxially mid grey green, abaxially light grey green, glaucous waxy; lamina divided for ca 44% of its length, with 45-60 segments, depth of apical cleft ca 4% of the segment length, apical lobes rigid; lamina moderately undulate, angles of undulations  $91^\circ$  or more usually much greater; mid-leaf segments 4-5 cm wide where the segments diverge; parallel veins 7-8 each side of midrib; transverse veins thicker than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes, 195-225 cm long, not extending beyond the limit of the crown, branched to 3 orders, but with central axis slightly more robust than the lateral axes; each axis with 6-10 partial inflorescences; 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.; peduncular bracts 2-4; 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, straight, subterete to angular, 2-3 mm thick, basally with chocolate brown tomentum, distally with cream-green tomentum. **Flowers** solitary or in clusters of 2-4, tightly aggregated in bud and during anthesis, ca 1.2 mm high; sepals basally fused, lobes long, triangular, ca. 1 mm long, red, apically acute, longitudinally nerved; petals triangular, obtuse, red, apically acute, ca 1 mm long, ca 1.2 mm wide at the base; connective very thin, ca 0.5 mm long; anthers ca 0.1 mm long; carpels ca 0.8 mm high, stigmas pointed. **Fruit** globose, ca 25 mm diam., shiny orange-red; epicarp with scattered lenticellular dots and light 3 mm long lines pointing in longitudinal direction toward the apex; stigmatic remains apical to slightly subapical; 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 seed coat to ca two-thirds across, intrusion broadly kidney-shaped; embryo lateral. **Eophyll** 5-ribbed.

*Specimens examined:* PAPUA NEW GUINEA: Morobe Prov. Lababia,

Bulili Ridge, 400 m alt., *Barfod 514 with Kjaer & Magun* (AAU, LAE); Gulf Prov. Vailala R., hills inland, *Lane-Poole 332* (BRI); Central Prov. Kuriva Mission, *Ferrero 980080, 980081, 980083* (LAE); 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., *Barfod 466 with Banka, Dowe & Kjaer* (AAU holotype, BRI, CANB, K, LAE).

*Local and vernacular name:* Manganau (Lababia language).

*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.

*Conservation status:* Vulnerable.

*Distribution:* Papua New Guinea. In Central Province in the Kuriva area, in Gulf Province on hills near the Vailala R., and in Morobe Province near Lababia on Bulili Ridge (Fig. 7).

*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 collected again in 1998 by M. Ferrero, and then again in 2000 by Barfod *et al.*, and from whose collections the type *Barfod 466* was chosen. The species is distinguished 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 proximal surfaces of the partial inflorescences and rachillae, and globose fruit to 25 mm diameter that mature orange-red.

9. *Livistona tothur* Dowe & Barfod, *Austrobaileya* 6 (2001) 171, fig. 3. – 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, *Damborg 418 with Barfod* (holotype, AAU; isotype, BRI, K, LAE). **Plate 6d-e, Plate 7a-d.**

Hermaphroditic palm. **Trunk** to 20 m tall, 15-20 cm dbh, leaf scars slightly raised, narrow, dark grey, internodes broad, grey. **Leaves** 24-40 in a globose crown; petiole 150-200 cm long, proximally ca 10 cm wide, distally ca 1.5 cm wide, adaxially flat, 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; appendage to 60 cm long; hastula raised, small, semi-circular; lamina costapalmate, regularly segmented, subcircular, 150-200 cm long, 120-150 cm wide, adaxially bluish-green, abaxially silvery glaucous; lamina divided for 62-85% of its length, with 60-75 segments, depth of apical cleft 1-3% of the segment length, apical lobes rigid, but becoming pendulous with age or damage, segment 3-4 cm wide where the segments diverge; parallel veins 6-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes, branched to 3 orders, each axis ca 200 cm long, not extending beyond the limit of the crown, with 5-6 partial inflorescences; 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 nonfibrous showing only minor disintegration; rachillae 6-12 cm long, to 3 mm diam., straight, green-red, glabrous. **Flowers** solitary; sepals basally fused, red, with lobes to 1-1.2 mm long; petals broadly triangular, ca 2 mm long, basally connate for ca. half their length, thick, fleshy, red, apical margins recurved, 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., semi-glossy 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, ca. 2 mm wide. **Seed** globose, 22-28 mm diam., endosperm deeply intruded by orange pulpy tissue; embryo lateral. **Eophyll** not seen.

*Specimens examined:* PAPUA NEW GUINEA: West Sepik Prov. Oenake Mts, Apol area, on road to Niau Kono from Vanimo, 2°45.89'S, 141°04.06'E, 500 m alt., *Dowe 516 with Ferrero* (JCT, LAE); Oenake Mts, Niau, 2°46.276'S, 141°03.611'E, 425 m alt., *Barfod 510 with Banka & Kjaer* (AAU, BRI, JCT, K, LAE); Oenake Mts, on road to Niau Kono from

Vanimo, 2°45.89'S, 141°04.06'E, 500 m alt., *Damborg 418 with Barfod* (AAU holotype, BRI, K, LAE).

*Local and vernacular names:* Tot-hur and Yu Bbraal (Bewani language).

*Habitat and ecology:* Rainforest on ridges, limestone and metamorphic rocks, at 400-600 m alt. Flowers Nov-Jan; fruits Feb-Mar.

*Ethnobotany:* Roofs and umbrellas are made from the leaves, bows from the split trunk, and salt is obtained from the ash of burned petioles.

*Conservation status:* Near threatened.

*Distribution:* Papua New Guinea. In West Sepik Prov., Oenake Mts (Fig. 7).

*Notes:* The first recognition of *Livistona tothur* in the literature was an informal note by Essig & 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 resembled 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 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*, 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.

*Livistona tothur* is a moderate canopy palm to 20 m tall; leaves are moderate and regularly segmented; segment apices are rigid, and with a bifurcate cleft 1-3% of the segment length; the inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 6 partial inflorescences; bracts are loosely sheathing; flowers (sepals, petals and carpels) are red; fruit are globose, to 25 mm diam., and shiny orange-red at maturity.

10. ***Livistona surru*** Dowe & Barfod, *Austrobaileya* 6 (2001) 169, fig. 2. -**Type:** Papua New Guinea. West Sepik Prov., Miwaute, 03° 25'S, 142° 07'S, 950-1000 m alt., 20 Nov 1996, *Barfod 390 with Ferrero & Damborg* (holotype, AAU; isotypes, BRI, K, LAE). **Plate 8a-e.**



Hermaphroditic palm. **Trunk** to 20 m tall, 18-25 cm dbh, usually covered by crustaceous lichens, leaf scars slightly raised, internodes narrow, light grey, petiole stubs not retained. **Leaves** 17-29 in a  $\pm$  globose crown; petiole 140-180 cm long, slightly arching, green, ca. 25 mm wide in the middle, adaxially flat, 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 coir-mat like fibres, reddish brown, persistent until leaf fall then deciduous in sheets; appendage to 1 m long, to 10 mm thick; hastula very prominent, 2 cm high, 5 cm across; lamina costapalmate, regularly segmented, subcircular to ovate, undulate, 180-224 cm long, 143-160 cm wide, adaxially mid green, abaxially similar green; lamina divided for 45-80% of its length, with 70-90 segments, depth of apical cleft ca. 6% of the segment length; apical lobes pendulous, hanging  $\pm$  vertically; mid-leaf segments 4.5-7 cm wide where the segments diverge; parallel veins 5-6 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** trifurcate with  $\pm$  similar collateral axes ca 120 cm long, not extending beyond the limit of the crown, branched to 3 orders; each axis with 5-7 partial inflorescences; 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, peduncular bract(s) lacking; 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 in cross section, pubescent with dense long coarse red appressed scales in the proximal portion, distally with long white scales, less dense to glabrous 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 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 seed coat to ca. two-thirds across, intrusion broadly kidney-shaped, orange; embryo lateral. **Eophyll** not seen.

*Specimens examined:* PAPUA NEW GUINEA: West Sepik Prov., Miwaute,

03°25'S, 142°07'E, 950-1000 m alt., *Barfod 399 with Ferrero & Damborg* (AAU, LAE); West Sepik Prov., Miwaute, 03° 25'S, 142° 07'S, 950-1000 m alt., *Barfod 390 with Ferrero & Damborg* (AAU holotype, BRI, K, LAE); West Sepik Prov., Upper Freida R., Mt Ekwai, 1200-1300 m alt., *Ferrero 980029* (LAE). Madang Prov., Goibang, near Bosmun 2, mouth of Ramu R., on road from Bogia, *Baker 582 with Utteridge* (BH, FTG, K); Madang Prov., Bosmun Village at mouth of Ramu R., 04°07'S, 144°43'E, *Damborg 354 with Ferrero & Barfod* (AAU).

*Local and vernacular names:* Surru, Bop or Tim (Olo language at Miwaute).

*Habitat and ecology:* In rainforest and swampforest, 10-1300 m alt. 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.

*Conservation status:* Near threatened.

*Distribution:* Papua New Guinea. In Madang Province near Bosmun village at the mouth of the Ramu R., and in West Sepik Province in the Miwaute area and Mt Ekwai (Fig. 7).

*Notes:* The first mention of *Livistona surru* was by Hay (1984, p. 208) who noted a *Livistona* at Ramu R.: “... here the *Livistonas* are growing in a remarkable rain forest 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 Ferrero (1997) and by Barfod who collected the type specimen, *Barfod 390*. The specific name was taken from the vernacular *surru*, from the Olo language used in the Miwaute area of West Sepik Prov., Papua New Guinea.

*Livistona surru* is a moderate to large canopy palm to 20 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 6% of the segment length; the inflorescence is basally trifurcate, not extending beyond the limit of the crown, and with up to 7 partial inflorescences; bracts are loosely tubular; fruit are globose, to 65 mm diam., and orange-red at maturity.

11. ***Livistona halongensis*** T.H.Nguyen & Kiew, Gard. Bull. Singapore 52 (2000) 198, pl.1a; Wild Pl. Ha Long Bay (2000) 35, pl. 24. – **Type:** Vietnam. Quang Ninh Prov., Ha Long Bay, 12 May 1999, *Nguyen, Averyanov & Nguyen NTH2630* (holotype, HN; isotype, SING). **Plate 9a-b.**

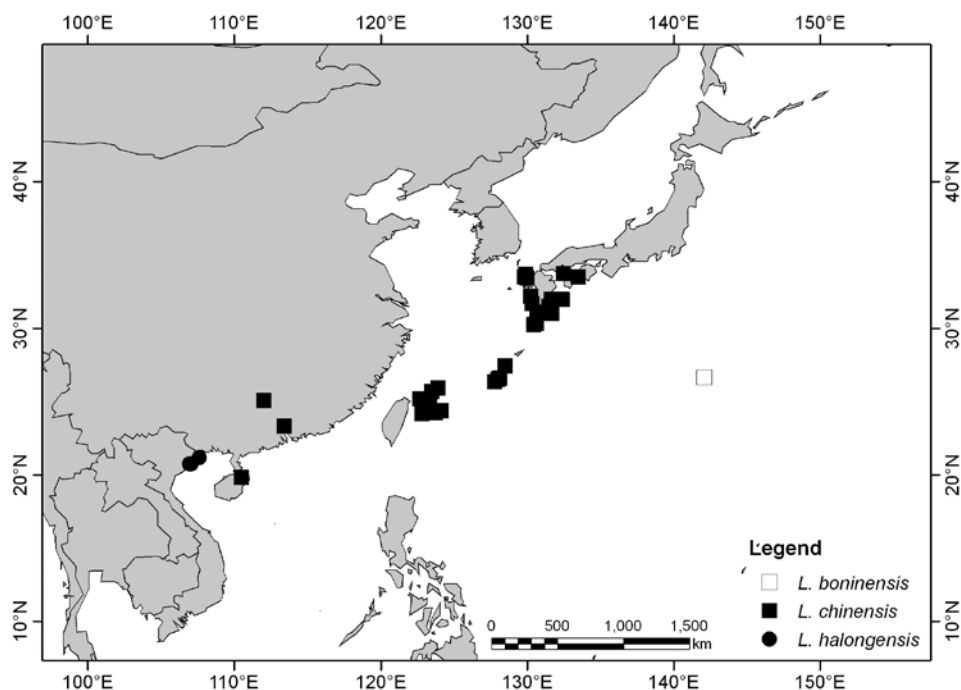
Hermaphroditic palm. **Trunk** to 10 m tall, ca 20 cm dbh, leaf scars conspicuous, internodes narrow. **Leaves** ca 40 in a  $\pm$  globose crown; petiole 125-130 cm long, ca 2 cm wide at the base, ca 1.5 cm wide distally, adaxially flat, green with a light yellow band along the margin, margin with irregularly spaced triangular hooked dull orange spines along entire length but more aggregated proximally; leaf-base fibrous, appendage triangular, rich brown, fibrous, distally tattered into ribbons; hastula papery, to 2.5 cm high; lamina costapalmate, regularly segmented, circular, 75-80 cm long, undulate, adaxially dark green, abaxially lighter green; mid-leaf segments ca. 4 cm wide where the segments diverge; lamina divided for 42-73% of its length, with 45-64 segments, depth of apical cleft ca. 40% of the segment length, apical lobes rigid to semi-pendulous; parallel veins 11-13 each side of midrib; transverse veins thinner than parallel veins; basal part of outer segment with a 2 cm long row of fine teeth on the margin. **Inflorescences** unbranched at the base, ca 340 cm long, erect, projecting vertically above the crown and extending well beyond the limit of the crown, branched to 3 orders; partial inflorescences 6-7, longest to 95 cm; peduncle ca 160 cm long, 2 cm diam.; prophyll to 33 cm long, basally 5 cm wide, distally to 3 cm wide; peduncular bracts 5, each ca 50 cm long, tightly tubular, thick, leathery-fibrous; rachis bracts ca 27 cm long, otherwise similar to peduncular bracts; rachillae 1.0-1.5 mm diam., cream, velvety tomentose. **Flowers** in pairs on pedicel ca 0.3 mm long, ovoid in bud, pale cream-yellow; sepals basally fused with lobes ca 1 mm long, glabrous; petals ca 2 mm long; stamens ca 1 mm long, subulate, staminal tube rich brown, filament very short; anthers white, ca 0.3 mm long; carpel obovoid, deeply ridged, dark reddish brown, ca 1 mm long; style pale brown, ca 0.3 mm long; stigma minute. **Fruit** globose, 10-12 mm diam., epicarp smooth, glossy dark green; mesocarp leathery; endocarp crustaceous, brittle, ca 0.75 mm thick; endosperm intruded by seed coat to ca halfway through; pedicel 2-5 mm long. **Eophyll** not seen.

*Specimens examined:* VIETNAM: Quang Ninh Prov., Ha Long Bay, *Nguyen, Averyanov & Nguyen NTH2630* (HN holotype, SING); Quang Ninh Prov., Ha Long Bay, 15 Jul 1999, *Nguyen & Kiew s.n.* (HN); Ha Long Bay, 11 Apr 2000, *Nguyen & Kiew s.n.* (HN); Hai Phong Prov., Cat Ba NP, limestone hill, ca 300 m alt., *Nguyen Tien Hiep NTH 4853* (HN).

*Habitat and ecology:* Confined to limestone islands, in soil-filled crevices on rocky limestone substrate, sometimes gregarious, 100-300 m alt. Flowers May-Jun; fruits July.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Vietnam. Islands in Ha Long Bay (Fig. 8).



**Figure 8.** Distribution of *Livistona halongensis* (●), *L. chinensis* (■), and *L. boninensis* (□).

*Notes:* *Livistona halongensis* was described by Nguyen and Kiew (2000) from limestone islands in Ha Long Bay, Gulf of Tonkin, Vietnam, based on *Nguyen Tien Hiep NTH 2630*. 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 Is.

*Livistona halongensis* is a smallish sub-canopy palm to 10 m tall; leaves are small and regularly segmented; segment apices are rigid to semi-pendulous, and with a bifurcate cleft to 40% of the segment length;

the inflorescence is unbranched, extending vertically above the crown by about 1 m, and with up to 7 partial inflorescences; bracts are tightly tubular; flowers are cream-yellow; fruit are globose, to 12 mm diam., and glossy dark green at maturity.

- 12. *Livistona chinensis*** (Jacq.) R.Br. ex Mart., Hist. Nat. Palm. 3(7) (1838) 240. -*Latania chinensis* Jacq., Fragm. Bot. (1801) 16, t. 11, fig. 1. -*Saribus chinensis* (Jacq.) Blume, Rumphia 2 (1838) 49. -*Livistona sinensis* Griff., Palms Brit. E. Ind. (1845) 131, *ortho. var.* – **Type:** Illustration in Jacquin, Fragm. Bot. (1801) t. 11, fig. 1, (lectotype, *fide* Moore, 1979). **Plate 9c-f.** -*Latania borbonica* auct. non Lam., Encyclop. 3 (1792) 427. -*Livistona mauritiana* Wall. ex Mart., Hist. Nat. Palm. 3 (1838) 240, *nomem.*
- Chamaerops biroo* Siebold, Syn. Pl. Oecon. Jap. (1830) 11; Martius, Hist. Nat. Palm. 3 (1838) 242. -**Type:** Lectotype here chosen. Japan. undated, *Siebold s.n.* (lectotype, L).
- Livistona olivaeformis* (Hassk.) Mart., Hist. Nat. Palm. 3 (1850) 319; Miquel, Fl. van Ned. Ind. 3 (1855) 59; Palm. Archip. Ind. (1868) 13. -*Saribus olivaeformis* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9 (1842) 176. -*Latania olivaeformis* (Hassk.) Devansaye, Rev. Hort. 47 (1875) 34, *nom. inval.* -**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 & 1131-C).
- Livistona subglobosa* (Hassk.) Mart., Hist. Nat. Palm. 3 (1850) 319; Miquel, Fl. van Ned. Ind. 3 (1855) 59; Palm. Archip. Ind. (1868) 13; Nakai, J. Jap. Bot. 11 (1935) 224. -*Saribus subglobosus* Hassk., Tijdschr. Natuurl. Gesch. Physiol. 9 (1842) 177; Cat. Hort. Bot. Bog. (1844) 65. -*Livistona chinensis* var. *subglobosa* (Hassk.) Becc., Webbia 5 (1921) 2, 16. -**Type:** Lectotype, here chosen. Indonesia. Cultivation, Bogor Botanic Gardens, May 1878, *Beccari s.n.* (lectotype, FI, sheets 11333 & 11333-B).
- Livistona japonica* Nakai ex Masam., (as *Livistonia japonica*), Prelim. Rep. Veg. Yak. (1929) 50; Masamune & Suzuki, Ann. Rep. Taihoku Bot. Gard. 1933, 3 (1933) 73. **Type** not designated.

Hermaphroditic palm. **Trunk** to 15 m tall, 20-30 cm dbh, leaf scars obscure, roughened and with remnant tissue, light coloured, internodes narrow, irregular, brown to grey with age, petiole stubs not persistent, longitudinal fissures prominent. **Leaves** 40-60 in a globose to ovoid crown; petiole slightly arching, to 180 cm long, ca 15 cm wide in the middle, adaxially flat or slightly ridged, surface glabrous; margins with single curved spines in the proximal one-half or less or sometimes absent, distal margins

otherwise sharp and slightly winged; spines 2-20 mm long, subulate, green to black; leaf-base fibre not prominent, coarse, and disintegrating; lamina costapalmate, regularly segmented, subcircular to reniform, 120-200 cm long, 120-180 cm wide, light yellowish green on both surfaces, dull to glossy, nonwaxy; lamina divided for 45-55% of its length, with 50-90 segments, depth of apical cleft ca 13% of the segment length, apical lobes pendulous; lower segments 2-5 mm wide, filamentous, apical cleft extends almost to the hastula; parallel veins 8-9 each side of midrib; transverse veins thinner than parallel veins; hastula ca 3 cm high. **Inflorescence** unbranched at the base, 100-120 cm long, not extending beyond the limit of the crown, slightly curving, branched to 3 orders; 6-7 partial inflorescences; rachillae 10-18 cm long, to 9 mm diameter, glabrous; peduncular bract(s) lacking; rachis bracts tomentose or scaly, loosely tubular, disintegrating into open chartaceous fibres with age, brown, apex acute. **Flowers** in clusters of 4-7, subglobose in bud, 2-2.5 mm long, white to yellowish; sepals imbricate, ca 1.5 mm long, rounded, margins hyaline, inner surface striate; petals triangular, apically pointed, fleshy, ca 2.2 mm long, ca 2 mm wide; filaments united at the base, free in the upper part, connective thickish, ca 0.5 mm long; anthers ca 0.5 mm long; style sharply tapered, ca the same height as the anthers. **Fruit** globose, subglobose, ellipsoid or pyriform, 15-26 mm long, 9-18 mm wide, glossy blue-green to bright green; epicarp ceramic-like; suture line extends for full length of fruit, marked with lip-like structures; mesocarp ca 1.5 mm wide, fleshy, slightly oily, moderately fibrous, endocarp woody, ca 0.5 mm wide; pedicel 2-3 mm long. **Seed** globose, subglobose to ellipsoid, variously reniform in longitudinal section, ca 14 mm long, ca 10 mm wide; endosperm intruded by the testa to ca one-half to two-thirds through to form a cavity filled with brown crystalline tissue; embryo supra-lateral to lateral. **Eophyll** 7-ribbed.

*Specimens examined*: JAPAN: Yakushima, Ambo, *Ohwi & Okamoto* 995 (A, B, BM, BR, K, L, NY, UC, US); Ryukyu Islands (Loo-Choo Islands). 1853-56, *Wright s.n.* (A); Ryukyu Islands. Dharen Is., *Wilson* 8164 (K); Ryukyu Islands. Okinawa Is., Motobu Peninsula, Mt Awa, *Walker* 7636 (S); Ryukyu Islands. Yaeyama Islands, Mt. Kubura, Yonakuni, *Furuse* 4570, 4577 & 4579 (K); No location, *Siebold s.n.* (L). TAIWAN: Bankinsing Mts, *Henry* 821 (K, NY). CHINA: Canton. 1880, *Hance s.n.* (K); Hainan Is. Loktung, *Lau* 27175 (A); Guangdong Prov., *Levine* 479 (US); Guangdong Prov., *To Kang Ping* 10956 (BO, NY); No location: *Burch* 1591 (L).

*CULTIVATION*: ANTIGUA: *Collector name illegible* 11 (K); CHINA:

Hong Kong, Victoria Is., Deep Water Bay, *Shiu Ying Hu* 7067 (K, US); Victoria Peak, *Shiu Ying Hu* 5452 (K); CUBA. Botanic Garden Havana, *Curtiss* 656 (K); GUAM: Merizo, *Fosberg* 35668 (BH, US); GUYANA: Henritta roadside, Essequibo, *Harris* 538 (K); INDIA: Ex H. Bot. Sahar, 1887, *Beccari s.n.* (K); Tiruchirapalli, St Josephs College House, *Matthew* 30953 (K); Tamilnadu, Villupura District, Auroville Shakti, *Matthew* 72880 (K); INDONESIA: Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI, K); Bogor Botanic Gardens, 'nel viale presso la chietta', May 1878, *Beccari s.n.* (FI, sheets 1131, 1131-B & 1131-C); Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI, sheets 11333 & 11333-B). JAPAN: Ryukyu Islands, Okinawa, Gesashi, 26°36'N, 128°08.75'E, *Morgan* 5058 (UC, US); MALAYSIA: Sabah, Sandakan, Elopura, *Melgrito* 10029 (K); NIGERIA: Calabar, *Ndozi* 15441 (K); PANAMA: Panama City, Curundu District, *Churchill* 6023 with *Churchill* (K); PHILIPPINES: Luzon, Laguna Prov., Mt Makiling Garden, *Pancho* 3684 (CAHP); Zamboanga City, Zambowooe, Canadian Logging Concession, *Hernaes* 3663 (CAHP); TRINIDAD: *Holloway s.n.* (BRI); SEYCHELLES: Insula Platte, *Bojer s.n.* (K); SINGAPORE: Location not given, 24 Dec 1894, *anon. s.n.* (MEL); Singapore Botanic Gardens, Lawn D, 22 Jun 1929, *Nur s.n.* (K); Singapore Botanic Gardens, *Furtado* 29396 & 29397 (A, BRI, K); Singapore Botanic Gardens, Lawn B, *Furtado* 29398 (K); MacRitchie Reservoir, 27 Aug 1970, *Tambi s.n.* (K, SING); SOCIETY ISLANDS: *Moore* 443 (BRI); SRI LANKA: Royal Botanic Gardens, Peradeniya, *Rutherford* 52 with *Bandara* (K); Royal Botanic Gardens, Peradeniya, Garden Q-237, *Rutherford* 101 with *Bandara* (K); TANZANIA: Amani, *Greenway* 1042 (K); THAILAND: Pattani, Pattani University Campus, *Barfod* 40986 with *Uecharakan* (AAU); Trang, Khao Chong, ca 15 km E of Trang, *Barfod* 141431 with *Uecharakan* (AAU); Trang, Khao Chong, Peninsula Botanic Garden, *Barfod* 43885 (AAU, BKF); UNITED KINGDOM: Ex Herbarium Benthonianum, Hort. Chil. May 1823, *anon. s.n.* (K); Ex Herbarium Hookerianum 1867, *anon. s.n.* (K); Royal Botanic Gardens Kew, Feb 1880, *anon. s.n.* (K); Royal Botanic Gardens Kew, 1880, *anon. s.n.* (K); Royal Botanic Gardens Kew, Propagating House, 1880, *anon.* 210 (K); Royal Botanic Gardens Kew, 29 Apr 1882, *anon. s.n.* (K); Royal Botanic Gardens Kew, Temperate House, *Dransfield* 4463 (K); Royal Botanic Gardens Kew, *anon.* 1982-5601 (K); UNITED STATES: Florida. Fairchild Tropical Gardens, *Balick* 3388 (NY); Hawaii. University of Hawaii campus, 80 ft alt., *Krajina* 6288 (NY); Kauai, Lihue District, Nuhou Grove Farm, *Wood* 2102 with *Schleck* (K).

*Local and vernacular names:* Chinese fan palm, Biro (Japanese).

*Distribution:* Japan, China and Taiwan. 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 Is., and in China on Hainan Is. and formerly recorded in Guangdong Province but now apparently extinct there in the wild (Fig. 8).

*Habitat and ecology:* Coastal forests on various soils, often in sand, sometimes in dense mono-specific colonies, otherwise in small isolated colonies, 1-100 m alt. Flowers Feb-Apr; fruits Apr-Sept.

*Conservation status:* Vulnerable.

*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 Jacquin (1801), Tab. 11, Fig. 1. 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 southeast China and Indochina during the period 1740-1767. Martius (1838) provided the transfer to *Livistona*, based on Brown (1810) who suggested it should correctly have been in *Livistona*, but without formal transfer.

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 (1845); and *L. japonica* (Nakai, 1928). Of these names, a lectotype is here chosen for *C. biroo* (Siebold, 1830), it being *Siebold s.n.*, 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 olive-like and subglobose respectively. *Livistona olivaeformis* was synonymised under *L. chinensis* by Beccari (1921), and the specimens collected by Beccari in May 1878 from 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 his *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. The taxon was elevated to specific status by Nakai (1935) and Kanehira (1936), but it otherwise was referred to most commonly as a subspecies (Moore & 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* (cf. 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*.

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

*Livistona chinensis* is a moderate sub-canopy palm to 15 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 13% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 7 partial inflorescences; bracts are loosely sheathing; flowers are white to yellow; fruit are globose, subglobose, ellipsoid, to pyriform, to 26 mm long to 18 mm wide, and glossy blue green to bright green at maturity.

13. ***Livistona boninensis*** (Becc.) Nakai, J. Jap. Bot. 11 (1935) 222; Nakai, Sci. World (Japan) (Rigakkai) 26(4) (1928) 10, *nomen*; Bull. Biogeogr. Soc. Japan 1(3) (1930) 255, *nomen*. -*Livistona chinensis* var. *boninensis* Becc., Webbia 5 (1921) 12, 16; Ann. Roy. Bot. Gard, Calcutta 13 (1931) 62; Moore & Fosberg, Gentes Herb. 8 (1956) 435, fig. 130C. – **Type:** Japan. Bonin Islands, Haha-jima, 23 Apr 1917, *Wilson 8271* (lectotype, A; isoelectotypes, BM, FI, K, US) (*fide* Moore and Fosberg, 1956). **Plate 10a-b.** -*Corypha japonica* Kittlitz, Veg.-Ansicht. 48 (1844) t.14-16, *nom. inval.* (Nakai, 1936).

Hermaphroditic palm. **Trunk** to 20 m tall, ca 30 cm dbh, leaf scars raised, with remnant leaf-base fibres, internodes narrow, petiole stubs not persistent. **Leaves** 40-60 in a globose to flattened crown; petiole adaxially moderately

ridged, margins with single curved green spines well spaced in proximal portion of petiole; leaf-base fibres not prominent, very coarse, persistent; lamina costapalmate, regularly segmented, subcircular, 120-200 cm long, adaxially grey-green, abaxially lighter grey-green, nonwaxy; lamina divided for 45-75% of its length, with 50-82 segments, depth of apical cleft ca 20% of the segment length; apical lobes pendulous; parallel veins 5-6 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, 130-220 cm long, not extending beyond the limit of the crown, branched to 3 orders; 6-7 partial inflorescences; rachillae 4-16 cm long, glabrous; prophyll not seen; peduncular bract 1, tubular, glabrous; rachis bracts tubular, glabrous. **Flowers** in clusters of 5-8, 2.0-2.8 mm long, cream. **Fruit** globose to pyriform, 19-30 mm long, 14-28 mm diam., glossy bright green; pedicel 3-4 mm long. **Seed** reniform. **Eophyll** not seen.

*Specimens examined:* JAPAN: Bonin Islands, Haha-jima, *Wilson* 8271 (Lectotype, A; isoelectotypes, BM, K, US); Haha-jima, Okimura, *Furuse* 7719 (K); Haha-jima, Koshin-dzuka, top of Mt. Sekimon, 200-400 m alt., 18 Mar 1972, *Momiyama, Kobayashi & Ono s.n.* (MAK); Chichi-jima, 75 m alt., *Fosberg* 31545, 31547, 31548 (US); Chichi-jima, Mt. Mikazuki, *Fujita & Shimizu* 23 (A); Chichi-jima, vicinity of Tsutsujiyama, *Murata* 171, with *Tabata, Tsuchiya & Takada* (A); Chichi-jima, Futami Graveyard, 3 Jul 1976, *Kanai & Ono s.n.* (MAK); Chichi-jima, Mt Mikadzuki, S slope, 250 m alt., *Ono & Kobayashi* 79009 (MAK); Chichi-jima, enroute from the northern valley of Mt Akahatayama to Mt Tori-yama, 50-150 m alt., 6 May 1974, *Ono, Kobayashi & Wakabayashi s.n.* (MAK); Mei-jima, 24 Aug 1980, *Ono, Kobayashi, Sugawara & Sugawara s.n.* (MAK); (Bonin Islands), 1853-56, *Wright s.n.* (US).

*Local and vernacular names:* Bonin Island Fan-palm.

*Habitat and ecology:* Coastal and near coastal forest, 50-500 m alt. Flowering Apr–May; fruiting Oct–Dec.

*Conservation status:* Near threatened.

*Distribution:* Japan. Bonin (Ogasawara) and Volcano Islands (Fig. 8).

*Notes:* The first mention of *Livistona boninensis* was by Kittlitz (1844) in an account of his voyage through the northwest Pacific, where he noted "... eine grosse schöne Fächerpalme (*Corypha japonica*?) ...", and included it in various illustrations of the Bonin Islands. Nakai (1936) argued that

the name *Corypha japonica* was invalid. 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*. The first use of the name raised to specific rank as *L. boninensis*, was by Nakai (1928) in his *Plants in Ogasawara Islands*. Beccari (1931) maintained it as a subspecies of *L. chinensis*, and provided an expanded description. However, Nakai (1935) continued using the name at specific level, and placed Beccari's subspecies in synonymy. Moore & Fosberg (1956) re-established it as a subspecies, provided comparative illustrations with other subspecies, and established the type as *Wilson 8271*.

Recently collected specimens seen at MAK carry larger fruits than originally described, up to 30 mm long as opposed to 25 mm long in previous descriptions. 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 lacking 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 *L. boninensis* 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 endauensis*** J.Dransf. & K.M.Wong, *Malayan Nat. J.* 41 (1987) 121, fig. 1. -**Type**: Malaysia. Johore, G. Janing, Ulu Endau, 16 Jun 1977, *Dransfield JD5089* (holotype, K; isotype, KEP). **Plate 10c-e**.

Hermaphroditic palm. **Trunk** to 15 m tall, 12-20 cm dbh, leaf scars obscure, internodes narrow, pale grey brown, petiole stubs at first persistent at the base only, but deciduous with age, vertical fissures shallow. **Leaves** ca 75 in a globose to conical crown; petiole ca 175 cm long, arching, orange to reddish-brown, ca 15 mm wide by 12 mm wide, triangular in cross-section, adaxially concave, covered in thin, caducous, grey-brown indumentum, margins unarmed in the distal half, armed in the proximal half with single retrorsely recurved 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 triangular, chocolate-brown appendage to 35 cm long, to 10 cm wide; lamina costapalmate, regularly segmented, circular to subcircular in outline, ca 100 cm long, slightly undulate, adaxially bright green, abaxially lighter

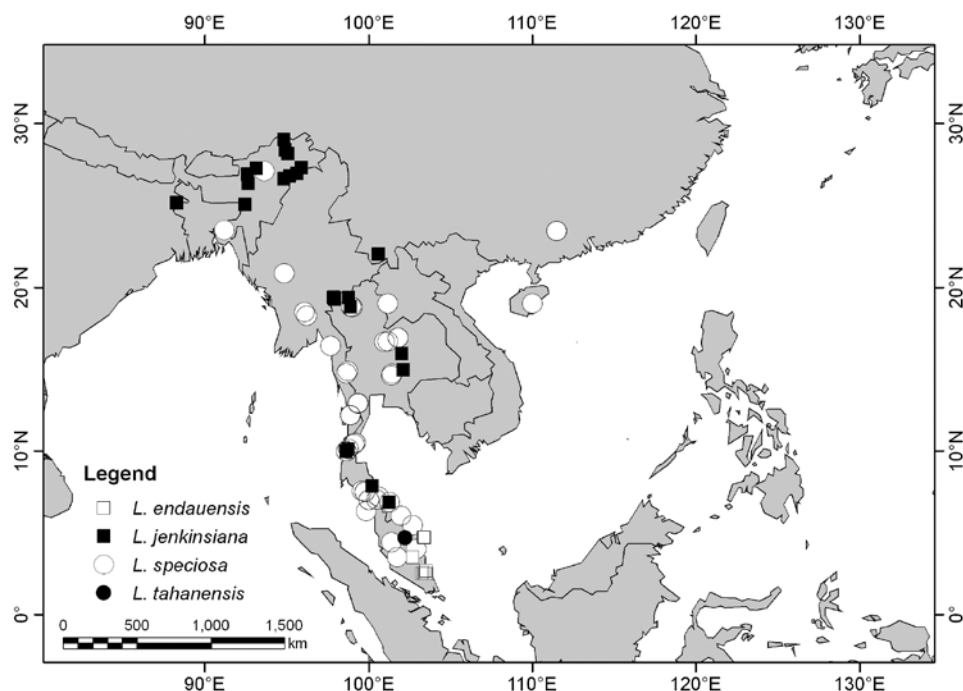
green, glabrous on both surfaces; lamina divided for ca 61% of its length, with 60-70 segments, depth of apical cleft ca 8% of the segment length, apical lobes rigid to occasionally pendulous through damage or age; mid-leaf segments ca 3 cm wide where the segments diverge; outer segments ca 0.8 cm wide where the segments diverge; parallel veins 4-5 each side of mid rib; transverse veins thinner than parallel veins; hastula conspicuous, ca 10 mm high, triangular, crescent shaped. **Inflorescences** unbranched at the base, to 150 cm long, not extending beyond the limit of the crown, arching, branched to 3 orders; partial inflorescences ca 8; peduncle ca 60 cm long, laterally compressed at the base, 3 cm wide by 0.5 cm thick, ca 2.5 cm wide distally by 1.0 cm thick; prophyll tubular, 30 cm long by 2.5 cm thick, dark brown, glabrous except for scattered caducous rust coloured indumentum; peduncular bract(s) lacking; rachis bracts tubular, glabrous; partial inflorescences to ca 35 cm long; rachillae 6-10 cm long, ca 0.25 cm diameter, rigid, yellow, pubescent. **Flowers** solitary or in clusters of 2-3, sessile, globular, ca 1 mm high, 1.5 mm wide, golden yellow; calyx basally tubular, ca 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, abaxially rugulate, adaxially striate; stamens basally fused to form a tube ca 0.4 mm high; filaments very short, free; anthers ca 0.1 mm diam.; carpels ca 0.6 mm high, style to ca 0.2 mm high, stigma punctiform. **Fruit** obovoid to pyriform, ca 16 mm long, 14 mm wide, bluish green; epicarp smooth, wrinkled on drying; mesocarp ca 2 mm wide; endocarp crustaceous ca 1 mm wide; pedicel 1-2 mm long. **Seed** globose, ca 1 cm diam, intruded shallowly by the testa. **Eophyll** 5-ribbed.

*Specimens examined:* MALAYSIA: Trengganu. Kuala Dungun, Bukit Bauk, 350 m alt., *Dransfield* 915 (K); Dungun, Bukit Bauk, ridge top, *Dransfield* 5184 (K); Dungun Bukit Bauk, *Kamarudin* 31445 (K); Kemaman, Compt. 4, Rasau Kerteh Ulu Chukai Forest Reserve, *Meijer & Yong* 94940 (K, KEP, L, SING); Pahang, Lesong Forest Reserve, Ulu Sg. Teroh, *Wong* 32280 (K); location not given, 'ridge-top vegetation', *Saw* 34174 (K); Johore. Kuala Jasin, S. Endau, 300 ft (c. 90 m) alt., 12 Nov 1972, *Heaslett & Ahmad Shukor s.n.* (SING); Gunung Janing, Ulu Endau, *Dransfield* JD5089 (K holotype, KEP); Gunung Janing via Kahang, 350 ft (ca 110 m) alt., *Heaslett, Shah, Samsuri & Shukor* 2609 (SING); Gunung Janing Barat, steep slope near summit, *Kiew* 1912 (K); Hutan Simpan Labis, sandstone plateau S of Gunung Janing, *Wong* 32461 (K).

*Habitat and ecology:* In rainforest at 90-660 m alt. Flowers all year; fruits all year.

*Conservation status:* Lower risk, near threatened (IUCN, 2006).

*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 (Fig. 9).



**Figure 9.** Distribution of *Livistona endauensis* (□), *L. tahanensis* (●), *L. jenkinsiana* (■), and *L. speciosa* (○).

*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*. In the protologue, a population of a then unidentified *Livistona* in Trengganu was compared to this taxon, though maintained as distinct pending further study. Subsequent examination of collections from Trengganu confirmed it as the same taxon, and therefore giving the species a disjunct range in eastern Peninsular Malaysia.

*Livistona endauensis* is a moderate sub-canopy palm to 15 m tall; leaves are large and regularly segmented; segment apices are rigid to pendulous, and with a bifurcate cleft to 8% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown,

and with about 8 partial inflorescences; bracts are loosely tubular; flowers are golden yellow; fruit are obovoid to pyriform, to 16mm long to 14 mm wide, and bluish green at maturity.

15. **Livistona tahanensis** Ridl. ex Becc., *Webbia* 5 (1921) 17; in Ridley, J. Fed. Malay States Mus. 6 (1915) 189, *nomen.* – **Type:** Malaysia. Pahang, Gunung Tahan, 1 Jun 1905, *Wray & Robinson* 5355 (holotype, BM; isotype, FI, SING). **Plate 11a.**

Hermaphroditic palm. **Trunk** to 8 m tall, ca 12 cm dbh, leaf scars narrow, internodes narrow, petiole stubs persistent for most of its length. **Leaves** 30-40 in a  $\pm$  globose crown; petiole to ca 70 cm long, 12-15 mm wide in the middle, 5-6 mm wide distally, adaxially flat, 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; appendage very long, membranous, bright mahogany red, polished on both surfaces; lamina costapalmate, regularly segmented, subcircular, 57-76 cm long, ca 90 cm wide, rigid, flat to undulate, adaxially dark green, abaxially grey-green; lamina divided for ca 58% of its length, with 40-50 segments, depth of apical cleft ca 16% of the segment length, apical lobes rigid; parallel veins 6-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, 80-91 cm long, not extending beyond the limit of the crown, branched to 3 orders; partial inflorescences ca. 4, longest to ca 23 cm long; prophyll not seen; peduncular bracts lacking; rachis bracts loosely tubular; peduncle 2.5 cm wide at the base; rachillae 7-10 cm long, thin, green-red, tomentose. **Flowers** very small; sepals ovate, cream tipped red; petals oblong, blunt, tip thickened, incurved, cream; anthers white; style short, conic. **Fruit** globose to depressed-globose, 12-14 mm long, glossy green; epicarp smooth; suture line extends for the full length of the fruit, marked with lip-like structures; pedicel 2-3 mm long. **Seed** not seen. **Eophyll** not seen.

*Specimens examined:* MALAYSIA: Pahang. Gunung Tahan, *Wray & Robinson* 5355 (BM holotype, FI); Gunung Tahan, 3500-4000 ft alt., *Nur* 8006 (SING); Gunung Tahan, 3500-4500 ft alt., *Holtum* 20631 (BO, K, SING, UC); Gunung Tahan, 3000 ft., *Corner* 36597 (BO, K, SING); Gunung Tahan, 3500 ft, Jan 1923, *Pendlebury* s.n. (K); Gunung Tahan, 3500 ft, Jan 1923, *Pendlebury & Kloss* s.n. (BM); Gunung Tahan, Tahan Woods near Wrays Camp, *Dransfield* 659 (K).

*Local and vernacular names:* Tahan Serdang, Daun Tau.

*Habitat and ecology:* In moist montane forest, at 900-1500 m alt. Wild elephants are reported to eat the cabbage (Kiew and Davison, 1989).

*Conservation status:* Lower risk, conservation dependent (IUCN, 2006).

*Distribution:* Malaysia. In Pahang, endemic to Gunung Tahan. (Fig. 9).

*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 an indication that the species was pending description by Beccari. Beccari (1921) provided the first formal description, based on the collection *Wray & Robinson 5355* from 1000 m on Gunung Tahan.

*Livistona tahanensis* is a moderate canopy palm to 8 m tall, with persistent petiole stubs on most of the stem; leaves are moderate and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 16% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with about 4 partial inflorescences; bracts are loosely tubular; flowers are cream with red tipped sepals; fruit are globose to depressed globose, to 14 mm long to 12 mm wide, and glossy green at maturity.

16. ***Livistona jenkinsiana*** Griff., Calcutta J. Nat. Hist. 5 (1845) 334; Palms Brit. E. Ind. (1850) 128, figs 226A, 226B; Anderson, Journ. Linn. Soc. 11 (1871) 13. -*Livistona jenkinsii* Griff. ex Mart., Hist. Nat. Palm. 3 (1849) 242, *orth. var.* -*Latania jenkinsiana* (Griff.) Devansaye, Rev. Hort. 47 (1875) 34. -*Saribus jenkinsii* (Griff.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** India. Assam, Nowgong, 1842, *Jenkins s.n.* (holotype, BR). **Plate 11b-f.**

Hermaphroditic palm. **Trunk** to 10 m tall, 15-23 cm dbh, leaf scars prominent, narrow, roughened, light coloured, internodes narrow, dark coloured, petiole bases persistent in the lower portion. **Leaves** 20-50 in a ± globose crown; petiole 130-200 cm long, 20-25 mm wide distally, adaxially slightly concave, margins armed throughout with single or double retrorsely recurved reddish to brown spines 15-20 mm long, 10-12 mm wide at the base, base frequently swollen, spines reducing in size to tubercles toward the apex; leaf-base fibres moderately prominent, coarse, disintegrating or persistent; appendage to 25 cm long; lamina costapalmate, regularly segmented, ovate-reniform in outline, 105-130 cm long, 150-200 cm wide, adaxially shiny green, abaxially subglaucous grey or bluish; lamina

divided for 72-75% of its length, with 70-80 segments, depth of apical cleft 8-16% of the segment length, 3-8 cm wide where the segments diverge, apical lobes rigid; parallel veins 9-10 each side of midrib; transverse veins thinner than parallel veins; hastula cordate. **Inflorescences** unbranched at the base, 60-100 cm long, not extending beyond the limit of the crown, branched to 3 orders; partial inflorescences 3-6; prophyll 30-45 cm long, woody, keeled; peduncular bract(s) lacking; rachis bracts loosely tubular, reddish-brown, glabrous, expanded distally into lanceolate acuminate lobes, sometimes longitudinally split, scurfy to glabrous; rachillae 10-30 cm long, 3-4 mm wide, rigid, yellow-green, puberulous. **Flowers** in clusters of 3-5, sessile, greenish cream, with inconspicuous bracteoles; sepals fused basally, fleshy, 1.2-4 mm long, 1.3- 1.5 mm wide, lobes broadly ovate, with thin and subhyaline margins; petals basally fused, deltoid, acute, 2.5-4 mm long, 2.5-3 mm wide; stamens with basally fused filaments, thick and short, contracted into elongate apices, connective very short, narrow; carpel turbinate-obconical, yellow, distinctly sculptured, and contracted into a short trisulcate, filiform style, stigma simple. **Fruit** globose to reniform, 19-28 mm long, 16-25 mm diam., somewhat asymmetrical, apically rounded, slightly tapered below to an acute base, 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, cinnamon brown inside, 0.5-1 mm wide; pedicel 3-6 mm long, 2.5-4 mm wide. **Seed** globose, 17-20 mm diam., slightly flattened on one side; intruded broadly and deeply by the testa; embryo sublateral. **Eophyll** 7-ribbed.

*Specimens examined:* INDIA: Assam. Nowgong, *Jenkins s.n.* (BR holotype); Valley of the Mali Itka, Masum, PutooRd, 1000-2500 m alt., *Kingdon-Ward 1288* (BM); Assam. *Griffith 1205* (BM). CHINA: Yunnan. You-louh Shan, Che-li Hsien, *Wang 78114* (A); THAILAND: Mae Hong Son, Doi Nam Bon Musir, *Smith 18* (K); Mae Hong Son, Nai Sai Village, *Smith 21* (K); Chiang Mai, Doi Suthep, ca 1200 m alt., *Kerr 3430* (AAU, K, NY); Chiang Mai, Doi Suthep, ca 1500 m alt., *Kerr 4686* (AAU, BK, BM, K, NY); Chiang Mai, Suthep, Hue Me Pan, Doi Suthep, *Rock 437* (K); Phetchabum, Muanga Lom, Kao Keo Ngoi, ca 900 m alt., *Kerr 5761* (AAU, BK, BM, NY); Chaiyaphum, Pu Kio, ca 1000 m alt., *Kerr 20241* (AAU, BK, BM, NY); Nakhon Ratchasima, Khao Yai NP, near headquarters, *Whitmore 3172 with Chamlong* (K); Nakorn Ratchasima, Khao Yai NP, Phatabak, *Smith 3* (K); Ranong, La-un, *Kerr 16472* (AAU, BK, K); Suratthani, Kaw Tao, ca 200 m alt., *Kerr 16033* (AAU, BK, K, BM); Suratthani, Ban Ta Khun, Bang Chang, Klong Saeng Wildlife Sanctuary, *Smith 66 with Sumawong*



(K); Pattani, Kao Kalakiri, ca 900 m alt., *Kerr 7791* (AAU, BK, BM, K).

*CULTIVATION*: INDONESIA: Bogor Botanic Gardens, May 1878, *Beccari s.n.* (FI); SINGAPORE: Singapore Botanic Gardens, Apr–May 1936, *C.X. Furtado 31108* (L).

*Distribution*: India, Sikkim, Bangladesh, Myanmar, China and Thailand. In northeast India in the Naga Hills, Khasia Hills, Jaintia Hills, Nowgong, Darjeeling Hills; in Siang, Lohit and Tirap Valleys in Arunachal Pradesh; and Gubro Purbat in Assam. In Sikkim in the Teesta Valley; Bangladesh in Chittagong; China, in Yunnan; and in northern Thailand (Fig. 9).

*Habitat and ecology*: In high rainfall areas in moist evergreen forest mostly on sandy loam with a laterite mixture, at 100–2500 m altitude. Datta and Rawat (2003) observed foraging of mature fruit by Hornbills in northeast India. Flowers Jul–Aug; fruits Oct–Nov.

*Ethnobotany*: Leaves are used for thatch and hats (Lepchas tribe of northeast India and Sikkim). The endosperm, presumably prior to maturity, is reported to be consumed.

*Conservation status*: Near threatened.

*Notes*: *Livistona jenkinsiana* was first described by Griffith (1845), based on observations 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. The type is in BR. 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 226A and 226B) of a leaf, a partial inflorescence, flowers and fruit.

*Livistona jenkinsiana* is a moderate canopy palm to 10 m tall; leaves are large and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 16% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 6 partial inflorescences; bracts are loosely tubular; flowers are greenish cream; fruit are globose to reniform, to 28 mm long to 25 mm wide, and leaden blue to dark bluish purple at maturity.

17. ***Livistona speciosa*** Kurz, J. Asiat. Soc. Bengal 43(2) (1874) 204, pl. 13 & 14. –*Saribus speciosus* (Kurz) Kuntze, Revis. Gen. Pl. 2 (1891) 736. –

**Type:** Burma (Myanmar). Pegu Yomas, Chounmenahchy, Feb 1871, *Kurz* 3330 & 3331 (holotype, B, destroyed; isotypes, BM, K). **Plate 12a-d.**

-*Livistona fengkaiensis* X.W.Wei & M.Y.Xiao, J.S. China Agric. Coll. 8(1) (1982) 22, figs. 1 & 2. -Type: China. Guangdong, Fengkai, Heishi Ding, 450 m alt., 6 Dec 1981, *Fengkai Exped. 1587* (holotype, CANT).

Hermaphroditic palm. **Trunk** to 25 m tall, 20-30 cm dbh, leaf scars lightly raised, light grey, petiole stubs sometimes persistent, particularly at the base, otherwise smooth, longitudinal fissures not evident. **Leaves** 40-50 in a globose or oblong crown; petiole slightly arching, 140-159 cm long, 20-25 mm wide distally, adaxially slightly concave to flat, abaxially convex, margins armed throughout with single retrorsely recurved orange-brown spines to 25 mm long, to 10 mm wide at the base, base frequently swollen, apically acute, spines reducing in size to tubercles toward the apex; leaf-base fibres moderately prominent, coarse, persistent; appendage to 25 cm long; lamina costapalmate, regularly segmented, circular to subcircular in outline, 150-200 cm long, to 200 cm wide, adaxially green, abaxially glaucous grey; lamina divided for 25-75% of its length, with ca 100 segments, depth of apical cleft 3-4% of the segment length, 3.5-8 cm wide where the segments diverge, apical lobes rigid; basal segments overlap at the hastula; parallel veins 9-10 each side of midrib; transverse veins thinner than parallel veins; hastula cordate. **Inflorescences** unbranched at the base, 120-200 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 3-6, 40-60 cm long; prophyll 30-45 cm long, woody, keeled; peduncular bract(s) lacking; rachis bracts loosely tubular, reddish-brown, glabrous, expanded distally into lanceolate acuminate lobes, sometimes longitudinally split, scurfy to glabrous; rachillae 10-20 cm long, 3-4 mm diameter, spreading to drooping or rigid, yellow-green, glabrous. **Flowers** in clusters of 5-6, sessile, greenish cream, carried on small, sessile tubercles, broadly ovate in bud, to 2.5 mm long; sepals fused basally, fleshy, 1.2-2 mm long, 1.3-1.5 mm wide, semi-ovate, subacute, with subhyaline margins; petals basally fused, thick, deltoid, acute, 2.5-4 mm long, 2.5-3 mm wide; stamens, with briefly basally fused filaments, partly adnate to the petals, thick and short, contracted into elongate apices, connective very short, narrow; anthers suborbicular-didymous; carpel turbinate-obconical, yellow, distinctly sculptured, and contracted into a short trisulcate, filiform style to 2.5 mm long, stigma simple. **Fruit** obovate, obpyriform, to ovoid, rounded apically, narrowed basally, 25-35 mm long, 18-25 mm diam., greenish-blue to light-blue at maturity; epicarp less than 1 mm wide, with scattered lenticellular

pores; suture line extends full length of the fruit, marked with lip-like structures; mesocarp thinly woody, brittle, whitish within; endocarp woody, brittle, to 1 mm wide. **Seed** oblong-elliptical, rounded at both ends, to 17 mm long, to 12 mm wide; intruded to more than half the width of the endosperm; embryo lateral. **Eophyll** 7- ribbed.

*Specimens examined:* MYANMAR: Pegu Yomas, Chounmenahchy, *Kurz* 3330 & 3331 (BM, K); Tharapon, *Meebold* 14335, 14423 (M). CHINA: Guangdong Prov., Fengkai, Heishi Ding, 450 m alt., *Fengkai Exped.* 1587 (CANT); Hainan. *Liang* 36627 (NY); Hainan. Mo-San-Leng, 3000 ft alt., *Chun & Tso* 44362 (A, K, NY, US). THAILAND: Chiang Mai. Muang, Doi Suthep, E side above Rusee Cave, *Song See* 86 (PHCMU); Chiang Rai. Ban Thing Sai, 8 km NW of Chiang Khong, *Anderson* 6042 (PHCMU); Lampoon. Mae Tah, Doi Kuhn Dahn NP, southside, Doi Hou Chang, *Maxwell* 94978 (BKF, CMU); Loei, Phu Kradang, 16°53'54"N, 101°47'49"E, 1150-1250 m alt., *Murata* 49918 with *Phengklai, Mitsuta, Yahara, Nagamusa & Natasan* (A, BKF, L); Khao Kho, 600-700 m alt., *Dowe* 560 (JCT); Kho Yai NP, 20 km S of Main Rd, *Dowe* 565 (JCT); 45 km N of Thong Pha Phum, Goengavia village, *Dowe* 566 (JCT); Ranong Prov. 37 km NE of Ranong, less than 200 m alt., *King* 5586 (US); Petchaburi Prov., Kaeng Krachen NP, 12°54'N, 99°20'E, 500-700 m alt., *Barfod* 45194 with *Uecharakan* (AAU); Petchburi Prov., Kaeng Krachen NP, 2 km after Panoentung Camp, westward on Khao Panoen Rd, *Damborg* 2 (AAU); Chumphon, *Dowe* 569 (JCT); Songkla, 1 km SW of Songkhla, Ton Nga Waterfall, 20 km W of Hat Yai, 07°00'N, 100°00'E, 100-250 m alt., *Barfod* 141040 with *Uecharakan* (AAU, K); Songkhla, Hat Yai, Nathawi Rd, *Whitmore* 3100 with *Charal & Chamlong* (BKF, K); Trang. Khao Chong, ca 15km E of Trang, 07°30'N, 99°45'E, 200 m alt., *Barfod* 141333 with *Uecharakan* (AAU, PSU); Trang, Kantang, Kuan Kantrang Reserved Forest, *Luang Samarn* 64 (BKF); Yala. Village of Sungai Kolok, near Sirindhorn Waterfall at Ban Bala, 6 km N of turnoff, *Damborg* 3 & 4 (AAU). MALAYSIA: Perak. Ulu Batang Padang, on Pahang boundary, ca 6000 ft alt., *Henderson* 23665 (BO, BRI, K, SING, NY).

*Distribution:* Bangladesh, Chittagong; Burma, Pegu Yoma and Tenasserim; China, Guangdong, Fengkai, and Hainan Is. at Mo San; throughout Thailand at 400-900 m alt.; and Peninsula Malaysia, on Langkawi Is., Gunung Inas to Genting Sempah in the west and Gunung Stong and Gunung Mandi Angin in the east at 700-1200 m alt. Moderately common in moist to wet forest (Fig. 9).

*Habitat and ecology:* In high rainfall areas in moist evergreen forest, at 200-3000 m altitude. Flowers Jul–Aug; fruits Oct– Nov.

*Conservation status:* Near threatened.

*Notes:* *Livistona speciosa* was described by Kurz (1874) from the mountains of Pegu Yoma of central Myanmar, based on *Kurz 3331*. Although Kurz did not specifically record himself as the collector of the specimen from Pegu Yoma, it is hereby accepted as the holotype as reference to the Pegu Yoma collection is sufficient to confirm the connection. This taxon's similarity 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.

*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*.

*Livistona speciosa* is a large canopy palm to 25 m tall; leaves are large and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 4% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 6 partial inflorescences; bracts are loosely tubular; flowers are greenish cream; fruit are obovate, obpyriform to ovoid, to 35 mm long to 25 mm wide, and greenish blue to light blue at maturity.

18. ***Livistona carinensis*** (Chiov.) J.Dransf. & N.W.Uhl, Kew Bull. 38 (1983) 200. -*Hyphaene carinensis* Chiov., Fl. Somalia 1 (1929) 319. -*Wissmannia carinensis* (Chiov.) Burret, Bot. Jahrb. Syst. 73 (1943) 184; Monod, Bull. de l'I.F.A.N. 17 (1955) 343, figs 3-23. -**Type:** Somalia. Carin, Oasis of Uncud, 6 July 1924, *Puccioni & Stefanini 1027* (holotype, FT). **Plate 13a-d.**

Hermaphroditic palm. **Trunk** to 40 m tall, ca 40 cm dbh, leaf scars prominent, slightly oblique, irregular in width, internodes narrow, petiole stubs persistent in the lower 1-2 m. **Leaves** 30-40 in a globose to conical crown; petiole to 125 cm long, 5-8 cm wide proximally, 1-2 cm wide distally, adaxially flat to shallowly concave, 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 recurved, brown-black, 7-25 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;

appendage rigid, 6-7 cm long, brown to black; lamina costapalmate, regularly segmented, subcircular in outline, 80-95 cm long, thick, both surfaces waxy, glabrous, grey-green on adaxial surface, grey abaxially, drying chartaceous; lamina divided for 75-85% of its length, with 50-70 segments, depth of apical cleft 40-50% of the segment length, apical lobes rigid, segment midrib very prominent; parallel veins 18-20 each side of midrib; transverse veins thinner than parallel veins, inconspicuous on the surface; segment margins thickened, with a deciduous filament, the remains of which persist where the segments diverge from 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). **Inflorescences** unbranched at the base, 200-240 cm long, extending beyond the limit of the crown by ca 20 cm, slender, arching, eventually pendulous, branched to 3 orders; partial inflorescences 6-12; rachillae very thin, yellowish, with scattered long hairs; peduncular bract 1, glabrous; rachis bracts tubular, brown red, striate, glabrous. **Flowers** in clusters of ca 5, ca 2 mm long, yellow-green, abaxial surface of perianth segments with scattered long hairs; sepals much shorter than the petals, irregular, margins hyaline, scattered long hairs on the abaxial surface near the apex; petals apically pointed, scattered long hairs near the apex; filaments basally connate; carpels scarcely fused, similarly the styles. **Fruit** globose, 5-20 (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; intruded by the seed coat to displace most of the endosperm; embryo sublateral. **Eophyll** 7-ribbed.

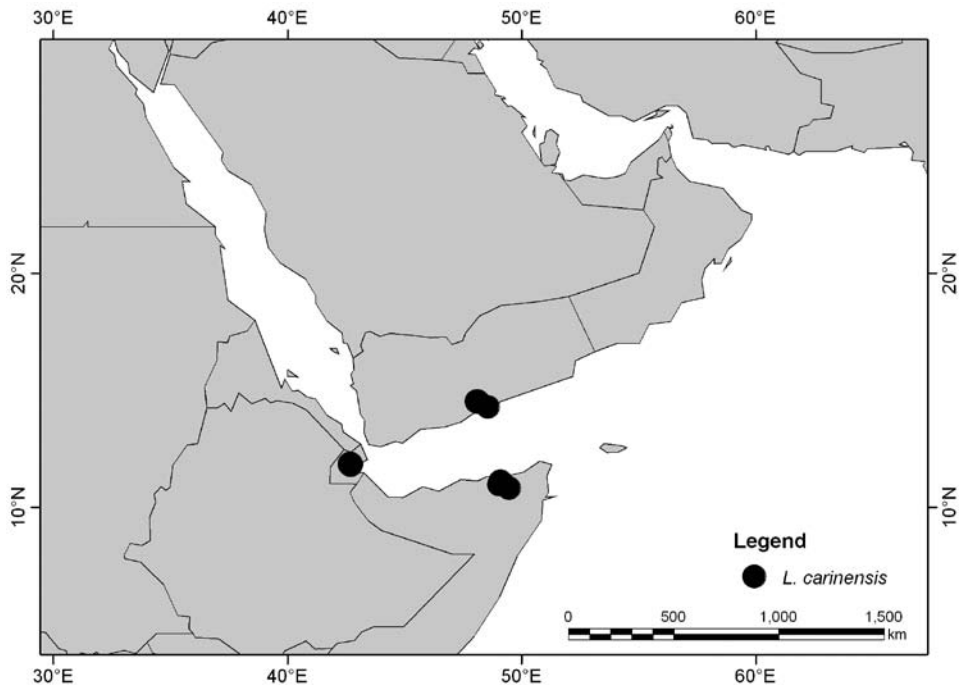
*Specimens examined*: SOMALIA: Carin. Oasis of Uncud, *Puccioni & Stefanini* 1027 (FT holotype); Galgala, 10°58'N, 49°02'E, *Barbier* 972 (K); Galgala, 25 km W of Carin, 10°59'N, 49°02'E, *Lavranos & Carter* 24835 (K). DJIBOUTI: Bankouale Wadi, Nov. 1985, *Coghlan s.n.* (K); Bankouale, 2000, *Welch s.n. with Welch* (K).

*Local and vernacular names*: Bankouale Palm, Nakilto (Afar), Daban, Madah (Somali), N,tug, somm (Arabic).

*Habitat and ecology*: Grows in or adjacent to intermittently flowing streams or soaks in valley bottoms, but never fully dry soils, in semi-arid regions with rainfall less than 400 mm per annum, at 200-975 m alt.

*Conservation status:* Vulnerable (IUCN, 2006), but here upgraded to Endangered based on Welch & Welch (1999) and Ford & Bealy (2004).

*Distribution:* Djibouti, Somalia and Yemen. 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 (Fig. 10).



**Figure 10.** Distribution of *Livistona carinensis* (●).

*Notes:* The geographic isolation of *Livistona carinensis*, some 4000 km from the nearest *Livistona* species in northeast India, introduces interesting questions with respect to historical distribution and phylogeny. Based on morphology it is similar to species in western and northwestern Australia, but this appears to be an example of ecological convergence. Recent molecular analysis (Isagi *et al.*, in prep.) places it close to *L. jenkinsiana*.

*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 & Stefanini 1027*, was collected in 1924.

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 northeast 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 discoverer of the palm in Yemen, H. von Wissmann, and thus established the name *Wissmannia carinensis* (Chiov.) Burret. Burret only had leaves at his disposal, so there still remained questions about the affinities of the species.

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 (1973, 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 transfer of *Wissmannia* to *Livistona*, and established the name *Livistona carinensis*.

*Livistona carinensis* is listed as a critically endangered species. Reports on the palm's ecological status have been prepared by Welch and Welch (1998, 1999) and Ford and Bealy (2004). Surveys in Djibouti, Somalia and Yemen, resulted in the location of all adult palms, and with a total of less than 1800 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 developed a conservation plan.

*Livistona carinensis* is a large canopy palm to 40 m tall; leaves are large and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 50% of the segment length; the petiole is armed with very large spines; the inflorescence is unbranched, extending beyond the limit of the crown and pendulous, and with up to 12 partial inflorescences; bracts are tubular; flowers are yellowish green with long unbranched hairs on

the sepals and petals; the rachillae are also covered with long unbranched hairs; fruit are globose, to 50 mm diameter, and dark brown to black at maturity.

19. **Livistona humilis** R.Br., Prodr. (1810) 268. -*Saribus humilis* (R.Br.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** Australia. Northern Territory, Gulf of Carpentaria, Blue Mud Bay, Morgans Is (Brown's island 's'), 20 Jan 1803, *Brown* (*Bennett no. 5796*) (lectotype, BM; isolectotypes, FI, K).

**Plate 14a-d.**

-*Livistona leichhardtii* F.Muell. ex F.Muell., Fragm. 8 (1874) 221; Fragm. 5 (1865) 49, *nomen*. -**Type:** Australia. Northern Territory, MacAdam Ra., 1855, *Mueller s.n.* (lectotype, MEL) (*fide* Rodd, 1998).

-*Livistona humilis* var. *minutiflora* Becc., Ann. Roy. Bot. Gard. (Calcutta) 13 (1931) pl. 7, fig. 3a, *nom. inval.* Corrected to *L. humilis* R.Br. in *Errata*.

Dioecious palm. **Trunk** to 7 m tall, 5-8 cm dbh, leaf scars raised, roughened and with remnant tissue, internodes narrow, grey, petiole stubs persistent or deciduous with extreme age or fire. **Leaves** 8-15 in a globose crown; petiole 40-70 cm long, 6-14 mm wide, margins with small, single, curved dark red spines; leaf-base fibres not prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular, 30-50 cm long, chartaceous, adaxially dark green, abaxially lighter green, glossy; lamina divided for 60-87% of its length, with 30-44 segments, depth of apical cleft 35-89% of the segment length, apical lobes acuminate, rigid; parallel veins 6 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, sexually dimorphic, vertically erect in both sexes, extending well beyond the limit of the crown; those on fruiting plants (functionally female) straight, to 230 cm long, branched to 3 orders, with a single terminal partial inflorescence; peduncular bracts 5-8, scurfy pubescent; inflorescences on nonfruiting plants (functionally male) arcuate, to 180 cm long, branched to 3 orders; peduncular bract(s) lacking; partial inflorescences 4-7; rachis bracts are tightly tubular, scurfy pubescent; rachillae 3-12 cm long, pubescent. **Flowers**, male and females similar in gross morphology, 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 ca 1.3 mm long. **Fruit** ellipsoidal or pyriform to 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.



*Specimens examined:* AUSTRALIA: Northern Territory. Gulf of Carpentaria, Blue Mud Bay, Morgans Is, 20 Jan 1803, *Brown* (Bennett no. 5796) (BM lectotype, FI, K); Melville Is, Jul-Aug 1911, *Spencer s.n.* (MEL, NSW); Coburg Peninsula, 13.5 miles S of Danger Point, *Chippendale* 8220 (MEL); ca 2 miles NW of Caiman Ck, 11°12'S, 132°12'E, *Byrnes* 1014 with *Maconochie* (DNA, K, LAE, NSW, PERTH); 19 miles NW of Mount Norris Bay, *Chippendale* 8164 (BRI); Port Denier, *Hill* 41 (K); Wessell Islands, *Latz* 3470 (CANB, DNA); Elcho Is, *Maconochie* 2179 (CANB, DNA, K, NSW); Arnhem Land, 10.5 km NNE of Murgengella, 11°26'S, 132°58'E, *Ross* 3306 (MEL); 160 km from Pine Ck, Oenpelli Rd, *Gittens* 2646 (BRI); Arnhem Land, *Schultz* 7 (MEL); Arnhem Land, undated (ex Herbarium Hookerianum 1867), *Mueller s.n.* (K); MacAdam Ra., 1855, *Mueller s.n.* (MEL); 5 km S of Gove Airport, 12°19'S, 136°48'E, *Eurell* 78714 (L); 21 km from Gove Airport on Katherine Rd, *Forster PIF6028* (BRI); Gove Peninsula, half way between Gove Airport and Nhulanbuy, *Rodd* 2926, 2927 & 2928 (CANB, DNA, K, NSW); Yirrkala, 12°12'S, 136°47'E, *Specht* 901 (A, BRI, K, L, MEL, PERTH, US); Munmarlary Stn., *Latz* 3729 (BRI, CANB, DNA, K); 36.3 miles N of Oenpelli, *Chippendale NT8108* (DNA, NSW); Oenpelli, 12°18'S, 133°40'E, *Specht* 1221 (AD, BRI, K, L, LAE, US); ca 80 km E of Oenpelli, 12°20'S, 133°56'E, *Maconochie* 1598 (AD, BRI, DNA, PERTH); ca 20 km SE of Maningrida, *Rodd* 2923 & 2924 (BH, DNA, K, NSW); Gunn Point, *Dunlop* 3035 (BRI); Near Darwin, ironstone ridges near coast, *Allen* 158 (K); Port Darwin, *Schultz* 372 (K); Cannon Hill Airstrip, *Martensz* 617 & 618 with *Schodde* (BRI, CANB, DNA, K, L); Darwin, CSIRO Research Stn, *Irvine* 1674 (QRS); 5 km NWW of Humpty Doo, *McKean* 39 (K); MacMillan Rd, 8 miles SE of Darwin, *Chippendale NT4391* (DNA, NSW); Palmerston Escarpment Reserve, 12°29'09"S, 130°59'24"E, *Smith* 4334 (DNA, JCT); Palmerston, Stapleton, Nov 1915, *Hill s.n.* (BM); Palmerston, 10 Jun 1886, *Lea s.n.* (BM); 35-40 miles from Darwin, on turnoff to Berry Springs, *Moore* 9227 (BRI); 11 miles S of Berry Springs, turnoff on Stuart Hwy, *Beauglehole* 10997 (MEL); 2 miles SSW of Mudginberri Stn, *Adams* 2725 (CANB, K); 34 miles SE of Midginberry HS, 12°45'S, 133°20'E, *Lazarides* 7795 (K); 30 km W of Jabiru on Kakadu Hwy, Kakadu NP, *Dowe* 203 (BRI, FTG); Kakadu NP, *Craven* 5572 (L, MEL); Kakadu NP, 6 km N of Barramundi Ck, *Dowe* 207 (JCT); Kakadu NP, *Lazarides* 9090 (MEL); 3 km S of Kakadu NP Headquarters, 12°40'S, 132°43'E, *Munir* 5590 (NY); 10 miles W of Jim Jim, *Byrnes* 1725 (CANB, DNA); Obiri Rock, *Maloney* 2 (NSW); Between Rum Jungle and Batchelor, *Shaw* 868 (BRI); ca. 35 km N of Batchelor, Stuart Hwy, *Eichler* 17887 & 17888 (AD); ca 160 km SSE of Darwin, Stuart Hwy, *Jackson* 1050 (AD); 4 miles E of Lake Evella turnoff, 12°45'S, 135°51'E,

*Maconochie 1513* (DNA, MEL, NY, PERTH); ca 15 km W of BHP Camp, near Caledon Bay, 12°47'S, 136°22'E, *Maconochie 1560* (CANB, DNA, K, NSW); Cox Peninsula, 10 km E of Finnis R Stn turnoff, *Dowe 214* (JCT); Cox Peninsula, 1.5 km S of Belyuen, *Dowe 215* (JCT); Daly Ra., 14 km S of Manton Rd, on Stuart Hwy, *Rodd 2910 & 2911* (BH, DNA, K, NSW); Dorisvale Rd, 41 km W of Stuart Hwy, *Dowe 213* (BRI, DNA); 140 miles ESE of Darwin, *Everist 9267* (BRI); Macdonnell Airstrip, 67 miles N of Katherine, *Maconochie 1300* (B, BRI, CANB, DNA, L, K); 16 miles NE of Tipperary Homestead, *Lazarides 6687* (BRI, CANB, K, NSW, US); near Grove Hill, 13°28'S, 131°35'E, *Blake 16347* (A, BRI, K, L); 3 miles S of Adelaide R., *Trapnell 99* (BRI); Daly R. Rd, 30 km SSW of Adelaide R. township, 13°30'S, 131°01'E, 150 m alt., *Streimann 8956 with Curnow* (L); Adelaide R., 18 Jun 1943, *Tyack Bake s.n.* (BRI); Stuart Hwy, 11 km NW of Pine Ck, 13°46'S, 131°45'E, 240 m alt., *Streimann 8955 with Curnow* (L); 22 miles NW of Pine Ck, *Perry 1948* (BRI); ca 4 miles W of Pine Ck, *Lazarides 227 & Adams* (CANB); 36 miles N of Wilton R., Bumen Crossing, 13°55'S, 134°35'E, *Maconochie 1457* (BRI, CANB, DNA, K, L, NY); Liverpool R., *Gulliver s.n.* (MEL); Castlereagh Bay, *Gulliver s.n.* (MEL); (Darwin), Leanyar, *Bosshart 1* (QRS); (Port Darwin), 1855, *Mueller s.n.* (BO); Wood Is., 1855, *Mueller s.n.* (BO, MEL); Liverpool R., 1855, *Mueller s.n.* (BO); MacAdam Ra., 1855, *Mueller s.n.* (MEL); Strauss Airstrip, 28 miles S of Darwin, *Must 957* (BRI, CANB, DNA, K, L); Port Darwin, *Schultz 373* (MEL); Woodah Is, Apr 1922, *Tindale* (US); N of Pine Ck on Stuart Hwy, *Walter 3494* (B); (Northern Territory), 1892, *Holtze s.n.* (MEL); (Port Darwin), *Holtze 332* (MEL).

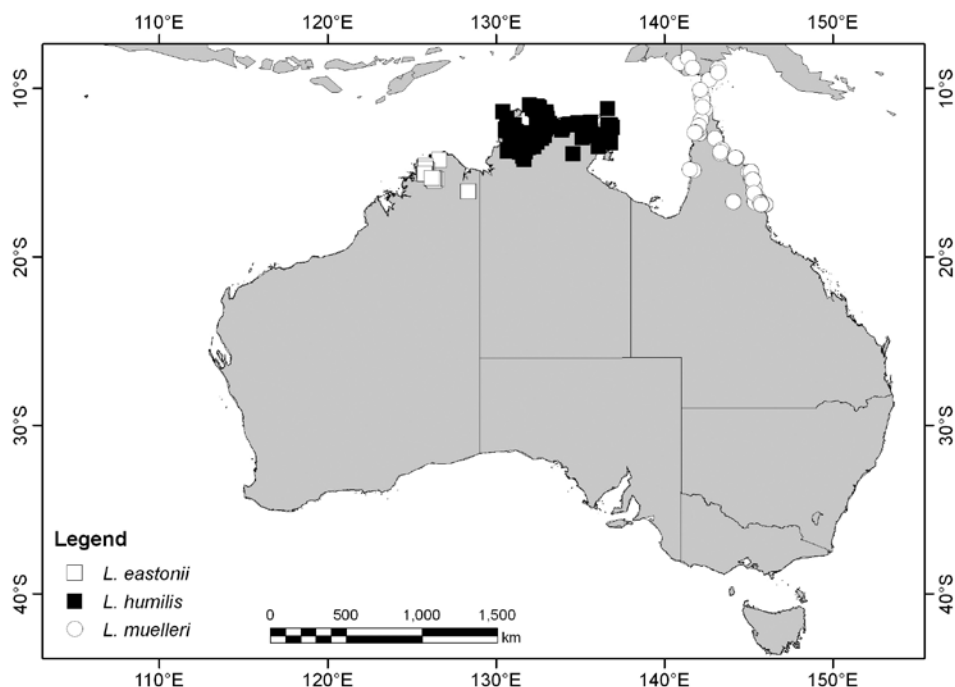
*Local and vernacular name:* Sand Palm.

*Habitat and ecology:* Most common in open forest and woodland growing in deep sandy soils, mostly at low elevation, 0-240 m alt.; occasionally on rocky ironstone or granite ridges. Usually occurs in extensive populations. Flowers May-Dec; fruits Nov-May.

*Conservation status:* Least concern.

*Distribution:* Australia. Northern Territory. From near Fitzmaurice R. across the Top End to Cape Arnhem and islands in north-western Gulf of Carpentaria, and as far inland as Katherine (Fig. 11).

*Notes:* *Livistona humilis* was one of two species described by Brown (1810) when establishing *Livistona*. Moore (1963a) chose it as the lectotype for



**Figure 11.** Distribution of *Livistona humilis* (■), *L. muelleri* (○), and *L. eastonii* (□).

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

Mueller (1874b) described *L. leichhardtii* based on a collection made from MacAdam Ra., Mueller s.n., Northern Territory. Kuntze (1891) provided the combination *Saribus humilis*.

*Livistona humilis* is a small sub-canopy dioecious palm to 7 m tall; leaves are small and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 89% of the segment length; the inflorescence is unbranched in both male and female plants, extending vertically to

sub-vertically well beyond the limit of the crown; male plants have up to 8 partial inflorescences, and female plants a single distal partial inflorescence; bracts are tightly tubular; flowers are yellow; fruit are ellipsoid, pyriform, to obovoid to 19 mm long, and shiny purple black at maturity.

20. **Livistona muelleri** F.M.Bailey, Queensl. Fl. 5 (1902) 1683. – **Type:** Australia. Queensland, Cairns, Oct 1900, *Cowley s.n.* (holotype, BRI; isotype, FI). **Plate 15a-f.**

-*Livistona humilis* R.Br. 'var.', F.M.Bailey, Queensland Agric. J. 2 (1898) 130, *prop. stat.*

-*Livistona humilis* var. *sclerophylla* Becc., Webbia 5 (1921) 20. –Type: Australia. Queensland, Bloomfield R., *Bauer 3* (lectotype, FI) (*fide* Rodd, 1998).

-*Livistona humilis* var. *novoguineensis* Becc., Webbia 5 (1921) 20. -Type: Indonesia. Papua, Merauke Division, Merauke R., Apr 1901, *Jaheri s.n.* (holotype, FI; isotype, BO).

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

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

Functionally dioecious palm. **Trunk** to 12 m tall, 15-25 cm dbh, leaf scars narrow, raised, roughened and with remnant tissue, internodes narrow, grey, 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, adaxially concave, margins with single curved black spines 2-12 mm long throughout, larger 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 costapalmate, regularly segmented, 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; lamina divided for 50-65% of its length, with 48-60 segments, depth of apical cleft 5-14% of the segment length; apical lobes acute, rigid; parallel veins ca 8 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 80-160 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 5-10; peduncular bract(s) lacking; rachis bracts loosely tubular, with silver scales,

splitting and disintegrating with age, but margins not lacerate; rachillae 2-13 cm long, papillose, maroon to red. **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, bright yellow, subacute; stamens ca. 1.4 mm long, yellow; carpels pink to maroon. **Fruit** ellipsoid, 10-12 mm long, 8.5-10 mm diam., powdery blue, reddish black or bluish black; 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 wide. **Eophyll** 3-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Torres Strait, Saibai Is., *Stocker 1376* (QRS); Torres Strait, Badu Is., *Cameron 2737* (QRS); Torres Strait, Horn Is., *Cameron 2031* (QRS); Torres Strait, Horn Is., *Cameron 2246* (QRS); Torres Strait, Horn Is., 11 July 1943, *Tyack Bake s.n.* (BRI); Torres Strait, Prince of Wales Is., *Cameron 20244* (QRS); Torres Strait, Prince of Wales Is., *Cameron 20335* (QRS); Lockerbie Scrub, *Dowe 407* (JCT); Jardine R., N bank, near crossing of Peninsula Dev. Rd, *Hind 576* (NSW); 10 km S of Jardine R., bypass road, *Dowe 378* (JCT); ca 24 km W of Peninsula Dev. Rd, on track to west coast between Pt Musgrave and Skardon R., *Clarkson 9157* (BRI, QRS); 11.5 km N of Weipa Mission, *Specht 120* (BRI); 31 km E of Weipa-Batavia Rd, *Maconochie 2699* (BRI); 4 km NNW of Beagle North Camp, ca 41 km NNE of Aurukun, *Clarkson 4359* (K); between Nesbit and Chester Rivers, *Hyland 6834* (QRS); Silver Plains Stn, 8 Apr 1958, *Wassell s.n.* (BRI); Silver Plains-Goanna Ck Rd, *Webb 3186* (BRI); 2 miles S of Scrubby Ck, *Irvine 72* (BRI, QRS); Upper Massey Ck, 15 miles S of ENE of Coen, *Smith 11916* (BRI); Flinders Is., *Elsol 754* (BRI); Flinders Is., *Clarkson 2262* (BRI); Edward R. Aboriginal Reserve, 6.8 km S of Musgrave-Edward R road, *Clarkson 3538* (BRI); E of Edward R. Community, *Clarke WCC1082* (BRI); Musgrave Stn, *Hind 749* (NSW); Starke Homestead, along track 7.5 km N, 14°59'S, 145°08'E, ca 40 m alt., *Kanis 1947* (BRI, L); Durkam Stn, 10 km NE of Cooktown, *McDonald 1541* (BRI); 11 km WNW of Cooktown, N side of Endeavour R., nears Jones Lagoon, *Rodd 3159 & 3160 with Jacobs* (BH, BRI, K, NSW); Near Cooktown, *Webb 6159* (BRI); Helensvale-Bloomfield Rd, ca 3 km N of Ayton, *Rodd 3170 & 3171* (BH, BRI, K, NSW); Bloomfield R., *Bauer 3* (FI); Daintree R., *Hind 216* (QRS); Near Port Douglas, *Blake 19722A* (BRI); Craiglea, Cook Hwy near Port Douglas, 38.5 miles N of Cairns, *Moore 9244* (BRI); Craiglea, Cook Hwy near Port Douglas turnoff, *Hind 226* (NSW); NW of Walsh R., 7.2 km NW of Nolans Ck, 16°45'S, 144°06'E, 200 m alt., *Dowe 608* (BRI); Trinity Beach, 16°47'S,

145°42'E, *Smith & Pedley 10001* (BRI, L); Trinity Beach, N of Cairns, *Maconochie 1717* (DNA); Captain Cook Hwy, W side of road, 2.5 km N of the Cook Hwy and Kennedy Hwy junction, *Irvine 1776, 1777, 1778 & 1779* (QRS); Cairns, Oct. 1900, *Cowley s.n.* (BRI holotype, FI); Cairns, *Flecker 3251* (QRS); Cairns, Scott St, 8 May 1941, *Wright s.n.* (QRS); Cairns, Port Rd, 2 km E of Mulgrave Rd, *Dowe 271* (JCT); Few kms S of Cairns opposite Golf Links on the Bruce Hwy, *Moriarty 1168* (BRI); PAPUA NEW GUINEA: Western Prov. Middle Fly R., Lake Daviumbo, *Brass 7668* (A, BO, BM, BRI, L); Western Prov. Dava (Daru) Is, 09°05'S, 143°10'E, 70 m alt., *Gillison 45* (LAE); Western Prov., Dagwa, Oriomo R., *Brass 5950* (A, BM, BO, BRI, NY). INDONESIA: Papua. Merauke Division, road from Mopa Airstrip to Manggatrikke, ca 10 m alt., *van Royen 4545* (A, BO, K, L, LAE); Merauke Division, *Jaheri 197* (BO); Merauke Division, *Jaheri s.n.* (BO); Merauke Division, Merauke R., Apr 1901, *Jaheri s.n.* (BO, FI).

*Local and vernacular name:* Cairns Fan Palm.

*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., and most common in areas that have a strongly seasonal rainfall pattern. Flowers Sep-Apr; fruits Nov-May.

*Conservation status:* Least concern.

*Distribution:* Australia, Indonesia and Papua New Guinea. In north Queensland from the Torres Strait islands to near Innisfail. In Papua New Guinea in the Western Province; and in Indonesia, in Papua, Merauke Division (Fig. 11).

*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.* 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 another manuscript name in his hand-written *Plantae novae hollandiae*, based on plants he saw near the Endeavour R., Queensland, but this name 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*. Bailey (1898) made

no reference to Wendland's name and there appears to be no connection in Bailey's choice of the name, as in reference to *L. benthamii* noted that he named both of these species 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* from the Bloomfield R., Queensland, and *L. humilis* var. *novoguineensis*, based on *Jaheri s.n.*, 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* and *Brass 7668* respectively. Both taxa were synonymised under *L. muelleri* by Rodd (1998).

Although the relationships of *L. muelleri* are obscure, it most closely resembles *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 morphological resemblance to *L. fulva* of central Queensland, with similarity in both leaf and inflorescence.

*Livistona muelleri* is a moderate sub-canopy palm to 12 m tall; leaves are moderate and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 14% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 10 partial inflorescences; bracts are loosely sheathing; flowers have maroon sepals, yellow petals and mauve carpels, on maroon to red rachillae; fruit are ellipsoid, pyriform, to obovoid, to 12 mm long to 10 mm wide, and powdery blue, reddish black to bluish black at maturity.

21. ***Livistona eastonii*** C.A.Gardner, Forest Depart. Bull. Western Australia 32 (1923) 36 (as *L. eastoni*). – **Type:** Australia. Western Australia, Broome Bay, Napier, Lower King Edward R., 22 Aug 1921, *Gardner 1544* (lectotype, PERTH; isoelectotypes, B, BH, CANB, K, MEL) (*fide* Rodd, 1998). **Plate 16a-c.**

Functionally dioecious palm. **Trunk** to 15 m tall, 10-15 cm dbh, leaf scars raised, internodes narrow, grey, leaf-bases often persistent. **Leaves** 10-20 in a 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 larger and closer in the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented, subcircular, 60-90 cm long, coriaceous, adaxially pale greyish green, abaxially lighter green, yellowish with age, pruinose, waxy; lamina divided for 50-90% of

its length, with 40-50 segments, depth of apical cleft 49-63% of the segment length, apical lobes acute, rigid; parallel veins 5-9 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 100-200 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 5-6; prophyll not seen; peduncular bract 1, tubular; rachis bracts tubular with scattered appressed scales; rachillae 1-9 cm long, glabrous. **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 ca. 1.5 mm long. **Fruit** obovoid, infrequently approaching ellipsoid, 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. **Eophyll** not seen.

*Specimens examined:* AUSTRALIA: Western Australia. 15 miles S of mouth of Mitchell R., 20 Jan 1973, *Schultze s.n.* (PERTH); Mitchell Plateau, *Beard 6992* (PERTH, NSW); Mitchell Plateau, 15 miles (c.23 km) N of Amax Bauxite Camp, *Maconochie 1281* (BRI, CANB, DNA, K, L, PERTH); Mitchell Plateau Airfield, 14°47'S, 125°48'E, *Hnatiuk MP28 & MP36* (K, PERTH); 2.9 km SE of Mitchell Plateau mining camp, 14°50'S, 125°51'E, *George 14503* (CANB, LE, PERTH); Mitchell Plateau, Bauxite Camp, 18 km SSW of head of Port Warrender Bay, Montagu, 14°47'S, 125°49'E, 300 m alt., *Rodd 2889* (K); Mitchell Plateau, Bauxite Camp, 20 km SSW of head of Port Warrender Bay, 14°49'S, 125°50'E, 300 m alt., *Rodd 2888* (BH, K, NSW, PERTH); Mitchell Plateau, 25 km SSW of head of Port Warrender Bay, 14°51'S, 125°49'E, 270 m alt., *Rodd 2887* (BH, K, NSW, PERTH); 15 miles S of Admiralty Gulf, *Gardner 972* (PERTH); Broome Bay, Napier, Lower King Edward R., *Gardner 1544* (B, BH, CANB, K, MEL, PERTH lectotype); 75 miles NNW of Gibb R Stn, *Speck 4949* (CANB); 10 km SE of mining camp on track to Mitchell Falls Homestead, 14°53'S, 125°55'E, *Fryxell & Craven 4044* (K, MEL, PERTH, UC); 100 miles S of Kalumburu, *Hutchinson 84* (PERTH); Kalumburu Rd, 40 km N of Drysdale Stn, 15°21'S, 126°13'E, *Dowe 360* (BRI); Kalumburu Rd, 40 km N of Drysdale Stn, 15°21'S, 126°13'E, *Dowe 359 & 361* (JCT); 11 km N of Doongan Homestead, 15°21'S, 126°13'E, *George 15220* (AD, CANB, K, NSW, PERTH); 8 km N of Doongan Homestead, 15°22'S, 126°13'E, *George 15221* (CANB, K, NSW, PERTH); Doongan Stn, Crosland Ck at Gibb R., 15°23'S, 126°17'E, 380 m alt., *Telford 6096 with Butler* (CBG, NSW, PERTH); 15 km S of Doongan Stn, 34 km N of Drysdale R. Crossing, 15°25'S, 126°18'E, *Forbes 2293* (L, MEL, PERTH); 25 miles N of new Drysdale Stn, *Maconochie 1228* (CANB, DNA, LAE, MEL, NSW, NY,



PERTH); 40 km N of Drysdale HS on Kalumburu Rd, *Dowe 360* (BRI); 40 km N of Drysdale Stn crossing, 15°25'S, 126°18'E, 7 June 1984, *Willis s.n.* (MEL, PERTH); ca 12 km N of Drysdale R crossing, Kalumburu Rd, *Symon 10254* (NSW); Kimberley District, 4 May 1922, *Kessell s.n.* (MEL).

*Habitat and ecology:* Grows in a strongly monsoonal climate in open woodland, usually on flat sites or depressions and forms extensive colonies, 100–380 m alt. Soils are lateritic in origin. Flowers Apr– Sep; fruits Dec–June.

*Distribution:* Australia. Western Australia. In the Kimberley Region confined to the Mitchell Plateau to as far south as Doongan Stn (Fig. 11).

*Notes:* *Livistona eastonii* was described by Gardner (1923) from Lower King Edward R. in Western Australia, and named for William R. Easton, who directed 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*, a specimen collected from the Lower King Edward R. in Western Australia, as the lectotype.

*Livistona eastonii* most closely resembles *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 noted that the 'female flowers' were not seen, however providing an illustration of a 'female inflorescence'.

*Livistona eastonii* is a moderate sub-canopy palm to 15 m tall; leaves are moderate and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 63% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 6 partial inflorescences; bracts are tubular; flowers are cream to yellow; fruit are obovoid to ellipsoid, to 16 mm long to 9 mm wide, and glossy purple black at maturity.

22. ***Livistona inermis*** R.Br., Prodr. (1810) 268. –*Saribus inermis* (R.Br.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** Australia. Northern Territory, Gulf of Carpentaria, Sir Edward Pellew Group, North Is. (Brown's island 'h'), 16? Dec 1802, *Brown (Bennett no. 5795)* (holotype, BM; isotypes, FI, K). **Plate 16d-g.**

Functionally dioecious palm. **Trunk** to 10 m tall, 6–10 cm dbh, leaf scars

prominently raised, internodes narrow, grey, persistent petiole stubs in the lower portion only. **Leaves** 10-30 in a globose crown; petiole arching, 60-90 cm long, 6-10 mm wide, adaxially flat or shallowly concave, 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 to 1 mm long; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular to subcircular, 30-70 cm long, coriaceous, adaxially light green to green-grey, abaxially lighter green-grey glossy to lightly pruinose, segments extended along the costa; lamina divided for 80-97% of its length, with 24-48 segments, depth of apical cleft 70-84% of the segment length, apical lobes acuminate to filiform, rigid to semipendulous; parallel veins 8-10 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 40-90 cm long, not extending beyond the limit of the crown, branched to 3 orders; partial inflorescences ca 3; 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 bract(s) lacking; rachis bracts loosely tubular, papyraceous, glabrous, slightly pubescent toward the apex; rudimentary bracts subtend the distal partial inflorescences; rachillae 1-9 cm long, glabrous. *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 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.

*Specimens examined:* AUSTRALIA: Northern Territory. Melville Is., Jul–Aug 1911, *Baldwin-Spencer s.n.* (MEL); 2 km W of West Alligator R., Arnhem Hwy, *Benson 952* (NSW); 72 km E of Kakadu NP boundary on Kakadu Hwy, *Dowe 200* (BRI, FTG); Kakadu NP, *Craven 6053* (MEL); Kakadu NP, 6 km from Mt Brockman, *Telford 8064 & Wrigley* (CBG, NSW); Kakadu NP, 2.5 km NW of Koongarra Saddle, *Telford 814 & Wrigley* (CBG, NSW); Nourlangie, 220 km ESE of Darwin, *Beaulehole 58707* (MEL); Banks of Liverpool R., Aug 1819, *Cunningham s.n.* (M); W of Liverpool R., June 1869, *Gulliver s.n.* (MEL); headwaters of Liverpool R., 12°46'S, 133°44'E, *Craven & Wightman 8410* (A, MEL); Munmarlary Stn, *Latz 3728* (CANB, DNA, QRS); 21 miles NW of Katherine, *Lazarides 6627* (B, CANB, L); Katherine Gorge, 15 miles E of Katherine, *Lazarides 7040* (BRI,

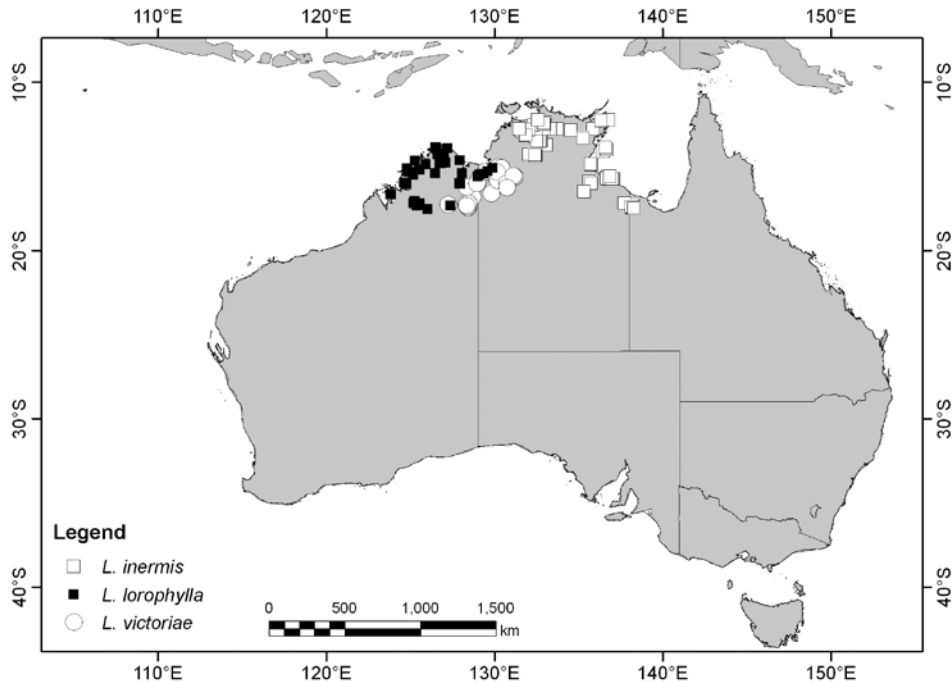
DNA, K, L); 90 miles S of Maningrida, 12°51'S, 134°32'E, *Maconochie 1581* (CANB, DNA, K); El Sharana Mining Camp, *Martensz 384a with Schodde* (B, BRI, CANB, DNA, K, L, NSW, US); 8 km NW of El Sharana, *Benson 994* (NSW); 13 miles E of El Sharana Mining Camp, *Lazarides 7974* (K); Katherine Gorge, ca 0.5 km SE of NP HQ, *Rodd 2931 & 2932* (BH, DNA, K, NSW); Katherine Gorge, *Must 985* (BRI); Katherine Gorge, 15 miles NE of Katherine, *Lazarides 6990* (CANB, NSW); 90 km from Pine Ck, *Gittens 2590* (BRI, DNA, NSW); Nitmiluk, above visitor centre, *Evans 3544* (CANB, DNA, K); Pine Ck-Oenpelli Rd, near Mudginberri Stn, *Symon 10347* (NSW); South West Is., 15°41'S, 136°40'E, *McKey 101* (DNA, K, NSW); Maria Is., 14°52'S, 135°44'E, *Dunlop 2836* (AD, BRI, CANB, DNA, DWL, NSW); Groote Eylandt, 25 km W of Umbakumba on main road, *Fosberg 62325* (BRI); Sir Edward Pellew Islands, North Is., *Brown (Bennett no. 5795)* (BM holotype, FI, K); Sir Edward Pellew Islands, Centre Is., *Rice 2037* (BRI, NSW); Sir Edward Pellew Islands, Centre Is., *Craven 3841* (CANB); Wollgorang Stn, Echo Gorge, *Thomson 802* (DNA, NSW). Queensland. Wentworth-Troutbeck Stn, *Gasteen 20* (BRI); Westmoreland Stn, near Burketown, 17°26'S, 138°10'E, 16 June 1991, *Birch s.n.* (BRI); Stockyard Camp, 17°29'S, 138°13'E, *Melville 1122* (BRI); 50 km E of Wollgorang on road to Burketown, *Halford 605* (BRI).

*Habitat and ecology:* Grows in open forest and woodland and in sandstone gorges and outcrops, 2–300 m alt. Flowers Aug–Mar; fruits Jun–Sept.

*Conservation status:* Least concern.

*Distribution:* Australia. Northern Territory and Queensland. In the northern part of the Northern Territory from the headwaters of the Daly R. across the Top End inland to Katherine. In northwest Queensland, including near-shore islands in the Gulf of Carpentaria (Fig. 12).

*Notes:* *Livistona inermis* was one of two species described by Brown (1810) in establishing *Livistona*, based on the collection *Brown s.n.* from Sir Edward Pellew Islands, Gulf of Carpentaria, Australia in 1802, and named for the unarmed petioles. The other species was *L. humilis*. The identity of *L. inermis* has been confused by many taxonomists. 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



**Figure 12.** Distribution of *Livistona inermis* (□), *L. lorophylla* (■), and *L. victoriae* (○).

(1893) placed it as a possible synonym of *L. leichhardtii* (= *L. humilis*). Beccari (1931) applied considerable discussion on 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*.

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 naturally occurring event. Spontaneous branching is usually the result of physical damage to the apical meristem, with the result that more than one growing point can develop. During fieldwork, populations of *L. inermis* were observed in which individual plants were tightly grouped and may be incorrectly

interpreted as ‘basally branching’. However, examination of these palms revealed that ‘branches’ were indeed separate plants or individuals that had been damaged by fire or termites.

*Livistona inermis* is a moderate sub-canopy palm to 10 m tall; leaves are small and regularly segmented; segment apices are rigid to semi-pendulous, and with a bifurcate cleft to 84% of the segment length; the petiole is unarmed, or with very small spines or calli; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 3 partial inflorescences; bracts are loosely tubular; flowers are white to cream; fruit are obovoid to pyriform, to 13 mm long to 7 mm wide, and glossy black at maturity.

23. ***Livistona lorophylla*** Becc., Webbia 5 (1921) 18 (as *L. loriphylla*).

– **Type:** Australia. Western Australia, Cambridge Gulf, 1885, *Johnston s.n.* (holotype, FI; isotypes, NSW, MEL). **Plate 17a-b.**

– *Livistona kimberleyana* A.N.Rodd, Telopea 8 (1998) 121, figs. 4g, 17d.

– **Type:** Australia. Western Australia, Kimberley Region, Durack Ra., SW base of Mt King, 24 Oct 1974, *Rodd 2866* (holotype, NSW; isotypes, CANB, K, PERTH).

– *Livistona* sp. ‘A’, Wilson, Fl. Kimberley Region (1992) 1250, *prop. stat.*

– *Livistona alfredii* auct. non F.Muell., Fitzgerald, J. & Proc. Roy. Soc. Western Australia 3 (1918) 24; Gardner, Forest Depart. Bull. Western Australia 32 (1923) 36.

Functionally dioecious palm. **Trunk** to 15 m tall, 8-20 cm dbh, leaf scars raised, internodes narrow, grey, persistent petiole stubs in the lower portion only. **Leaves** 25-40 in a globose crown; petiole arching, 70-200 cm long, 10-17 mm wide, adaxially flat, margins with scattered single curved black spines up to ca. 10 mm long; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular, 60-100 cm long, coriaceous, glossy mid green to pruinose grey on both surfaces; lamina divided for 85-98% of its length, with 34-50 segments, depth of apical cleft 55-78% of the segment length, apical lobes acuminate to filiform, semi-pendulous; parallel veins 8-10 each side of midrib; transverse veins thinner than parallel veins. **Inflorescence** unbranched at the base, not sexually dimorphic, 20-160 cm long, not extending beyond the limit of the crown, branched to 3 orders; partial inflorescences 4-8; prophyll not seen; peduncular bract 1; rachis bracts loosely tubular, sparsely tomentose; rachillae 1-6 cm long, glabrous. **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, cream; stamens ca 1.6 mm long. *Fruit* obovoid to pyriform, 8-14 mm long, 6-9 mm diam., pruinose dull black; epicarp with scattered lenticellular pores; mesocarp thin, fibrous; endocarp thin, crustaceous. **Seed** ellipsoid, 7-9 mm long. **Eophyll** not seen.

*Specimens examined:* AUSTRALIA: Western Australia. S slopes of Sir Graham Moore Is. facing the Geranium Islands, *Willing 293* (PERTH); Sir Graham Moore Is., 13°56'S, 126°33'E, *Wilson 11222* (PERTH); Stewart R., ca. 68 km NNE of Derby, 14 km from Kimbolton Stn, *Telford 6404 with Butler* (CBG, NSW, PERTH); North Kimberley, *Speck 4916* (CANB, PERTH); Kalumburu, *Crawford 58* (PERTH); ca 3 km ESE of Kalumburu Mission, *Rodd 2871* (BH, K, NSW, PERTH); 19 km W of Cape Rulhiers, 13°56'05"S, 127°11'10"E, *Kenneally 10145* (PERTH); Kalumburu Mission, *Brigden DNA6885* (CANB); Kalumburu, 18 Jan 1975, *Lullfitz s.n.* (PERTH); Kalumburu, 3 Jul 1960, *Douglas & Mees s.n.* (PERTH); 190 km W of Wyndham, Gibb R.-Kalumburu Mission Rd, 1.5 km S of Doongan R., *Beauglehole 51787* (PERTH); Cambridge Gulf, 1885, *Johnston s.n.* (FI holotype, NSW, MEL); Mitchell Plateau, N of mining camp, *Beauglehole 59046 with Errey 2746* (PERTH); Drysdale R. NP, Fern Gully, 14°39'S, 126°57'E, *Kenneally 4557* (PERTH); Drysdale R. NP, 14°40'S, 123°00'E, *George 13758* (PERTH, NSW); Drysdale R. NP, Planigale Ck, 14°43'S, 126°54'E, *Kenneally 4447* (PERTH); Drysdale R. NP, Cracticus Falls, 14°47'S, 127°05'E, *Kenneally 4153* (PERTH, NSW); Drysdale R. NP, Carson Escarpment Plateau, 2 km N of Face Point (at Laryoo), 14°50'30"S, 126°48'30", 240 m alt., *Forbes 2341S* (MEL); Brunswick Bay, Unwins Is., 15°08'S, 124°48'E, *Wilson 11450* (PERTH); West Kimberleys, upper reaches of Roe R., 15°12'S, 125°32'E, *Kenneally 9991* (PERTH); Prince Regent R. Reserve, Marigui Promontory, 15°20'S, 124°56'E, *Kenneally 2162* (NSW, PERTH); King Leopold Ranges, Sale R. 29.2 km WSW of Mt French, 15°59'15"S, 124°38'30"E, *Alford 1402* (PERTH); Chamberlain R. Gorge, 7 km W of El Questro Stn Homestead, 16°00'S, 127°55'E, *Kenneally 10978* (PERTH, NSW); El Questro Stn, Cambridge Gulf, 100 m E of Pentecost R., *Dowe 362* (BRI, FTG); Sale R., 15.5 km W of Mt Lochee, 16°04'00"S, 124°45'45"E, 80 m alt., *Kenneally 10464* (PERTH); West Kimberleys, gorge of unnamed creek running W of Sale R. 30 km ESE of mountain, *Kenneally 9652* (PERTH); West Kimberleys, 6.5 km NW of Kimbolton Homestead on mid Stewart R., 16°41'S, 123°50'E, *Hastings B2* (PERTH); West Kimberley, 1901, *House s.n.* (PERTH); Kimberleys, 54.7 km SW of turnoff to Beverley Springs Homestead, Gibb R. Rd, *Kenneally 9793A* (PERTH); King Leopold Ranges, 2 km W of March Fly Glen towards Derby on Gibb

R. Rd near Mt Bell, 17°10'S, 125°17'E, *Hastings 1* (PERTH); Teroni Gorge, 12 miles NNW of Elgie Cliffs Stn, *Lazarides 6453* (CANB); King Leopold Ranges, 26 km NE of Inglis Gap, 17°12'S, 125°32'E, *Dowe 356, 357 & 358* (BRI, JCT); SW base of Mt King, Durack Ra., *Rodd 2867 & 2868* (CANB, K, NSW, PERTH, QRS); King Leopold Ranges, Lenard R. Gorge, ca 130 km ENE of Derby, *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, *Maconochie 1296* (L); ca 26 km NE of Inglis Gap, *Symon 10154* (NSW); Durack Ra., SW base of Mt King, *Rodd 2866* (CANB, K, NSW, PERTH); Mt Broome, *Fitzgerald 815* (PERTH); Mt Leake, *Fitzgerald 1206* (PERTH). Northern Territory. Victoria R. area, 15°16'S, 129°35'E, *Dunlop 8203 & Leach* (NSW).

*Habitat and ecology*: Grows in open forest and woodlands, and on sandstone outcrops and gorges, 10-300 m alt. Flowers Aug-Dec; fruits Dec-July.

*Conservation status*: Least concern.

*Distribution*: Australia. Kimberley region of Western Australia, from Sir Graham Moore Is. to Sale R. and Cambridge Gulf, and inland to the King Leopold and Durack Ranges, and just within Northern Territory in the Victoria R. area (Fig. 12).

*Notes*: *Livistona lorophylla* was described by Beccari (1921) based on *Johnson s.n.* 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* collected from Mt King, Western Australia. This taxon was distinguished from *L. lorophylla* primarily by grey pruinose rather than 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, some populations of *L. inermis* in the Northern Territory have been incorrectly named as *L. lorophylla* (Chippendale, 1972).

*Livistona lorophylla* is a moderate sub-canopy to canopy palm to 15 m tall; leaves are small and regularly segmented; segment apices are semi-pendulous, and with a bifurcate cleft to 78% of the segment length; petiole margins are strongly spined in the basal portion; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 8 partial inflorescences; bracts are loosely tubular; flowers are cream; fruit are obovoid to pyriform, to 14 mm long to 9 mm wide, and pruinose dull black at maturity.

24. ***Livistona victoriae*** A.N.Rodd, *Telopea* 8 (1998) 123, figs. 1b, 4f, 17c. – **Type:** Australia. Northern Territory, Victoria R. Crossing, Katherine-Kununurra Rd, 3 Nov 1974, *Rodd 2934* (holotype, NSW; isotypes, DNA, K, PERTH). **Plate 17c-d.**

–*Livistona* sp. ‘B’, Wilson, *Fl. Kimberley Region* (1992) 1250, *prop. stat.*

Functionally dioecious palm. **Trunk** to 17 m tall, 15-30 cm dbh, leaf scars narrow, internodes narrow, grey, petiole stubs not persistent. **Leaves** 25-40 in a globose crown; petiole arching, 80-200 cm long, pruinose, adaxially flat, margins with single, curved, blunt, black thorns, confined to the proximal portion; leaf-base fibres moderately prominent, fine, persistent; lamina costapalmate, regularly segmented, subcircular, 80-100 cm long, coriaceous, adaxially grey green or bluish green, strongly pruinose, dull, abaxially similar; lamina divided for 55-65% of its length, with 40-56 segments, depth of apical cleft 55-70% of the segment length, apical lobes attenuate, rigid; parallel veins 9-11 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 50-150 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 5-9; prophyll not seen; peduncular bract 1; rachis bracts loosely sheathing, fibrous with age, densely tomentose; rachillae 1-3 cm long, glabrous. **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 ca 0.9 mm long. **Fruit** globose to ellipsoid, 8-15 mm long, ca 10 mm diam., dull dark reddish brown to black; epicarp smooth; suture line extends for most of the length of



the fruit; mesocarp thin, fibrous; endocarp thin, brittle; pedicel 0.5-1 mm long. **Seed** globose, ca 9 mm wide. **Eophyll** 3- ribbed.

*Specimens examined:* AUSTRALIA: Western Australia. Kimberleys, 16 km NE of Bungle Bungle Outcamp, 17°13'S, 128°26'E, *Kenneally 9212* (PERTH); Bungle Bungle Ra., 3 km SE of Outcamp, *Kenneally 9260* (K, PERTH); between Njitparriya and Dilmariyu, 3 km SE of Bungle Bungle Outcamp, 17°21'30"S, 128°21'30"E, *Forbes 2587* (BRI, MEL); between Njitparriya and Dilmariyu, 3 km SE of Bungle Bungle Outcamp, 17°21'30"S, 128°21'30"E, 320 m alt., *Scarlett 315* (MEL); Kimberleys, 15 km SE of Bungle Bungle Outcamp, Piccaninny Ck Gorge, 17°27'S, 128°25'E, *Blackwell BB419* (PERTH); Bungle Bungle Ra., gorge off Piccaninny Ck, *Briggs 9309* (NSW); Bungle Bungle Ra., Frog Hole Canyon, *Briggs 9307* (NSW); Ord R basin, *Koford & Dortch 120* (PERTH); East Kimberleys, Carr Boyd Ranges, Cabbage Tree Ck, *Rodd 2800* (K, NSW, PERTH); East Kimberleys, Carr Boyd Ranges, Wyndham to Halls Ck Rd, 1978, *Hand s.n.* (NSW); Thompson Spring, ca 40 km SE of Kununurra, 6 Jun 1979, *Ryan s.n.* (PERTH, NSW); 7 miles E of Denham R. Stn, *Perry 2529* (BRI, CANB, K, MEL, NSW, US); near Lucky Hill, 23 km NNE of Dunham R Stn, *Lazarides 8552* (CANB, K, PERTH); Teroni Gorge, 12 miles NNW of Elgie Cliffs Stn, *Lazarides 6395* (CANB); Tributary of Keep R., Nov 1978, *Lullfitz s.n.* (DNA, NSW). Northern Territory. Gregory NP, Victoria R., ca 29 km NW of Bullita Outstn, *Duretto 991a with Coles* (MEL); Jasper Gorge, *Carr & Beaughton ACB 46741* (DNA, MEL); N side of Jasper Gorge, below sandstone cliffs, *McGillivray 3804 with George* (DNA, NSW); Jasper Gorge, *Parker 1065* (DNA, NSW); Jasper Gorge, 2 km S of Charles Crossing, *Dowe 208* (BRI, FTG); Victoria R. Crossing, Katherine-Kununurra Rd, *Rodd 2934* (DNA, K, NSW holotype, PERTH); 2 miles E of Victoria R., N of Katherine-Wyndham Rd, *Beaughton 11044* (MEL); ca. 3.5 km NE of Victoria R., *Carr & Beaughton ACB 46751* (MEL); Victoria R., *Dunlop 3158* (DNA); Victoria R., Yambarran Ra., *Leach 4554 with Walsh* (BRI, DNA, MEL, NSW); 5 km E of Victoria R. Crossing, Victoria Hwy, *Maconochie 2493* (DNA, K, NSW).

*Local and vernacular name:* Victoria River Fan Palm.

*Habitat and ecology:* Grows in open forest in sandstone gorges, in escarpment gullies and cliff bases and along streams and intermittent watercourses, 50-320 m alt. Flowers Mar.-Dec; fruits Dec-July.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Australia. Northern Territory and Western Australia. In the region between the Victoria R. basin and Bungle Bungle Ra (Fig. 12).

*Notes:* *Livistona victoriae* was described by Rodd (1998) based on a collection from Victoria R. Crossing, Rodd 2934, and named with references to the species occurring in the vicinity of the Victoria R. 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).

*Livistona victoriae* is a tall canopy palm to 17 m tall; leaves are moderate and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 70% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to nine partial inflorescences; bracts are loosely sheathing; flowers are cream to pale yellow; fruit are globose to ellipsoid, to 15 mm long to 10 mm wide, and dull dark reddish brown to black at maturity.

**25. *Livistona benthamii*** F.M.Bailey, Queensl. Fl. 5 (1902) 1683 (as *L. benthami*). – **Type:** Australia. Queensland, Cape York Peninsula, Somerset, Dec 1897, *Jardine s.n.* (holotype, BRI). **Plate 18a-c.**

–*Livistona humilis* R.Br., var., F.M.Bailey, Queensland Agric. J. 2 (1898) 130, *prop.stat.*

–*Livistona holtzei* Becc., Webbia 5 (1921) 18. –Type: Australia. Northern Territory, Port Darwin, undated (1882?), *Holtze & Holtze s.n.* (holotype, FI).

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

Functionally dioecious palm. **Trunk** to 18 m tall, 13-20 cm dbh, leaf scars raised, internodes narrow, grey, petiole stubs long because of the abscission of leaves occurring in about the middle of the petiole; stubs persistent on the trunk for most of its length, unless decayed by age or fire. **Leaves** 30-50 in a globose crown; petiole 120-200 cm long, 10-18 mm wide, adaxially moderately ridged, margins with single curved black spines congested in the proximal portion; leaf-base fibres prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular, 90-160 cm long, chartaceous, adaxially dark green, abaxially lighter green, glossy, nonwaxy; lamina divided for 60-75% of its length, with 50-80 segments, depth of apical cleft 60-75% of the segment length, apical lobes acute, pendulous; parallel

veins 8 either side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 120-210 cm long, not extending beyond the limit of the crown, branched to 2 orders; 7-9 partial inflorescences; prophyll not seen; peduncular bract(s) 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, 1.0-1.3 mm long, fleshy, acute; stamens ca 1 mm long. **Fruit** globose to obovoid or pyriform, 9-13 mm long, 9-11 mm diam., pruinose purple-black; epicarp smooth, suture line extends for the length of the fruit; pedicel 2-3 mm long. **Seed** ovoid, 8-9 mm long. **Eophyll** not seen.

*Specimens examined:* AUSTRALIA: Northern Territory. Port Darwin, undated (1882?), *Holtze & Holtze s.n.* (FI); Darwin, Black Jungle, *Trapnell 105* (BRI); Koolpinyah, Bankers Jungle, *Dowe 220* (JCT); S of Koolpinyah, 13°32'S, 131°14'E, *Blake 16967* (BRI, K, L); Howard R., *Must 1150* (CANB, DNA); Kakadu NP, Cooida, Home Billabong, *Dowe 206* (BRI); Elcho Is., Warangaiyu Lagoon, 11°57'S, 135°43'E, *Latz 6273* (BRI, CANB, DNA, K, L); Elcho Is., *Maconochie 2119A & 2119B* (CANB, DNA, NSW); Howard Springs, ca. 3 km N of Howard Springs, 23 km E of Darwin, 12°25'S, 131°03'E, *Rodd 2904 & 2905* (DNA, K, NSW, QRS); Howard Springs, E of Stuart Hwy, *Beauglehole 10970* (MEL); Fright Pt, E of Darwin, Ginger Palmers Camp, *Tracey 14045* (BRI); (Port Darwin), *Holtze 539* (MEL); Oenpelli, 12°18'S, 133°04'E, *Specht 1187* (AD, BRI, CANB, K, MEL, US); Jim Jim Ck, *Jacobs 1790* (NSW); East Alligator R., Obiri Rock, *Maloney 1978* (NSW). Queensland. Torres Strait, Saibai Is., *Stocker 1397* (QRS); Lockerbie Scrub, Bamaga-Pajinka Rd, ca 15 km S of Pajinka, 10°48'S, 142°29'E, 20 m alt., *Dowe 406 with Smith* (JCT); Somerset, Dec 1897, *Jardine s.n.* (BRI holotype); Cape York, 7 miles NE of Bamaga, Long Scrub, *Webb 6122 with Tracey* (BRI); Swamp Ck, *Irvine 1887* (QRS); Jardine R., N bank, near Peninsula Development Rd crossing, *Hind 377* (NSW); Archer R., gallery forest, *Hyland 7604* (QRS); Archer Bend, near junction of Archer R. and Coen R., *Webb 13470* (BRI); Archer Bend NP, *Smyth s.n.* (BRI). INDONESIA: Papua, Merauke Division. Wasur NP, Kali Maro, *Widjaja, Wally & Subari EW6031* (BO); Papua, Merauke Division. Wasur Village 2, *Maturbongs MAT661 with Wanggai & Wally* (AAU, BO, CANB, K, MAN). PAPUA NEW GUINEA: Central Prov. ca 7 miles W of Kanosia Plantation, Kairuku, ca. 10 ft alt., *Darbyshire 685* (A, BO, BRI, CANB, K, L, LAE); Waigani Swamp, 9°30'S, 147°10'E, *Gillison 22018* (A, BRI, CANB, L); Brown R., 9°15'S, 147°20'E, 100 ft alt., *Millar*

38385 (BRI, CANB, K, L, LAE); Brown R., ca 6 miles W of Karema, 50 ft alt., *Schodde* 2677 (BO, BRI, CANB, K, LAE). Western Prov., Daru Is., *Brass* 6310 (A, BM, BO, BRI, L); Upper Wassi Kussa R., left branch, *Brass* 8645 (A, BM, BO, BRI, L); Bula village at mouth of Morehead R., *Pullen* 7027 (CANB, L, LAE); Daru Is., *Brass* 6406 (A, BM, BRI, L); Daru Is., 9°05'S, 143°10'E, 2 m alt., *Streimann & Lelean* 18472 (L, LAE); Balimo District, 20 km NW of Daru, *Paijmans* 1523 (CANB).

*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, 0-100 m alt. Flowers Sep-Jan; fruits Nov-Apr.

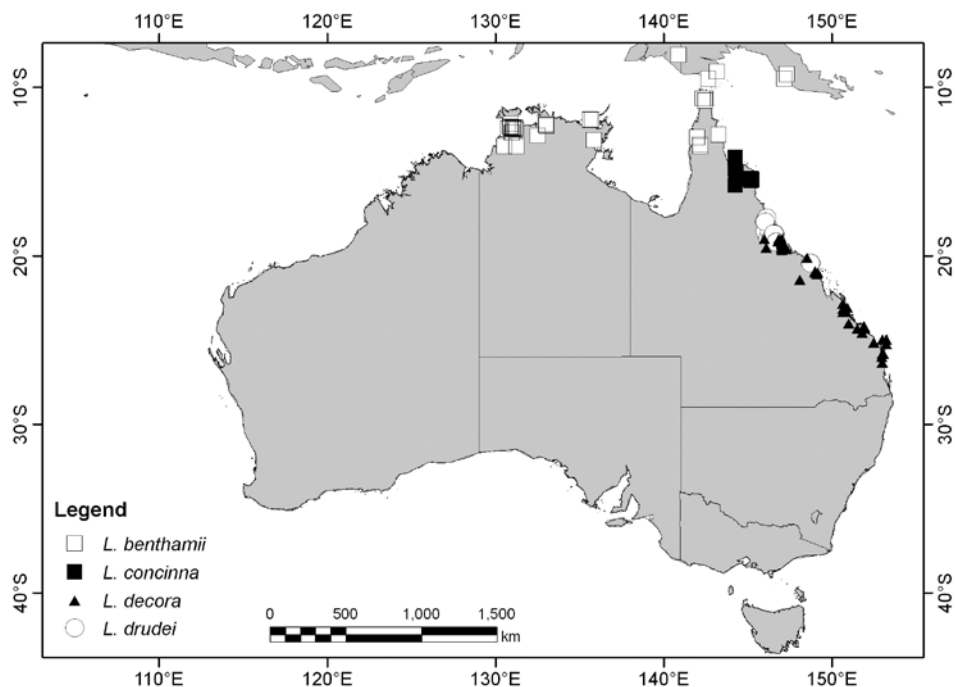
*Conservation status:* Least concern.

*Distribution:* Australia, Indonesia and Papua New Guinea. In Australia in the Northern Territory from Daly R. across the Top End to east Arnhem Land, and in Queensland from Moa Is. in Torres Strait through Cape York to McIlwraith Ra. In Papua New Guinea in the Western and Central Provinces, and in Indonesia in Papua, Merauke Division (Fig. 13).

*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.* (Bailey, 1902). Bailey 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: "... *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.* and for New Guinea, Burret (1939) provided the name *L. melanocarpa* based on *Brass* 6310 collected from Western Prov., Papua New Guinea. Both of these taxa are attributable to *L. benthamii*.

*Livistona benthamii* is a large canopy palm to 18 m tall, with long retained petiole stubs; leaves are moderate to large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 75% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 9 partial inflorescences; bracts are tightly sheathing; flowers are whitish cream to pale yellow; fruit are globose to



**Figure 13.** Distribution of *Livistona benthamii* (□), *L. concinna* (■), *L. drudei* (○), and *L. decora* (▲).

obovoid to pyriform, to 13 mm long to 11 mm wide, and pruinose purple black at maturity.

**26. *Livistona concinna*** Dowe & Barfod, *Austrobaileya* 6 (2001) 166, fig. 1. – **Type:** Australia. Queensland, ca 5 km N of Cooktown Airport, Barrett Ck, 15°25'S, 145°11'E, 5 m alt., 17 Oct 2000, *Dowe 607* (holotype, BRI; isotypes, AAU, K, QRS). **Plate 18d-g.**

Dioecious palm. **Trunk** to 30 m tall, 24-35 cm dbh, leaf scars raised; internodes narrow; grey, petiole stubs not persistent. **Leaves** 50-65 in a globose to conical crown; petioles 120-300 cm long, glabrous, green throughout, 5-11 cm wide proximally, 2.2-3.5 cm wide in mid area, ca 2.8 mm wide distally, triangular in cross-section, adaxially moderately ridged, margins with solitary symmetric or 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 costapalmate, regularly segmented, subcircular in outline, glabrous, adaxially midgreen, abaxially slightly lighter green,

glossy on both surfaces, nonwaxy, subcircular in outline, 155-165 cm long, ca 200 cm wide, undulate; lamina divided for ca 60% of its length, with 60-78 segments, depth of apical cleft ca 41% of the segment length, apical lobes acuminate, filamentous, pendulous; hastula raised, sharp, papery on the margins; parallel veins 9-10 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, sexually dimorphic; nonfruit bearing (functionally male) inflorescences 120-180 cm long, not extending beyond the limit of the crown, branched to 4 orders, slightly curved with 8-9 partial inflorescences; peduncle 25 mm wide, 10 mm thick, glabrous; fruit bearing (functionally female) inflorescences 160-250 cm long, branched to 5 orders, slightly curved, held horizontal to semi-pendulous with 8-9 partial inflorescences; peduncle ca 30 mm wide; peduncular bract(s) lacking; prophyll 27-35 cm long, glabrous; rachis bracts 30-50 cm long, tightly tubular, not disintegrating into open fibres but remaining intact with age, glabrous, apically acute, margins entire, lateral splits uneven, one ca. twice as deep as the other; rachillae 5-20 cm long, glabrous. **Flowers**, male and female similar in gross morphology, 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 ca 1.5 mm high, apices acute; petals triangular, slightly asymmetric, 2.0-2.2 mm long, 1.8-2 mm wide at the base, apex acute; stamen ca 1 mm high, filament subulate, connective 0.2 mm long; carpels ca 1 mm high. **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  $\frac{3}{4}$  the length of the fruit; mesocarp ca 1 mm wide, moist, oily, gritty; endocarp thin, crustaceous, light brown, tessellate, 0.1-0.2 mm wide; pedicel to 2 mm long. **Seed** globose to subglobose; intrusion extends to half or less of the width of the seed, contorted; embryo lateral to sublateral, ca 2 mm long. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Lakefield NP, Kennedy Bend, 15°50'S, 144°15'E, 50 m, *Dowe 415 with Smith* (JCT); Lakefield NP, Twelve Mile Waterhole, *Dowe 606 with Barfod* (BRI, K, JCT); Kennedy R., 5.5 km N of New Laura Stn, 15°27'S, 144°18'E, 50 m alt., riparian forest, *Irvine 2204 & 2205* (QRS); near Cooktown airport, Barrett Ck, *Gray 2764* (QRS); ca 5 km N of Cooktown Airport, Barrett Ck, 15°25'S, 145°11'E, 5 m alt., *Dowe 607* (AAU, BRI holotype, K, QRS); 3.3 km NE of Cooktown Airport, Barrett Ck, NW boundary, 15°25'S, 145°12'E, 0 m alt, riparian evergreen mesophyll vine forest bordering mangroves, *Irvine 2178, 2179 & 2180* (QRS); 16 km N of Cooktown, Barrett Ck, *Dowe 604 with Barfod* (BRI, JCT, K); Endeavour R., opposite the SW corner of the

*Cooktown Airport, 15°27'S, 145°11'E, 3 m alt., Irvine 2181 (QRS); 3.3 km off main road at N side of Cooktown Airport, Hind 4594 with Hill & Healy (NSW); Cooktown, N side of Endeavour R., near airport, Dowe 253 (JCT).*

**CULTIVATION:** AUSTRALIA: Queensland, Cooktown, Anzac Park, Dowe 252 (BRI, FTG, JCT); Queensland, Townsville, Anderson Park Botanic Gardens, Dowe s.n. (JCT).

*Local and vernacular names:* Cooktown *Livistona*, Kennedy River *Livistona*.

*Habitat and ecology:* In seasonally moist open forest, seasonally inundated *Melaleuca* swamp, along creek and river banks, and at mangrove margins in non-saline environments at low elevations, 0-100 m alt. Soils are usually alluvial; grows with *Corypha utan* in the Kennedy R. area and with *L. muelleri* in the vicinity of Cooktown. Flowers Dec-Mar; fruits Apr-Oct. Fire regularly occurs in most populations.

*Conservation status:* Vulnerable.

*Distribution:* Australia. Queensland. On Flinders Is, Kennedy R. and tributaries, Barrett Ck, north of Cooktown, and Archer Point (Fig. 13).

*Notes:* This taxon was placed tentatively under *L. drudei* by Rodd (1998), who cited three specimens, *Irvine 2204 & 2205*, and *Hind 4594* 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*, and named it in reference to the neat and regular appearance of the petioles in the crown. The species had been variously known as '*Livistona* sp. Cooktown', 'Kennedy River *Livistona*' and 'Cooktown Fan Palm' in informal accounts (Irvine, 1984; Jones, 1996; Tucker, 1988).

*Livistona concinna* is a large dioecious canopy palm to 30 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 41% of the segment length; the inflorescences are unbranched, not extending beyond the limit of the crown; male inflorescences to 180 cm long, branched to 4 orders, and with up to 9 partial inflorescences; female inflorescences to 250 cm long, branched to 5 orders, and with up to 9 partial inflorescences; bracts are tightly tubular; flowers are white to cream; fruit are globose, to 12 mm diam., and shiny black at maturity.

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

–*Livistona inermis auct. non* R.Br., Wendland & Drude, Linnaea 39 (1875) 229, *pro parte*.

Functionally dioecious palm. **Trunk** to 28 m tall, 15-20 cm dbh, leaf scars narrow, pale grey; internodes broad. **Leaves** 30-60 in a globose or conical crown; petiole 150-230 cm long, 15-25 mm wide, adaxially ridged, purple in basal portion, green distally, margins with single, curved reddish spines larger and closer in the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented,  $\pm$  circular, 100-150 cm long, coriaceous, adaxially dark green, abaxially lighter green, glossy; lamina divided for 60-70% of its length, with 60-84 segments, depth of apical cleft ca 60% of the segment length, apical lobes attenuate, pendulous; parallel veins 7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 150-300 cm long, not extending beyond the limit of the crown, branched to 3 orders; 7-8 partial inflorescences; peduncle subterete, 15-25 mm diam.; prophyll glabrous; peduncular bract 1, tightly tubular, glabrous; rachis bracts tightly tubular, glabrous, apices with acuminate lobes; rachillae 1-8 cm long, pubescent. **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 ca 1.5 mm long. **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 ca  $\frac{1}{2}$  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.

*Specimens examined:* AUSTRALIA: Queensland. Kurrimine Beach, 1 km N of Maria Ck, *Dowe 281* (BRI, FTG); Tully Heads Rd, 1 km W of Hull Heads turnoff, *Dowe 290* (JCT); Rockingham Bay, Sept. 1865, *Dallachy s.n.* (MEL lectotype); Hinchinbrook Is., *Webb 11170* (BRI); Herbert R., 1886, *Dittrich s.n.* (MEL); 14.5 km NW of Ingham, N side of Herbert R., at SW base of Mt Leach Ra., *Rodd 3135 with Jacobs* (BRI, K, NSW); Mouth of Herbert R., *Webb 11176 with Tracey* (BRI); Braemeadows, near Ingham, 27 Nov 1959, *Thomas s.n.* (BRI); Halifax, 2 km along road to Lucinda,



*Irvine 1832* (BRI, NSW, QRS); Little Crystal Ck, near Youth Camp, 22 Jan 1982, *Irvine s.n.* (K); Kinduro, Hen Camp Ck, near Bruce Hwy, *Irvine 1833 & 1834* (BRI, NSW, QRS); Kinduro, Hen Camp Ck, near Bruce Hwy, *Irvine 1841* (BRI, QRS); Conway Beach, 20 km from Proserpine, 20°28'S, 148°45'E, *Dowe 329* (BRI, FTG).

*CULTIVATION.* Australia: Queensland. Brisbane, CSIRO, Long Pocket, *Tracey 15264* (BRI); CSIRO, Long Pocket, *Tracey 15296* (BRI).

*Habitat and ecology:* Grows on the landward side of mangroves, in fore-dune swales, open forest and swamp forest on coastal plains and along the margins of streams and estuaries at low elevations, 0-100 m alt. Flowers Aug-Dec; fruits Dec-June.

*Conservation status:* Endangered (IUCN, 2006; Dowe, 2007).

*Distribution:* Australia. Queensland. Coastal and near-coastal areas between Kurrimine Beach and Townsville, and with a disjunction to Conway Ra. near Proserpine (Fig. 13).

*Notes:* *Livistona drudei* was first mentioned informally by Mueller (1878) as "... *palme nunc pro speciei vel varietatis distinctione 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 & 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.*. The mention of the "*valley of the Mackay*" on a slip accompanying the type is a reference to present-day Tully R., of which Mackay R. was an earlier name; a Mt Mackay still exists at this location though. This does not refer to the present-day Mackay R., which is associated with the city of Mackay in central Queensland.

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. However, as the Dallachy specimen was not cited by Beccari, I have chosen Drude's (1893) treatment as the valid place of publication of the name.

*Livistona drudei* is a tall canopy palm to 28 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate

cleft to 60% of the segment length; the petiole bases are distinctively purple; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 8 partial inflorescences; bracts are tightly tubular; flowers are cream to yellow; fruit are globose to pyriform, to 12 mm long by 11 mm wide, and semi-glossy purple black at maturity.

28. **Livistona decora** (W.Bull) Dowe, *Austrobaileya* 6 (2004) 979. -*Corypha decora* W.Bull, Catal. (1887) 10; Watson, in Kew Bull. 3 (1889) 294. -**Neotype**: Australia. Queensland, Yepoon-Emu Park Rd, ca 11 km S of Yepoon, 12 May 1976, *Rodd 3069 with Jacobs* (neotype, BRI; isoneotypes, BH, K, NSW).  
 -*Livistona decipiens* Becc., *Webbia* 3 (1910) 301, fig. 1, tav. 2. -Type: France. Cultivation, Nice, May 1908, 'sheet with older inflorescence', *Robertson-Proschowsky* (lectotype, FI) (*fide* Rodd, 1998).  
 -*Livistona inermis* auct. non R.Br., *Wendland & Drude, Linnaea* 39 (1875) 229, *pro parte*.  
 -*Livistona australis* auct. non (R.Br.) Mart., *Bentham, Fl. Austral.* 7 (1878) 146, *pro parte*.  
 -*Livistona decipiens* var. *polyantha* Becc., *Webbia* 5 (1921) 15, 18. -Type: Indonesia. Cultivation, Bogor Botanic Gardens, undated, *Beccari s.n.* (holotype, FI; isotype, BO).

Functionally dioecious palm. **Trunk** to 18 m tall, 25-30 cm dbh, leaf scars narrow, internodes broad to 30 cm wide, smooth, brown in newly exposed parts, grey with age, with shallow vertical fissures, petiole stubs frequently retained at the base of the trunk. **Leaves** 30-60 in a ± globose crown; petiole 150-280 cm long, 18-24 mm wide, adaxially flat or slightly concave, green throughout, margins with single curved black spines to 20 mm long in the proximal portion; leaf-base fibres moderately prominent, coarse, disintegrating; lamina costapalmate, regularly segmented, ± circular in outline, 120-185 cm long, coriaceous, adaxially bright green, abaxially lighter green, segments extended along the costa; lamina divided for 82-88% of its length, with 70-84 segments, depth of apical cleft 44-54% of the segment length, apical lobes pendulous; parallel veins 6-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 100-350 cm long, not extending beyond the limit of the crown, branched to 4 orders; 8-13 partial inflorescences; longest partial inflorescence to 110 cm, each with a single rachis bract; prophyll 37 cm long, 11-16 cm wide, woody; peduncular bract(s) lacking; rachis bracts glabrous to sparsely papillate; primary rachis bract loosely sheathing, apically fibrous-lacerate, bracts subtending partial

inflorescence branches 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 5-20 mm long, papillose. **Flowers** solitary or in clusters of 2-6, funnel-shaped, 1.5-2 mm long, yellow; sepals ovate-triangular, ca 1.3 mm long, membranous, obtuse; petals broadly ovate, 1.5-1.8 mm long, fleshy, obtuse; stamens ca. 1.5 mm long. **Fruit** globose, 12-18 mm diam., shiny black; epicarp with scattered lenticellular pores; suture line extends ca.  $\frac{1}{2}$  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, ca 10 mm wide; intrusion  $\frac{1}{2}$ - $\frac{3}{4}$  across endosperm. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Magnetic Is, Gustav Ck, on track 1.5 km from Mandalay Rd, *Dowe 250 & 251* (BRI, FTG); Magnetic Is., *Sandercoe 943* (BRI); Cape Cleveland, 1 km from Mangrove Ck towards AIMS, *Dowe 330* (FTG); Cape Cleveland, 3 km from Mangrove Ck towards AIMS, *Dowe 331* (FTG); Cape Cleveland, 5 km from Mangrove Ck towards AIMS, 19°15'S, 147°00'E, *Dowe 332* (FTG); Palm Ck, Bruce Hwy, *Briggs 2071* (NSW); Haughton R., near Bruce Hwy, *Irvine 1817 & 1818* (QRS); West Barratta Ck, Bruce Hwy between Ayr and Giru, *Rodd 3117* (NSW); East Barratta Ck, near Bruce Hwy, *Irvine 1815 & 1816* (QRS); N of St Margaret Ck, Bruce Hwy between Ayr and Townsville, *Moriarty 767* (CANB, BRI); 51 miles S of Townsville, adjacent to creek, *Trapnell 305* (BRI, K); 27 miles N of Ayr, Bruce Hwy, *Moriarty s.n.* (BRI); Home Hill District, 1962, *Wyatt s.n.* (BRI); Cement Ck, tributary of Campaspe R., *Dowe 708* (BRI, JCT); 35 km NNE of Proserpine, E of Dingo Beach Rd, on Earlando Beach turnoff, *Rodd 3077 with Jacobs* (BRI, K, NSW); NE of Mt Dryander near coast, 15 Apr. 1978, *Byrnes s.n.* (BRI); Cape Hillsborough Rd, 4.4 km from Seaforth Rd, *Irvine 1840* (BRI, QRS); Mackay, Jane Ck, *Irvine 1812, 1813 & 1814* (QRS); Mackay, pasture lands, *Irvine 1748* (QRS); 10 km W of Mackay on bypass road, *Rodd 3075* (NSW); Mackay, Jun 1970, *V.K. Moriarty s.n.* (BRI); Farleigh, *Trapnell 26* (BRI); Denham Ra., headwaters of Sandy Ck, 520 m alt., 21°25'40.6"S, 148°06'01.6"E, *Dowe 742* (BRI, JCT); Between Byfield and Maryvale, *White 8197* (BRI); North Keppel Is., NE of Yeppoon, *Thomas 183* (BRI); Yeppoon, Byfield, *Flecker 11493* (BRI, QRS); Yeppoon-Emu Park Rd, ca 11 km S of Yeppoon, *Rodd 3069 with Jacobs*, (BH, BRI neotype, K, NSW); Yeppoon-Emu Park Rd, 11 km S of Yeppoon, *Rodd 3070 with Jacobs* (BRI, K); Yeppoon-Emu Park Rd, ca 11 km S of Yeppoon, *Rodd 3069* (BH, BRI, K, NSW); Near Emu Park, *Blake 19968* (BRI); Kinka Beach, Yeppoon-Emu Park Rd, 2 km

S of Kinka town, 23°20'S, 150°50'E, *Dowe 312b* (FTG); Joskeleigh, 15 miles E of Rockhampton, *Everist 7634* (BRI, K, L); (Queensland) Moore's Ck Ra., (pre-1875), *Thozet s.n.* (MEL); Palm Ck, 8 km S of Miriam Vale, *Hind 257* (BRI); Eurimbula, near Bustard Bay, Jul 1966, *Cooper s.n.* (BRI); Just off Round Hill Head on inland of Peninsula, 27 Mar 1970, *Everist s.n.* (BRI); Between Agnes Waters and Round Hill Head, S of Bustard Bay, 28 Mar. 1970, *Everist s.n.* (BRI, K); Agnes Waters, 40 km E of Miriam Vale, *McDonald 1224X & Batianoff* (BRI); Wide Bay, Woodgate Reserve, 25°10'S, 152°30', *Dowe 311 & 312a* (FTG, JCT); Reedy Ck, 8 km SE of Lowmead on Bundaberg Rd, *Rodd 3045 with Jacobs* (BRI, K, NSW); Cooloola SF, ENE of Gympie, *Moriarty 668, 668A & 669* (BRI); Tewantin, *Blake 23786* (BRI, CANB, K).

**CULTIVATION.** AUSTRALIA: Brisbane, Long Pocket, CSIRO, *Tracey 15295* (BRI); FRANCE: Nice, May 1908, 'sheet with older inflorescence', *Robertson-Proschowsky* (FI); Cannes, Villa Valetta, as '*Copernicia cerifera*', 12 Dec 1889, *anon. s.n.* (K); INDONESIA: Java, Bogor Botanic Gardens, Garden No. XII.E.91, *Furtado 30948* (BRI, K); Java, Bogor Botanic Gardens, undated, *Beccari s.n.* (BO, FI); SRI LANKA: Royal Botanic Gardens, Peradeniya, Q-291, *Rutherford 119 with Bandara* (K); UNITED KINGDOM: Royal Botanic Gardens Kew, 4 Dec 1889, "as *Livistona inermis*... being the true plant of R.Br., *Wendland s.n.* (K)".

*Local and vernacular names:* Weeping Cabbage Palm, Ribbon Fan Palm. **(Plate 20a-d)**

*Habitat and ecology:* Most common in coastal and near-coastal lowlands in large dense colonies or in scattered groups, in open forest, littoral rainforest and dry rainforest at low to moderate elevations, and with isolated inland populations at moderate elevations associated with permanent springs or seasonal streams, 0-550 m alt. Flowers Jul-Dec; fruits Dec-Apr.

*Conservation status:* Least concern.

*Distribution:* Australia. Queensland. From Magnetic Is. near Townsville, south to Tewantin and Rainbow Beach (Fig. 13).

*Notes:* The name *Corypha decora* 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*".

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.* 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 origin 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.*, from Moore's Ck near Rockhampton, central Queensland, now known to be of *L. decora* in their accounts of *L. inermis* and *L. australis* respectively. Many specimens in both the wild and in cultivation with a deeply segmented leaf were subsequently 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 and maintain while *L. decora* is exceptionally easy to germinate, and one of the fastest growing species of *Livistona*.

Beccari (1921) described a variety, *L. decipiens* var. *polyantha*, from plants cultivated in Bogor Botanic Gardens based on *Beccari s.n.*, 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 Is./Rainbow Beach area of southeastern Queensland, and it may be that hybridisation

has occurred as some individuals in that area are difficult to assign to either species.

*Livistona decora* is a large canopy palm to 18 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 54% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 13 partial inflorescences; bracts are loosely sheathing; flowers are yellow; fruit are globose to 18 mm diam., and shiny black at maturity.

**29. *Livistona australis*** (R.Br.) Mart., Hist. Nat. Palm. 3(7) (1838) 242. -*Corypha australis* R.Br., Prodr. (1810) 267. -*Saribus australis* (R.Br.) Kuntze, Revis. Gen. Pl. 2 (1891) 736. – **Type:** Australia. New South Wales, Port Jackson, undated, *Brown s.n.* (holotype, BM; isotype, FI). **Plate 21a-e.**

-*Livistona inermis auct. non* R.Br., Wendland & Drude, Linnaea 39 (1875) 229.

Functionally dioecious palm. **Trunk** to 25 m tall, 25-40 cm dbh, leaf scars raised, internodes broad, brown, longitudinal fissures prominent, petiole stubs retained in the lower 2 m or so, otherwise deciduous. **Leaves** 35-60 in a globose crown; petiole 150-250 cm long, 10-20 mm wide, adaxially moderately ridged, margins smooth or with short single black curved spines congested in the proximal portion, a thin yellowish-green longitudinal stripe present on the abaxial surface; leaf-base fibres prominent, finely woven, sheet-like, persistent; lamina costapalmate, regularly segmented,  $\pm$  circular, 100-130 cm long, chartaceous, adaxially dark green, glossy, abaxially slightly lighter green, nonwaxy; lamina divided for 49-69% of its length, with 80-100 segments, depth of apical cleft 50-63% of the segment length, apical lobes acute, pendulous; parallel veins 8 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 140-250 cm long, not extending beyond the limit of the crown, branched to 5 orders; partial inflorescences 6-9; peduncular bract(s) lacking; rachis bracts loosely sheathing, densely floccose; rachillae 5-25 mm long, glabrous. **Flowers** solitary or in clusters of 2-4, funnel-shaped, white to 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 ca 2.5 mm long. **Fruit** globose, 12-22 mm diam., dull reddish-brown to black, occasionally glaucous; epicarp with scattered lenticellular pores; suture line extends almost the length of the fruit; pedicel 2-3 mm long. **Seed** globose, 10-16 mm wide. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Paluma Ra., 6 km NW of Paluma Dam on forestry road, *Dowe 291* (JCT); Paluma Ra., Dotswood Holding, *Irvine 901* (QRS); Paluma Ra., Dotswood Holding, 22 km W of Bluewater Forestry Rd, 19°13'S, 146°25'E, 620 m alt., *Irvine 1928, 1929 & 1930* (K, MEL, NSW, QRS); Paluma Ra., Dotswood Holding, 22 km W of Bluewater Forestry Rd, 19°13'S, 146°25'E, 620 m alt., *Irvine 1929* (K); Bluewater Ck Forest Rd, 22 km from Bruce Hwy, *Rodd 3758 with P. Lavarack* (NSW); Bluewater Ra., 0.5 km past SF sign, *Dowe 171* (JCT); Bluewater Ra., 1 km past Rangers Hut, *Dowe 520* (JCT); Cathu State Forest, Clarke Ra., North Rd, 16 km along road to Palm Tree Lookout, 20°45'S, 138°35'E, 800 m alt., *Dowe 313* (BRI, FTG, JCT); Eungella Ra., SFR 679, *Irvine 1839* (QRS); Broken R. NP, *Webb 3322* (BRI); Eungella Ra., ca 2 km SE of Eungella on Broken R. Rd, *Rodd 3073 with Jacobs* (NSW); Eungella Ra., ca 3.5 km S of Broken R. crossing, S of Eungella, *Rodd 3798 & 3799* (BRI); Fraser Is, E side inland from Happy Valley, *Baxter 901* (BRI); Tin Can Bay, 20 Oct 1946, *Clemens s.n.* (A, K); 13 km E of Cooroy on Tewantin Rd, *Rodd 3030 & 3031 with Jacobs* (BRI, K, NSW, QRS); Nambour, Tuckers Ck, *Irvine 1893, 1894, 1895 & 1896* (QRS); 4.8 km N of Nambour, *Moriarty 671 & 672* (BRI); Forest Glen, 2 km SW of Buderim, 26°48'S, 153°00'E, *Dowe 310* (FTG); 18 km from Landsborough towards Nambour, *Carroll 1140 & Telford* (CANB); Yandina, 1 Mar 1891, *anon. s.n.* (BRI); Mooloolaba, 70 miles N of Brisbane, *Moore 9229 with Everist* (BRI); Between Mt Glorious and Mt Nebo, *Blake 21484* (BRI); Cabbage Tree Ck, 1 Mar 1888, *Simmonds s.n.* (BRI). New South Wales. Seal Rocks, 32 km E of Bulahdelah, 1 Aug 1964, *Briggs s.n.* (NSW); N of Ferny Ck, W of Wallis Ck, *Salasoo 3322* (NSW); Warrah, Pearl Beach, *Rodd 2672* (BRI, NSW, QRS); Bayview, Cabbage Tree Rd, W of golf course, *Rodd 3615* (NSW); Myall Lakes, Aug 1934, *Osborn s.n.* (K); Kuring-gai NP, McCarrs Ck, *Rodd 2671* (NSW); Royal NP, above Garie Beach, 34°10'S, 151°03'E, 60 m alt., 28 Aug. 1975, *Rodd s.n.* (K, NSW, QRS); Upper Kangaroo Valley, *Rodd 2398* (NSW); Port Jackson, undated, *Brown s.n.* (BM holotype, FI); near Sydney, *anonymous s.n.* (MEL); Botany Bay, Kurnell, May 1906, *Boorman s.n.* (NSW); near Mt Dromedary, 1881, *Bates s.n.* (MEL); (Australia), Nov 1806, *Caley s.n.* (BM); (New South Wales), 1864, *Daemel s.n.* (MEL); (New South Wales), *Johnson s.n.* (MEL); Kiama, 1872, *Henry s.n.* (MEL); Illawarra, *Kirton s.n.* (MEL); Mt Cambewarra, NW of Nowra, 7 Dec 1950, *Constable s.n.* (NSW); 13 km from West Bodalla, *Evans 96* (NSW); Tanja, ENE of Bega, Jul 1954, *anon. s.n.* (NSW); Ash Is., 25 Nov 1842, *Leichhardt s.n.* (MEL); (Australia), undated, *Lhotsky s.n.* (BM); Royal NP, *Meebold 2631* (M). Victoria. Gippsland, Cabbage Tree Ck, near Marlo, *Webb CBG010319* (CANB, NSW); Palm Ck, S of Cabbage Tree,

*Beauglehole 34001 with Beaton* (MEL); Palms Reserve, 5.4 km S from Princes Hwy along Palm Track on Palm Ck, 37°44'45"S, 148°39'E, 40 m alt., *Forbes 3222 with Worboys* (MEL); East Gippsland, 1888, *French s.n.* (MEL); East Gippsland, 1889, *French s.n.* (MEL); East Gippsland, Jan 1889, *Searle s.n.* (MEL); East Gippsland, *Weindorfer 2396* (MEL); NE of Marlo, Brodribb R., Curlip Jungle, *Melville 2933 with Wakefield & Hunter* (K); 16 km E of Marlo, Cabbage Tree Ck on Cabbage Palms Track, *Carroll 264* (CANB).

*Cultivation:* AUSTRALIA: Queensland, Brisbane Botanic Gardens, *White 7764* (A, BRI, K); UNITED KINGDOM: Royal Botanic Gardens Kew, 1891 *anon. s.n.* (K); Royal Botanic Gardens Kew, Feb 1862, *anon. s.n.* (K); Royal Botanic Gardens Kew, Temperate House, *Dransfield 392-26-23904* (K); INDIA: Madras, 4 Jun 1900, *Bourne s.n.* (K); Locality not provided, Mar 1900, *Kerchove de Deterghem s.n.* (K).

*Local and vernacular names:* Cabbage Palm, Cabbage Tree.

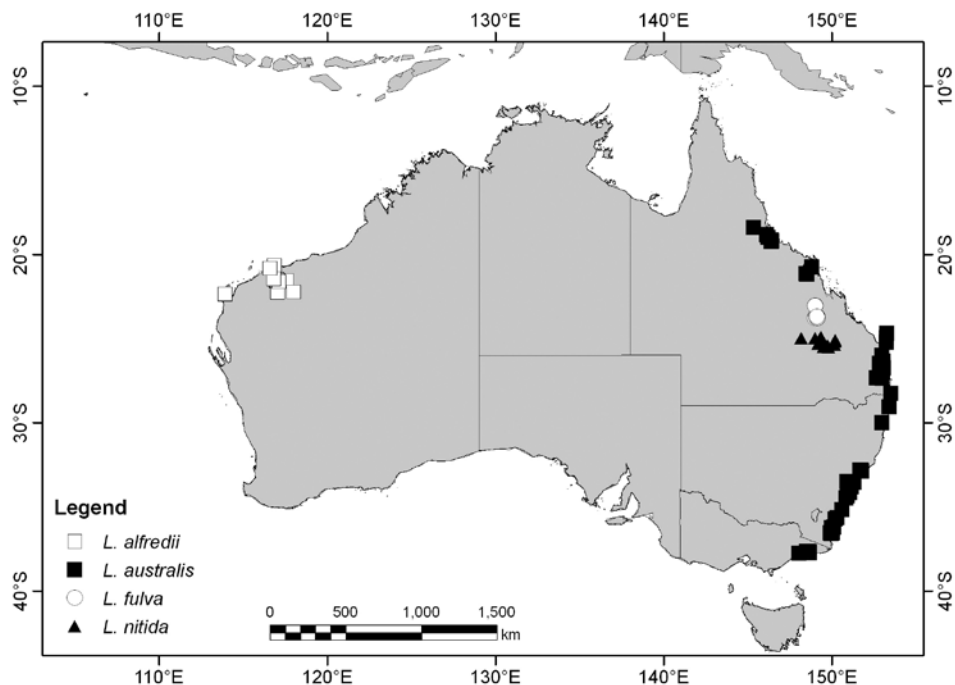
*Habitat and ecology:* Grows in moist areas of open forest, swamp forest, moist sclerophyll forests, along stream banks and in rainforest, 0-1000 m alt. Often locally common and may grow in large colonies. In the north confined to high elevation above 400 m and in central and southern parts in coastal and near-coastal lowland areas. Flowers all year; fruits all year.

*Conservation status:* Least concern.

*Distribution:* Australia. Queensland, New South Wales and Victoria. In the northern part of its range in Queensland confined to high elevation on Paluma Ra., Seaview Ra., Mt Elliot, Mt Abbott, and Eungella Ra. with a major disjunction to Fraser Is., and then more or less continuously at low to moderate elevation south through south-eastern Queensland, through coastal New South Wales and with a minor disjunction to the Brodribb R. in eastern Victoria (Fig. 14).

*Notes:* Brown (1810) described *L. australis*, as *Corypha australis*, from a specimen that he collected from Port Jackson, New South Wales, and which he distinguished from his *Livistona* species by the character of embryo position. Martius (1838) was the first to place it in *Livistona*. Previously, Solander (1768-1771) had included the species as another manuscript name in his hand-written and unpublished *Plantae Novae Hollandiae*, based on plants he saw at Botany Bay, the specimens of which are located





**Figure 14.** Distribution of *Livistona australis* (■), *L. nitida* (▲), *L. fulva* (○), and *L. alfredii* (□).

in BM. This species is the first palm to be mentioned in European accounts of Australia. Banks (Beaglehole, 1962) noted during Cook's Endeavour voyage of the Australian coast in 1770 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*.

*Livistona australis* is a tall canopy palm to 25 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 63% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 9 partial inflorescences; bracts are loosely sheathing; flowers are white to cream to pale yellow; fruit are globose to 22 mm diam., and dull reddish brown to black at maturity.

**30. *Livistona nitida*** A.N.Rodd, *Telopea* 8 (1998) 96, figs 2a-b, 3h, 8d, 9b-c. – **Type:** Australia. Queensland, NW of Cracow, junction of Dawson

R. and Delusion Ck, 9 May 1976, *Rodd 3055 with Jacobs* (holotype, NSW; isotypes, BH, BRI, K). **Plate 22a-c.**

Functionally dioecious palm. **Trunk** to 35 m tall, 25-40 cm dbh, leaf scars raised; internodes narrow, grey; petiole stubs persistent in the basal 1 m or so, otherwise deciduous. **Leaves** 35-50 in a globose crown; petiole 170-200 cm long, 20-26 mm wide, adaxially ridged, margins distally smooth, proximally with single, curved, dark red spines; leaf-base fibres moderately prominent, coarse, disintegrating; lamina costapalmate, regularly segmented,  $\pm$  circular in outline, 160-190 cm long, coriaceous, adaxially dark green, glossy, abaxially lighter green; lamina divided for 63-70% of its length, with 68-80 segments, depth of apical cleft 60-73% of the segment length, apical lobes pendulous; parallel veins ca 7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 150-200 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 8-12; peduncular bract(s) lacking; rachis bracts loosely sheathing, densely scaly; rachillae 5-20 cm long, glabrous to papillose. **Flowers** solitary or in clusters of 2-5, funnel-shaped, 2-3.2 mm long, cream to yellow; sepals triangular, ca 1.5 mm long, fleshy, subacute; petals broadly ovate, 2.0-2.2 mm long, thick, fleshy, acute; stamens ca 16 mm long. **Fruit** globose, 13-20 mm diam., glossy jet black; epicarp with scattered lenticellular pores, suture line extends for ca  $\frac{1}{2}$  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 wide. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Carnarvon Gorge, *White 11374* (BRI); Carnarvon Gorge, Dec 1939, *Waldron s.n.* (BRI); Carnarvon Gorge NP, Carnarvon Ck, *Rodd 1112* (NSW); Delusion Ck, Cracow-Theodore Rd, 12 miles N of Cracow, *Johnson 847* (BRI); Delusion Ck, Theodore-Cracow Rd, 25°11'S, 150°11'E, *Dowe 301* (BRI, FTG); Junction of Dawson R. and Delusion Ck, NW of Cracow, *Rodd 3051, 3052 & 3054 with Jacobs* (BH, BRI, K, NSW); NW of Cracow, junction of Dawson R. and Delusion Ck, *Rodd 3055 with Jacobs* (BH, BRI, K, NSW holotype); Cracow to Theodore Rd, Delusion Ck, 17.5 km W of Cracow, *Irvine 1898, 1899, 1900, 1901 & 1902* (QRS); 61 km W of Eidsvold at start of Isla-Delusion Rd, 21 Apr 1986, *Ladiges, Humphries & Bean s.n.* (BM); Robinson Ck, NW of Taroom, *Speck 1986* (BRI, CANB); Robinson Ck, 13 miles NW of Taroom, *Johnson 2764* (BRI); Palm Tree Ck, 12 miles N of Taroom, *Johnson 1671* (BRI); Palm Tree Ck, 12 km from Taroom, *Moriarty 1280* (BRI); Palm Tree Ck, 19 km N of Taroom, *Telford 5648*

(CBG, NSW); Palm Tree Ck, 10 miles (ca 16 km) N of Taroom, *Reeve II* (CANB); Taroom, 16 Sep 1960, *Stiller s.n.* (BRI).

*Local and vernacular names:* Carnarvon Gorge Cabbage Palm. Dawson River Fan-Palm.

*Habitat and ecology:* Abundant along the margins of streams and flood plains, but also associated with sandstone cliffs and gorges, 100-650 m alt. Flowers Sep-Dec; fruits Nov-Mar.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Australia. Queensland. In the catchments of the Dawson, Comet and Burnett Rivers, and Carnarvon Gorge (Fig. 14).

*Notes:* *Livistona nitida* was described by Rodd (1998) based on *Rodd 3055* collected from Delusion Ck near Cracow, Queensland, and named for its highly glossy jet black 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 R., 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".

*Livistona nitida* is a large canopy palm to 35 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 73% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 12 partial inflorescences; bracts are loosely sheathing; flowers are cream to yellow; fruit are globose to 20 mm diam., and glossy jet black at maturity.

31. ***Livistona fulva*** A.N.Rodd, *Telopea* 8 (1998) 103, figs 4a, 12, 13a. -**Type:** Australia. Queensland, Blackdown Tableland, 11 May 1976, *Rodd 3062 & Jacobs* (holotype, NSW; isotypes, BH, BRI, K). **Plate 22d-e.**

Functionally dioecious palm. **Trunk** to 13 m tall, 20-25 cm dbh, leaf scars raised, internodes narrow, grey or brown, petiole stubs deciduous. **Leaves** 25-35 in a globose crown; petiole 150-250 cm long, 12-15 mm wide, adaxially moderately ridged, basal margins armed with single, curved

black spines; leaf-base fibres moderately prominent, fine, persistent; lamina costapalmate, regularly segmented, circular in outline, 90-100 cm long, coriaceous, adaxially greyish green to glaucous, coppery brown floccose tomentum abaxially; lamina divided for 50-55% of its length, with 60-66 segments, depth of apical cleft 3-5% of the segment length, apical lobes acute to acuminate, rigid; parallel veins 8-9 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 100-230 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 7-9; peduncular bract 1, loosely sheathing, with orange-brown scales; rachis bracts loosely sheathing, with orange-brown scales; rachillae 5-16 cm long, papillose. **Flowers** solitary or in clusters of 2-3, funnel-shaped, yellow, 1.6-2 mm long; sepals narrowly triangular, 1.0-1.3 mm long, membranous, acute; petals broadly ovate, 1.6-2 mm long, thick, acute; stamens ca. 1.6 mm long. **Fruit** globose, 12-16 mm diam., pruinose dull black; epicarp smooth; suture line not obvious; mesocarp thin, fibrous; endocarp thin, crustaceous. **Seed** globose, 10-13 mm wide. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Blackdown Tableland, Rodd 3062 & Jacobs (BH, BRI, K, NSW holotype); slopes below N escarpment, Blaxell 921 with Johnson (NSW); Blackdown Tableland, Irvine 1903, 1904, 1905 & 1906 (QRS); N escarpment, Jones 6338 & Jones (CANB); Mimosa Ck, 23°05'S, 149°00'E, Henderson 1180 (BRI, K, NSW); 32 km SE of Blackwater, Henderson 876 (BRI); ca 35 km SE of Blackwater, 23°05'S, 149°00'E, Durrington & Sharpe 1180 (MEL); just below escarpment at NE end (roadpass), Rodd 3063, 3064 & 3065 (BH, BRI, K, NSW); below escarpment, 2 km from top, 23°43'S, 149°07'E, Dowe 300 (FTG).

*Local and vernacular name:* Blackdown Fan Palm.

*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, 400-900 m alt. Flowers Sep–Feb; fruits Dec–May.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Australia. Queensland. Endemic to Blackdown Tableland (Fig. 14).

*Notes:* *Livistona fulva* was described by Rodd (1998) based on Rodd 3062

from Blackdown Tableland, and named for the coppery brown floccose tomentum on the abaxial surface of the leaf. The relationships of *L. fulva* are unclear, but it is most 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.

*Livistona fulva* is a moderate sub-canopy palm to 13 m tall; leaves are moderate and regularly segmented, and with coppery brown floccose tomentum abaxially; segment apices are rigid, and with a bifurcate cleft to only 5% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 9 partial inflorescences; bracts are loosely sheathing; flowers are yellow; fruit are globose to 16 mm diam., and pruinose dull black at maturity.

32. ***Livistona alfredii*** F.Muell., Victorian Naturalist 9 (1892) 112 (as *L. alfredi*); Bot. Centralbl. 53 (1893) 28, *verbatim exemplar*. – **Type:** Australia. Western Australia, Hamersley Ra., Millstream, June 1878, *Forrest s.n.* (holotype, MEL). **Plate 23a-b.**

–*Livistona mariae* auct. non F.Muell., Mueller, *Fragm.* 11 (1878) 54.

–*Livistona mariae* auct. non F.Muell., Gardner, Forest Depart. Bull. Western Australia 32 (1923) 36.

Functionally dioecious palm. **Trunk** to 12 m tall, 20-50 cm dbh, leaf scars prominent, internodes narrow, pale grey, petiole stubs persistent in basal 1 m, otherwise deciduous. **Leaves** 25-30 in a globose crown; petiole 90-130 cm long, 25-30 mm wide, adaxially flat, margins with curved single black spines congested in the proximal portion; leaf-base fibres prominent, coarse, persistent; lamina costapalmate, regularly segmented, subcircular in outline, 90-140 cm long, rigid, adaxially pale green-grey to glaucous, waxy, dull; abaxially light green-grey, waxy; lamina divided for 60-70% of its length, with 50-66 segments, depth of apical cleft 60-75% of the segment length, apical lobes attenuate, rigid; parallel veins 6-8 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 80-270 cm long, not extending beyond the limit of the crown, branched to 3 orders; partial inflorescences 5-7; prophyll not seen; peduncular bracts 1-2, loosely sheathing, sparsely to moderately scaly; rachis bracts loosely sheathing, sparsely to moderately scaly; rachillae to 13 cm long, to 2 mm diameter, white pruinose, papillose. **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 ca. 2 mm long. **Fruit** globose, 25-40 mm diam., dark brown to black; epicarp with scattered lenticellular

pores; suture line extends to ca.  $\frac{1}{2}$  way to base; pedicel to 3 mm long. Seed globose, 17-20 mm wide. **Eophyll** 3-ribbed.

*Specimens examined:* AUSTRALIA: Western Australia. Hamersley Ra., Millstream, Jun 1878, *Forrest s.n.* (MEL holotype); On the Mill-stream, Fortescue R., *Forrest 301* (MEL); Hamersley Ra., 19 Feb 1879, *Forrest s.n.* (MEL); Millstream, Hamersley Ra., *Forrest s.n.* (MEL); Millstream, Hamersley Ra., 1892, *anon. s.n.* (MEL); Millstream R., 15 Oct 1915, *Thorpe s.n.* (K); Longreach, Millstream, Fortescue R., 21 Aug 1932, *Gardner s.n.* (PERTH); Pilbara, Millstream-Chichester NP, Fortescue R., Crossing Pool, 20°50'S, 116°35'E, *Dowe 354* (BRI); Pilbara, Millstream-Chichester NP, Fortescue R., Crossing Pool, 1 km downstream of Dawson Ck junction, *Dowe 355* (JCT); Millstream-Chichester NP, 28 Jul 1990, *Leyland s.n.* (PERTH); Millstream-Chichester NP, Fortescue R., below lookout overlooking Crossing Pool, 21°33'12"S, 116°58'5"E, *Bromilow LA2, LA5* (BRI, PERTH); Millstream Stn, 21°35'S, 117°04'E, 300 m alt, *Rodd 2847, 2849 & 2850* (BH, K, NSW, PERTH); Fortescue R., Millstream, Aug 1974, *Beauglehole s.n.* (PERTH); Fortescue R., *Brooker 2064* (PERTH); Fortescue R., Millstream, *George 3523* (PERTH); Fortescue R., Crossing Pool near Millstream Homestead, 13 Aug 1974, *Willis s.n.* (MEL); Millstream R., *Brooker 2064* (PERTH); Millstream/Yarraloola Rd crossing the Fortescue R., 21°37'58"S, 117°07'08"E, *Bromilow LA1* (BRI, PERTH); Fortescue R., 400 m E of Robe R. iron rail bridge, 21°28'35"S, 116°49'14"E, *Bromilow LA6* (BRI, PERTH); ca 32 km W of Mt Brockman Stn, Duck Ck, 3 May 1975, *Wark A & B* (NSW); Nichol Bay, 1879, *McRae s.n.* (MEL); Cape Ra., North West Cape, 22°22'09"S, 113°54'03"E, 29 Sept. 1988, *Waldock s.n.* (PERTH).

*Local and vernacular name:* Millstream Palm.

*Habitat and ecology:* Grows adjacent to watercourses and along drainage lines in well-drained sites, 50-560 m alt. Flowers Sep-Jan; fruits Dec-May.

*Conservation status:* Lower risk, conservation dependent (IUCN, 2006).

*Distribution:* Western Australia. In the Hamersley Region mainly in the upper reaches of the Fortescue, Robe and Ashburton Rivers. A small disjunct and apparently senescent population occurs in the Cape Ra., North West Cape Peninsula, on the western side of Exmouth Gulf (Humphreys *et al.*, 1990) (Fig. 14).

*Notes:* Specimens relating to *L. alfredii* were first cited by Mueller (1878) as part of the distribution of *L. mariae*. The protologue 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. Mueller named it in honour of Alfred, Duke of Edinburgh. The type, *Forrest s.n.* is mentioned in the account of *L. mariae*. Drude (1893) found *L. alfredii* distinct enough to place it in its own section, *Gregorya*. Beccari (1921) similarly provided only a meagre description, but in 1931 provided a complete description based on the Forrest and McRae specimens.

*Livistona alfredii* is the most geographically isolated species of *Livistona* in Australia.

*Livistona alfredii* is a moderate canopy palm to 12 m tall; leaves are large and regularly segmented; segment apices are rigid, and with a bifurcate cleft to 75% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 7 partial inflorescences; bracts are loosely sheathing; flowers are cream to yellow; fruit are globose to 40 mm diam., and dark brown to black at maturity.

33. ***Livistona nasmophila*** Dowe & D.L.Jones, *Austrobaileya* 6 (2004) 980. -*Livistona mariae* subsp. *occidentalis* A.N.Rodd, *Telopea* 8 (1998) 81, figs 3c, 5d. – **Type:** Australia. Western Australia, Durack Ra., SE base of Mt King, *Rodd 2868* (holotype, NSW; isotypes, BH, K, PERTH, QRS). **Plate 23c-e.**

Functionally dioecious palm. **Trunk** to 30 m tall, 30-65 cm dbh, leaf scars raised, internodes broad, grey, petiole stubs persistent in basal 1 m or so, otherwise deciduous. **Leaves** 35-55 in a globose crown; petiole 165-230 cm long, 4-10 cm wide, adaxially flat, margins with single or double retrorsely recurved reddish spines confined to the proximal portion, margin distally smooth; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular, 130-175 cm diam., undulate, rigidly coriaceous, adaxially glossy grey-green, abaxially dull grey to glaucous; lamina divided for ca 48% of its length, with 52-58 segments, depth of apical cleft ca 48% of the segment length, apical lobes at first rigid, becoming semi-pendulous with age or damage; parallel veins 7-9 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 260-300 cm long, not extending beyond the limit of the crown, branched to 5 orders; partial inflorescences 9-11; 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 5-9 cm long, glabrous. **Flowers** in clusters of 4-6, globose, angular in bud, 1.4-1.5 mm long, cream to yellow; sepals broadly ovate, ca 1.2 mm long, thin, acute; petals triangular, 1.4-1.5 mm long, obtuse; stamens ca 0.9 mm long. **Fruit** globose, 11-14 mm diam., purple-black; epicarp with scattered lenticellular pores; mesocarp fibrous, dry; endocarp thin, crustaceous; pedicel to 1 mm long. **Seed** globose, 7-11 mm wide. **Eophyll** not seen.

*Specimens examined:* AUSTRALIA: Western Australia. Northeast Kimberleys, Bens Springs, 3 km E of El Questro Homestead, 16°01'S, 128°01'E, *Kenneally 10965* (PERTH, NSW); Cambridge Gulf, El Questro Stn, Zebedee Springs, *Dowe 363* (BRI, FTG); Durack Ra., SW base of Mt King, 17°20'S, 127°23'E, *Rodd 2869* (PERTH); Durack Ra., SE base of Mt King, *Rodd 2868* (BH, K, NSW holotype, PERTH, QRS); King Leopold Ranges, Mt Ord Gorge, 20 miles SSW of Mt House Stn, *Lazarides 6453* (CANB, K, MEL); King Leopold Ranges, southern end of Eva Ck Gorge, *Sands 4620 & 4630* (K); SE Kimberleys, base of Osmond Ra. on Swamp Ck, 0.8 km N of Samim mining camp, *Forbes 25353* (MEL, PERTH).

*Cultivation.* AUSTRALIA: Queensland, Townsville Palmetum (ex seed from King Leopold Ranges, Mt Gladys, May 1987, *Willing s.n.*), *Dowe 117* (NSW).

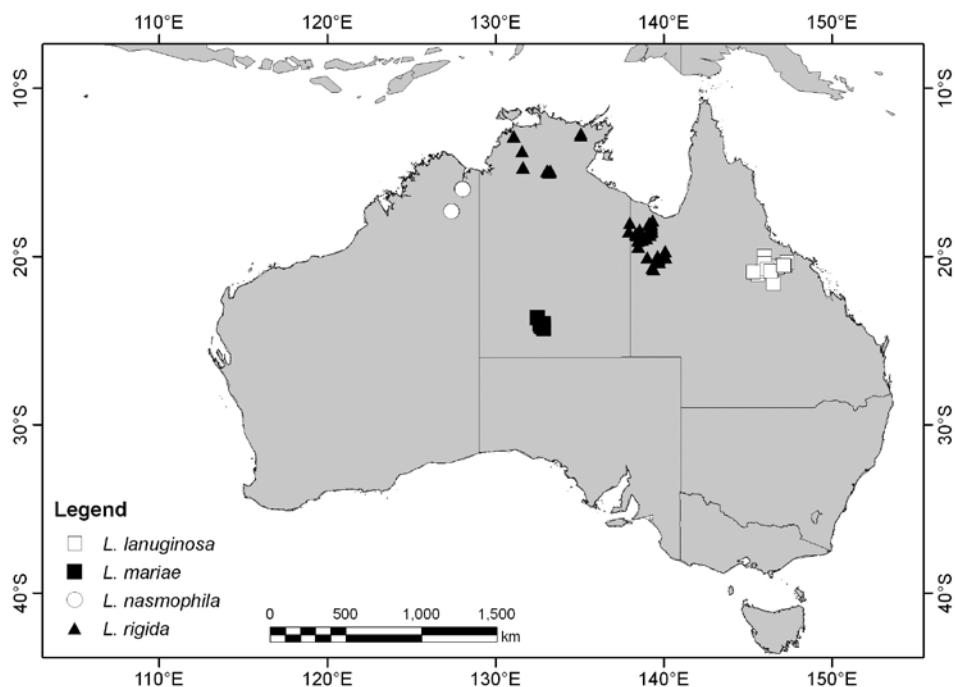
*Habitat and ecology:* Along intermittent or permanent water courses, in open forest, occurs in very large colonies in some areas, 50-200 m alt. Flowers Jul-Oct; fruits Oct-Dec.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Western Australia. In the Durack Ra. and Cambridge Gulf area (Fig. 15).

*Notes:* Rodd (1998) established this taxon as *L. mariae* subsp. *occidentalis*, based on the collection *Rodd 2868*, 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 subsequent fieldwork in the Kimberleys, with collections of fruit and flowers from both wild and cultivated sources, it became apparent that this taxon was distinct enough from both *L. mariae* and *L. rigida* to be raised to species rank. However, the correct nomenclatural procedure would have been to take Rodd's





**Figure 15.** Distribution of *Livistona nasmophila* (○), *L. mariae* (■), *L. rigida* (▲), and *L. lanuginosa* (□).

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 watercourses fed by springs through much of its range.

*Livistona nasmophila* is a large canopy palm to 30 m tall; leaves are large and regularly segmented; segment apices are rigid to semi-pendulous, and with a bifurcate cleft to 48% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 11 partial inflorescences; bracts are loosely tubular; flowers are cream to yellow; fruit are globose to 14 mm diam., and purple black at maturity.

34. ***Livistona mariae*** F.Muell., *Fragm.* 11 (1878) 54; *Fragm.* 8 (1874) 283, *nom. prov.*; Giles, *Geo. Trav. Central Austral.* (1875) 222, *nom. ined.* -*Saribus mariae* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2 (1891) 736. -*Livistona mariae* subsp. *mariae* A.N.Rodd, *Telopea* 8 (1998) 80, figs 3a, 5a. – **Type:** Australia. Northern Territory, Macdonnell Ranges, undated, *Giles s.n.* (holotype, MEL 67699, 67700, 67701) (*fide* Rodd, 1998, in part). **Plate 24a.**

Functionally dioecious palm. **Trunk** to 30 m tall, 30-40 cm dbh, leaf scars stepped, raised, internodes broad, grey, petiole stubs persistent only in the basal 1 m or so. **Leaves** 30-50 in a globose crown; petiole erect to arching, 150-250 cm long, 20-45 mm wide, adaxially ridged, margins with small, single, curved, black spines in the proximal portion, smooth distally; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, regularly segmented, circular in outline, 100-220 cm diam, rigidly coriaceous, adaxially grey green, glossy, abaxially lighter grey green, waxy pruinose; lamina divided for 45-55% of its length, with 50-86 segments, depth of apical cleft 45-65% of the segment length, apical lobes attenuate, pendulous, proximal margins of outer segments with small spines; parallel veins 7-9 each side of the midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 125-250 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 10-14; peduncular bract 1, loosely tubular with dense white-grey scales; rachis bracts loosely tubular with dense white scales; rachillae 3-8 cm long, pliable to flexuose, glabrous. **Flowers** in clusters of 3-6, campanulate, 1.0-1.8 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 ca 1.2 mm long. **Fruit** globose, 12-18 mm diam., semi-glossy black; epicarp with scattered lenticellular pores; suture line extends for ca  $\frac{3}{4}$  the length of the fruit, marked with lip-like structures; mesocarp fibrous; endocarp thin, crustaceous. **Seed** globose, 8-12 mm wide. **Eophyll** 3-ribbed.

*Specimens examined:* AUSTRALIA: Northern Territory. Macdonnell Ranges, undated, *Giles s.n.* (MEL holotype); Palm Valley, 1897, *Stirling s.n.* (K); Palm Valley, 17 Aug 1929, *Cleland s.n.* (AD); Palm Valley, *Colliver 5281* (QRS); Palm Valley, *Lothian 315* (AD); Palm Valley, ca 8 miles SSW of Hermannsburg Mission, 16 Sep 1965, *Willis s.n.* (MEL); Palm Valley, *Beaglehole 10460* (MEL); Glen of Palms (Palm Valley), *Beaglehole 23850* (MEL); Palm Valley, *Beaglehole 27516* (DNA, MEL, NSW); Palm Valley, *Mitchell 84* (DNA); Palm Valley, *Rodd 3215 with Jacobs* (DNA, QRS); Palm Valley, *Rodd 3216* (K); Palm Valley, 4 Aug 1978, *Latz s.n.* (QRS); Palm Valley, Oct 1951, *anon s.n.* (BRI); Palm Valley, *Maconochie 1665* (BRI); Finke Gorge NP, Palm Ck, 2 km W of carpark, 24°02'S, 132°41'E, *Dowe 352* (DNA); Finke Gorge NP, Palm Ck, 2 km W of carpark, *Dowe 353* (JCT).

**CULTIVATION.** AUSTRALIA: New South Wales. Royal Botanic Gardens Sydney, *Rodd 136879* (DNA, K).

*Local and vernacular names:* Central Australian fan palm, Central Australian cabbage palm, Palm Valley *Livistona*.

*Habitat and ecology:* Grows along creek lines and watercourses with a permanent shallow water supply, and in sandstone gorges, at 600-650 m alt. The total population includes about 2000 mature individuals confined to Palm Valley and Little Palm Ck. Flowers Jul-Dec; fruits Nov-Feb.

*Conservation status:* Lower risk, conservation dependent (IUCN, 2006).

*Distribution:* Australia. Northern Territory. Endemic to the Finke R. system in the Macdonnell Ranges (Fig. 15).

*Notes:* The name *Livistona mariae* was first used by Mueller (1874a) in notes under *L. leichhardtii*, with which he considered that it may be conspecific. Previously, Mueller (1874a) had mentioned it only as the palm from the ‘Glen of Palms’ collected by Gilles. These instances had no descriptions and in the former were 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 Britannia 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).

Subsequently, the identities of *L. mariae* and *L. alfredii* remained unclear to some botanists, with Gardner (1923) referring to the Millstream Palm (i.e. *L. alfredii*), as *L. mariae* and applying *L. alfredii* to yet another taxon in the Kimberleys. However, other taxonomists distinguished the two taxa (Drude, 1893; Beccari, 1931).

The closeness 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 *L. rigida* 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.

*Livistona mariae* is a large canopy palm to 30 m tall; leaves are large and regularly segmented; segment apices are pendulous, and with a bifurcate cleft to 65% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 14 partial inflorescences; bracts are loosely tubular and covered with dense white-grey scales; flowers are greenish cream to yellow; fruit are globose to 18 mm diam., and semi-glossy black at maturity.

35. ***Livistona rigida*** Becc., Webbia 5 (1921) 19. -*Livistona mariae* subsp. *rigida* A.N.Rodd, Telopea 8 (1998) 80, figs 3b, 5b-c, 6. – Type: Australia. Queensland, Gulf of Carpentaria, Albert R., Aug 1855, *Mueller s.n.* (holotype, K; isotype, FI). **Plate 24b-e.**

Functionally dioecious palm. **Trunk** to 28 m tall, 30-40 cm dbh, leaf scars raised, internodes narrow, grey, petiole stubs persistent in the basal 1 m or so, otherwise deciduous. **Leaves** 30-50 in a globose crown; petiole 150-250 cm long, 20-35 mm wide, adaxially concave, 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 costapalmate, regularly segmented, circular in outline, 125-170 cm long, 100-150 cm diam., rigidly coriaceous, adaxially grey to glaucous, midgreen, semi-glossy, abaxially lighter green, glaucous; lamina divided for 50-55% of its length, with 50-78 segments, depth of apical cleft 30-63% of the segment length, apical lobes acuminate, rigid or semi-pendulous; parallel veins 5-7 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 100-250 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 9-14; prophyll 25-38 cm long, 8-9 cm wide; peduncular bract 1, loosely tubular with moderate to dense white-grey scales; rachis bracts loosely tubular with sparse white scales; rachillae 3-8 cm long, rigid, glabrous. **Flowers** in clusters of 3-8, globose, ca 1.8 mm long, cream to yellow; sepals broadly ovate, ca 2 mm long, thin, acute; petals triangular, 1.0-1.4 mm long, obtuse; stamens ca 1.2 mm long. **Fruit** globose, 12-14 mm diam., semi-glossy black; epicarp with scattered lenticellular pores; suture line extends for ca ½ the length of the fruit, marked with lip-like structures; mesocarp fibrous; endocarp thin; pedicel ca. 2 mm long. **Seed** globose, 9-11 mm wide. **Eophyll** 5-ribbed.

*Specimens examined:* AUSTRALIA: Northern Territory. Mataranka, *Must*

1499 (DNA); Kapalga, *Dunlop 5052 with McKean* (CANB, DNA, NSW); Goyder R., *Dunlop 7259* (DNA, NSW); Roper Hwy, 20 k E of Stuart Hwy, *Latz 7828* (DNA, NSW); Near Roper R. crossing, Salt Ck, *Dowe 209 & 211* (JCT); Mataranka Stn, Salt Ck, 5 Jul 1964, *Schneider s.n.* (AD); Roper R., road crossing 1.5 km W of Mataranka Homestead, 14°55'S, 133°06'E, 120 m alt., *Dowe 210 & 212* (JCT); S of Mataranka, Warlock Ponds Bridge, *Symon 10358* (NSW); Elsie Ck, 20 km SE of Mataranka, *Beaulehole 58320 with Errey* (MEL). Queensland. Burketown-Camoweal Rd, Gregory R. between crossing of Beames Brook and Planet Downs Stn, 17 Aug 1973, *Williams s.n.* (BRI); Gregory R., 10 km N of Gregory Downs, *Irvine 1856, 1857, 1858 & 1859* (QRS); Lawn Hill Ck, SW of Burketown, Jun 1963, *Gittens s.n.* (BRI); Lawn Hill NP, Jan 1988, *O'Keefe s.n.* (BRI); Lawn Hill Ck, 3 km above Lawn Hill Homestead, *Rodd 2937 & 2938* (BRI, K, QRS, NSW); Lawn Hill Stn, Babbling Brook, *Latz 1619* (BRI, CANB, DNA); Adels Grove, *de Lestang 233* (QRS); Adels Grove, Lawn Hill Ck, 500 m W of camping grounds, 18°41'55"S, 138°31'06"E, *Dowe 630 with Kazandjian* (BRI, JCT, K); 34 miles S of Burketown, *Webb 10634* (BRI); Albert R., Aug 1855, *Mueller s.n.* (K holotype); 30 km E of Highland Plains, 18°43'S, 138°28'E, *Maconochie 1656 & 1657* (BRI); Palm Springs, junction of Police Ck and Leichhardt R., ca 40 km NNE of Mt Isa, *Farrell TF815* (BRI); Lake Julius Dam, 12 Feb 1977, *Schmid s.n.* (BRI); Dugald R., tributary of Flinders R., 20°12'08.8"S, 140°14'14.0"E, 178 m alt., *Dowe 749 with Martin* (BRI, JCT).

*Local and vernacular names:* Mataranka Palm, Gregory R. Cabbage Palm.

*Habitat and ecology:* Grows as a riparian element along stream margins, on seasonally inundated banks, in creek lines and watercourses, sometimes with intermittent flow, but with a permanent shallow water supply, 2-300 m alt. Flowers Jun-Dec; fruits Nov-May.

*Conservation status:* Lower risk, conservation dependent.

*Distribution:* Australia. Queensland and Northern Territory. In north-western Queensland in the catchments of the Gregory, Leichhardt, Nicholson, Albert and Flinders Rivers, and in the Northern Territory on the Roper R., South Alligator Rivers and east Arnhem Land (Fig. 15).

*Notes:* *Livistona rigida* was described by Beccari (1921), based on a collection, at that time by an unknown collector, from Albert R. in the Gulf

of Carpentaria, and named for the "... *spadix rigidus*". This specimen, conserved in K, is most likely 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 verified. But it is known that in August of 1855 Mueller traversed the area in which *L. rigida* is now known to occur and collected extensively (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" (ca 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 correctly determined that the leaf of *L. inermis*, the species that the illustrations were supposed to represent, were much smaller than those illustrated.

*Livistona rigida* is a large canopy palm to 28 m tall; leaves are large and regularly segmented; segment apices are rigid to semi-pendulous, and with a bifurcate cleft to 63% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 14 partial inflorescences; bracts are loosely tubular, with the peduncular bract with moderate to dense white-grey scales and the rachis bracts with sparse white-grey scales; flowers are cream to yellow; fruit are globose to 14 mm diam., and semi-glossy black at maturity.

36. ***Livistona lanuginosa*** A.N.Rodd, *Telopea* 8 (1998) 82, figs 3d, 7, 9a.  
 – **Type:** Australia. Queensland, 75 km SE of Ravenswood, Glenroy Ck, 20°35'S, 147°10'E, 25 Aug. 1978, *Irvine 1912* (holotype, NSW; isotypes, BH, BRI, K, MEL, QRS).  
 – *Livistona mariae* auct. non F.Muell., F.M.Bailey, *Queensl. fl.* 5 (1902) 1684. **Plate 25a-e.**

Functionally dioecious palm. **Trunk** to 18 m tall, 25-35 cm dbh, leaf scars raised, compressed, internodes broad, grey-brown, base with persistent petiole stubs. **Leaves** 35-45 in a globose crown; petiole 150-200 cm long, 30-35 mm wide, adaxially flat, margins with small single, curved black spines confined to the proximal portion; leaf-base fibres moderately prominent, coarse, persistent; lamina costapalmate, costa

arcuate, regularly segmented,  $\pm$  circular in outline, 130-190 cm long, coriaceous, adaxially pale grey-green, abaxially lighter grey-green, waxy, strongly pruinose; lamina divided for ca 34% of its length, with 70-92 segments, depth of apical cleft ca 24% of the segment length, apical lobes acuminate, semi-pendulous; parallel veins 8 each side of midrib; transverse veins thinner than parallel veins. **Inflorescences** unbranched at the base, not sexually dimorphic, 140-220 cm long, not extending beyond the limit of the crown, branched to 4 orders; partial inflorescences 8-12; prophyll densely tomentose; peduncular bracts 1-2, loosely sheathing, densely lanuginose; rachis bracts loosely sheathing, not disintegrating, densely lanuginose; rachillae 3-12 cm long, glabrous. **Flowers** solitary or in pairs, funnel-shaped, 2.8-3 mm long, cream to yellow; sepals narrowly triangular, ca 1.5 mm long, fleshy, acuminate to aristate; petals triangular, 2.8-3 mm long, thick, acute; stamens ca 2 mm long. **Fruit** globose, 25-36 mm diam., purple-brown to black with scattered white flecks; epicarp with large lenticellular pores; suture line extends for ca  $\frac{1}{2}$  the length of the fruit, marked with lip-like structures; mesocarp fibrous, dry; endocarp 2-3 mm wide; pedicel to 1 mm long. **Seed** globose, 18-22 mm wide. **Eophyll** 5 ribbed.

*Specimens examined:* AUSTRALIA: Queensland. Campaspe R., Hellenslie Stn, Jul 1900, *Berney s.n.* (BRI); Liontown Stn, Oaky Ck, 20°23'54.3"S, 146°03'35.4"E, 290 m alt., *Dowe 751* (JCT); Windsor Stn, Oaky Ck, 20°19'20.8"S, 146°03'58.7"E, 300 m alt., *Dowe 752* (JCT); Cement Ck, tributary of Campaspe R., *Dowe 707* (JCT); 75 km SE of Ravenswood, Glenroy Ck, 20°35'S, 147°10'E, *Irvine 1912* (BH, BRI, K, MEL, NSW holotype, QRS); Glenroy Ck, ca 3 km from Glenroy HS, *McLain 2* (QRS); Glenroy Ck, ca. 11 km N of Burdekin Falls, *Rodd 3759 with Jackes* (NSW); Glenroy Ck, 1 km N of junction with Stones Ck, 20°33'S, 147°06'E, *Dowe 292 & 293* (BRI, FTG); Middle Burdekin Valley near Burdekin Falls, 1978, *McLain s.n.* (NSW); Nosnillor Stn, Campaspe R., on Clermont Rd, 112 km S of Charters Towers, *Irvine 1912, 1913 & 1914* (QRS, NSW); Nosnillor St, Muckinbulla Waterhole, *Dowe 706* (JCT); Cattle Ck, 7 km E of Harvest Home, *Thompson 238* (BRI); Longton Stn, Garden Ck, S21° 04.482', E145° 36.185', 290 m, 28 Oct 2005, *Dowe s.n.* (JCT); Longton Stn, Amelia Ck, 9.8 km NW of Cape R. crossing on Pentland road, *Dowe 705* (JCT).

*Cultivation:* AUSTRALIA: Queensland. Townsville Palmetum (ex Burdekin R. near Burdekin Dam wall, 1986, *Tucker s.n.* (NSW); *ibid*, *Dowe III* (NSW).

*Local and vernacular names:* Cape River Fan-palm, Burdekin Livistona, Woolly Palm.

*Habitat and ecology:* Occurs as a riparian element along the margins of streams and in seasonal gullies and associated floodplains with high watertables, at 140-270 m alt. Flowers Mar-Nov; fruits Nov-Jan.

*Conservation status:* Endangered (Dowe, 2007).

*Distribution:* Australia. Queensland. Restricted to the Cape, Campaspe, Rollston, Burdekin and Belyando Rivers and tributaries (Fig. 15).

*Notes:* *Livistona lanuginosa* was described by Rodd (1998) based on *Irvine 1912* collected from Glenroy Ck, a tributary of the Burdekin R., 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 R., which in all probability belongs to this inland palm". Recently, the species was informally known as '*Livistona* sp. Cape River' (Jones, 1996). *Livistona lanuginosa* most closely resembles *L. mariae* and *L. rigida*, but is readily distinguished by its much larger fruit and the densely lanuginose prophyll and inflorescence bracts.

An interesting historical account was provided by Leichhardt (1847) who noted this palm in the diary of his transcontinental expedition of 1845: "... (in the Burdekin R. valley on 25 March 1845)... 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 (Dowe 2007). Pettit and Dowe (2003) undertook a population study and estimated that the total population consisted of less than 1000 mature individuals, all of which occur on private property within the Burdekin R. catchment. Primary threats are trampling and browsing of seedlings and juveniles by cattle, which prevents regeneration.

*Livistona lanuginosa* is a large sub-canopy to canopy palm to 18 m tall; leaves are large and regularly segmented; segment apices are rigid to semi-pendulous, and with a bifurcate cleft to 63% of the segment length; the inflorescence is unbranched, not extending beyond the limit of the crown, and with up to 12 partial inflorescences; bracts are loosely sheathing and distinctively densely tomentose/lanuginose; flowers are cream to yellow; fruit are globose to 36 mm diam., and purple brown to black at maturity.



### Excluded and uncertain names

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

*Livistona* ? *bissula* Mart., Hist. Nat. Palm. 3 (1850) 319. *Bissula* Rumph. Herb. Amboin. 1 (1741) 85. -*Licuala* ? *bissula* Miq., Fl. Ned. Ind. 3 (1855) 57. -*Saribus* *bissula* Blume ex Pfister, Beitr. Vergl. Anat. Sabaleenblät. (1892) 25. – *Bissula* was the name applied by Rumphius (1741) to a fan palm collected in Sulawesi. 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 monomial form and placed it 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* Blume 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) 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-Linnean monomial, the name is otherwise inadmissible under the ICBN.

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

*Livistona dournowiana* Hort. ex Taylor, Bailey Stand. Cycl. Hort. (1943) 1896, *nom. inval.* – This name was used for a palm in horticulture and described as “*a new palm with lvs. resembling those of Latania borbonica, which is Livistona chinensis, Hab. (?) – L. muelleri, Bailey.*” However, the fruit is further described as “*oval, nearly 6 in. long*” which excludes it from either of those species.

*Livistona enervis* Hort. ex anon., Ill. Gart.-Zeitung 16 (1891) 346. – 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. This could be a typographical error for *L. inermis* R.Br., which otherwise was the name incorrectly used for *L. decora* (W.Bull) Dowe in many informal accounts and nursery catalogues of that era.

*Livistona eocenica* Ettingsh. & J.S.Gardner, Proc. Roy. Soc. London 29 (1879) 393. – 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. inval.* – Moore listed this name in his annotated list of cultivated palms as ‘a name without botanical standing’.

*Livistona filamentosa* Hort. Petrop. ex R.Pfister, Beitr. Vergl. Anat. Sabaleenblät. (1892) 25. = *Washingtonia filifera* (Linden ex André) H.Wendl. ex de Bary (Beccari, 1921).

*Livistona filifera* Hort. ex H.Wendl., in Kerchove, Palmiers (1878) 250, *nomen.* – A name that appeared in a list of palms in the ‘Index Général’, without a description or reference to specimens. It was noted as a synonym of *L. inermis* R.Br., but without a description or reference to specimens, the name remains invalid.

*Livistona* (?) *gaudichaudii* Mart., Hist. Nat. Palm. 3 (1849) 242. -Type: Hawaii. 1836, *Gaudichaud-Beaupré s.n.* (FI, P) = *Pritchardia gaudichaudii* (Mart.) H.Wendl. = *Pritchardia martii* (Gaudich.) H.Wendl., Bonplandia 10 (1862) 199.

*Livistona hoffmanni* Hort. ex. André, Rev. Hort. 77 (1905) 527, *nomen.* – This name was applied to juvenile palms exhibited at a meeting of the Royal Horticultural Society of England by M.R.Hoffmann, of Streatham, England. André quoted that M.M.Watson, in the Gardeners’ Chronicle (no publication details provided) suggested that they were plants of *Livistona mariae* F.Muell. However, without a description or specimens this cannot be supported, and the name cannot be placed.

*Livistona humilis* R.Br. var. *bloomfieldiensis*, in Cuccuini & Nepi, Quad. Bot.

Amb. Appl., 17/1 (2006) 104, 192, *nom. inval.* – This name was included in a list of specimens conserved in FI. Cuccuini and Nepi (2006) suggested it was a synonym of *Livistona humilis* var. *sclerophylla* Becc. and *Livistona muelleri*. It is an invalid name that was used on a herbarium specimen sheet.

*Livistona humilis* var. *leichhardii* (F.Muell.), in Cuccuini & Nepi, Quad. Bot. Amb. Appl., 17/1 (2006) 104, *nom. inval.* – This name was included in a list of specimens conserved in FI. It is an invalid name that was used on a herbarium specimen sheet.

*Livistona kingiana* Becc., Malesia 3 (1889) 199. -Type: Malaysia. Perak, *Dr King s.n.* (holotype, FI) = ***Pholidocarpus kingianus*** (Becc.) Ridl., Mat. Fl. Malay. Penins. 2 (1907) 167 (Dransfield & Uhl, 1983b).

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

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

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

*Livistona minima* Reid & Chandler, London Clay Fl. (1933) 109. – A fossil taxon described from a single seed from southern England. -Type: United Kingdom. Sheppey, *Bowerbank V. 22021* (BM).

*Livistona moluccana* Hort. ex H.Wendl., in Kerchove, Palmiers (1878) 250, *nomen.* – A name that appeared in a list of palms in the ‘Index Général’, without a description or reference to specimens. Although there are a number of specimens in FI (sheets 1132G & 1132G-A) that are labelled as *L. moluccana*, in Beccari’s handwriting, the name remains invalid as it has not been validly published. Beccari (1921, 1931) included the name in the ‘*Sinonimi e specie escluse*’ section in his treatment of *Livistona*.

*Livistona mülleri* Hort. ex H.Wendl., in Kerchove, Palmiers (1878) 250, *nomen*. – A name that appeared in a list of palms in the ‘Index Général’ without a description or reference to specimens.

*Livistona occidentalis* Hort. ex Hook.f., Report on the progress and condition of the Royal Gardens at Kew 1882 (1884) 64. = ***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.) Hook.f. as synonyms of *Brahea dulcis*.

*Livistona okinawensis* Hort. ex L.H.Bailey, Hortus third (1976) 674, *nom. inval.* – A name used in horticulture and suggested to be a synonym of *L. chinensis* var. *subglobosa*. This name cannot be placed as there was no description or specimens cited.

*Livistona ovaliformis* Hort. ex R.M.Grey, in Rep. Harvard Botanic Garden, Cienfuegos, Cuba (1927) 66, *nom. inval.* – A name of horticultural origin, and which lacks a description and specimens. Otherwise, it may possibly be a misspelling of *Livistona olivaeformis* (Hassk.) Mart.

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

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

*Livistona ternatensis* Hort. ex Salomon, Palmen (1887) 174, *nomen*. – A name without a description or reference to specimens and cannot be placed.

*Livistona vidalii* Becc., Webbia 1 (1905) 343. -Type: Philippines. Luzon, Pampanga, Arayat, 27 Feb. 1903, *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 (1921) 22 (also as ‘*voganii*’, Beccari 1931). – A name attributed to Sander, possibly from

horticulture, but without a description or specimens, cannot be placed with certainty. Beccari (1921, 1931) questionably placed it as a synonym of *L. cochinchinensis*.

*Livistona zollingeri* Hort. ex Devansaye, Rev. Hort. 47 (1875) 34, *nom. inval.* -*Livistona zollingeriana* Blume, Salomon, Palmen 142 (1887) *nom. inval.* -*Saribus zollingerianus* Hassk., Salomon, Palmen (1887) 142, *nom. inval.* – This name was first used by Devansaye without a description or reference to specimens and cannot be placed with certainty. However, Zollinger (1857), in the protologue of *L. altissima*, stated that the name ‘Zollingerianus’ had been used on the herbarium label for that species. 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).

### Future work

There are a number of issues with regards to *Livistona* that are presently unresolved. A phylogenetic assessment of the entire genus has yet to be undertaken. Additionally, the relationships of *Livistona* to other genera have yet to be fully investigated and resolved. Detailed studies of pollen morphology and sexuality are lacking for many species. In addition, some records of unidentified species from unusual habitats have to be investigated. There is reference to a possible *Livistona* species on the karst limestone island of Palawan, and populations of unidentified *Livistona* species occurring in Sumatra. Within Australia, the full extent of the distribution of some species has yet to be ascertained, such as species in the Kimberleys of Western Australia and Cape York Peninsula in Queensland.

### Acknowledgements

I offer sincere thanks to Associate Professor Betsy Jackes, Dr Leone Bielig and Dr Anders Barfod for their support during my PhD candidature and project (from which this revision was largely taken) at James Cook University, Townsville. For assistance at Aarhus University, Denmark, I thank Annie Sloth and again, Dr Anders Barfod. For general herbarium assistance, I am indebted to J.Mogea, Irawati, K.Kramadibrata and C.Heatubun (BO): G.Guymer, A.Bolan, P.Forster and R.Henderson (BRI);

E.Fernando (CAHUP, LBC); P.Cuccuini and M.Tardelli (FT); N.G.Hiep (HN); B.Baker, J.Dransfield and M.Harley (K); L.G.Saw (KEP); M.Thijssse (L); O.Gideon and R.Banka (LAE); H.Ehara, R.Nobe, H.Kato, M.Ono and N.Yoshida (MAK); R.Maturbongs (MAN); C.Coles, P.Milne and B.Conn (MEL); K.Hill (NSW); P.Pignal (P); D.Madulid (PNH); and R.Kiew (SING). For assistance with field work and other logistical support, I thank A.Cairns, D.Dixon, P.Gadek and A.Kazandjian (James Cook University); S.van Leeuwen (CALM, WA); G.Kendrick (WA Museum); D.Greenwood (VUT); J.Conran (University of Adelaide); A.K.Irvine (CSIRO); and K.Tansasha, P.Vatcharakorn and M.Ferrero (Thailand). Mirjam Maughan (ACTFR) is thanked for preparing the distribution maps. Dr John Dransfield is thanked for assistance in the neotypification of *Livistona saribus*. I also thank the reviewers who provided constructive comments for improvements to this revision. Funding was provided by Australian Biological Resource Study; Australia Pacific Science Foundation; Pacific Biological Foundation; and James Cook University (Doctoral Merit Research Scheme and Internal Research Supplementary Funding).

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**List of publish names of taxa of *Livistona*** (currently used and accepted scientific names are in bold italics).

Bissula Rumph.  
***Brahea dulcis*** (Kunth) Mart.

Chamaerops biroo Siebold  
 Copernicia cerifera (Arruda) Mart.  
 Corypha australis R.Br.  
 C. decora W.Bull  
 Corypha elata Roxb.  
 C. japonica Kittlitz  
 C. minor Blanco  
 C. minor Jacq.  
 C. rotundifolia Lam.  
 C. saribus Lour.  
***C. umbraculifera*** L.  
***C. utan*** Lam.

Hightea elliptica Bowerb.  
 Hyphaene carinensis Chiov.

***Johannesteijsmannia*** H.E.Moore

Latania borbonica Lam.  
 L. chinensis Jacq.  
 L. jenkinsiana (Griff.) Devansaye  
 L. olivaeformis (Hassk.) Devansaye  
***Licuala*** Wurmbr.  
 Licuala bissula Miq.  
***L. celebica*** Miq.  
 L. excelsa Zipp.  
***L. ramsayi*** (F.Muell) Domin  
***Livistona*** R.Br.  
 Livistona subgen. Livistonella Becc.  
***Livistona alfredii*** F.Muell.



- L. altissima Zoll.
- L. australis** (R.Br.) Mart.
- L. beccariana Burret
- L. benthamii** F.M.Bailey
- L. bissula Mart.
- L. blancoi Merr.
- L. boninensis** (Becc.) Nakai
- L. brassii Burret
- L. brevifolia** Dowe & J.P.Mogea
- L. carinensis** (Chiov.) J.Dransf. & N.W.Uhl
- L. chinensis** (Jacq.) R.Br. ex Mart.
- L. chinensis var. boninensis Becc.
- L. chinensis var. subglobosa (Hassk.) Becc.
- L. chocolatina** Dowe
- L. cochinchinensis (Blume) Mart.
- L. concinna** Dowe & Barfod
- L. crustacea Burret
- L. decipiens Becc.
- L. decipiens var. polyantha Becc.
- L. decora** (W.Bull) Dowe
- L. diepenhorstii Hassk.
- L. dournowiana Hort. ex Taylor
- L. drudei** F.Muell. ex Drude
- L. eastonii** C.A.Gardner
- L. endauensis** J.Dransf. & K.M.Wong
- L. enervis Hort. ex anon.
- L. eocenica Ettingsh. & J.S.Gardner
- L. erecta
- L. exigua** J.Dransf.
- L. fengkaiensis X.W.Wei & M.Y.Xiao
- L. filamentosa Hort. Petrop. ex R.Pfister
- L. filifera Hort. ex H.Wendl.
- L. fulva** A.N.Rodd
- L. gaudichaudii Mart.
- L. halongensis** T.H.Nguyen & Kiew
- L. hasseltii (Hassk.) Miq.
- L. hoffmanni Hort. ex. André
- L. holtzei Becc.
- L. hoogendorpii Hort. ex Teysm. & Binn. ex Miq.
- L. humilis** R.Br.
- L. humilis var. bloomfieldiensis

- L. humilis var. leichhardii
- L. humilis var. minutiflora Becc.
- L. humilis var. novoguineensis Becc.
- L. humilis var. sclerophylla Becc.
- L. inaequisecta Becc.
- L. inermis** R.Br.
- L. japonica Nakai ex Masam.
- L. jenkinsiana** Griff.
- L. jenkinsii Griff. ex Mart.
- L. kimberleyana A.N.Rodd
- L. kingiana Becc.
- L. lanuginosa** A.N.Rodd
- L. leichhardtii F.Muell.
- L. loriphylla Becc.
- L. lorophylla** Becc.
- L. macrophylla Bruder
- L. macrophylla Roster
- L. mariae** F.Muell.
- L. mariae subsp. mariae A.N.Rodd
- L. mariae subsp. occidentalis A.N.Rodd
- L. mariae subsp. rigida A.N.Rodd
- L. martii Gaudich.
- L. martiana Gaudich. ex Mart.
- L. mauritiana Wall. ex Mart.
- L. melanocarpa Burret
- L. merrillii** Becc.
- L. microcarpa Becc.
- L. mindorensis Becc.
- L. minima Reid & Chandler
- L. moluccana Hort. ex. H.Wendl.
- L. muelleri** F.M.Bailey
- L. mülleri H.Wendl.
- L. nasmophila** Dowe & D.L.Jones
- L. nitida** A.N.Rodd
- L. occidentalis Hort. ex Hook.f.
- L. okinawensis Hort. ex L.H.Bailey
- L. olivaeformis (Hassk.) Mart.
- L. ovaliformis Hort. ex. R.M.Grey
- L. papuana** Becc.
- L. ramsayi F.Muell.
- L. rigida** Becc.

*L. robinsoniana* Becc.

***L. rotundifolia*** (Lam.) Mart

*L. rotundifolia* var. *luzonensis* Becc.

*L. rotundifolia* var. *microcarpa* (Becc.) Becc.

*L. rotundifolia* var. *mindorensis* (Becc.) Becc.

*L. rupicola* Ridl.

***L. saribus*** (Lour.) Merr. ex A.Chev.

*L. sinensis* Griff.

***L. speciosa*** Kurz

*L. spectabilis* Griff.

*L. subglobosa* (Hassk.) Mart.

***L. surru*** Dowe & Barfod

***L. tahanensis*** Ridl. ex Becc.

*L. ternatensis* Hort. ex Salomon

*L. tonkinensis* Magalon

***L. tothur*** Dowe & Barfod

***L. victoriae*** A.N.Rodd

*L. umbraculifera* Hort. ex Vilm.

*L. vidalii* Becc.

*L. vogamii* H.Sander ex Becc.

*L. whitfordii* Becc.

***L. woodfordii*** Ridl.

*L. zollingeri* Hort. ex Devansaye

*L. zollingeriana* Blume

***Maxburretia rupicola*** (Ridl.) Furt.

***Pholidocarpus*** Blume

*P. diepenhorstii* (Hassk.) Burret

***P. ihur*** (Giseke) Miq.

***P. kingianus*** (Becc.) Ridl.

*Pritchardia gaudichaudii* (Mart.) H.Wendl.

***P. martii*** (Gaudich.) H.Wendl.

***Sabal minor*** (Jacq.) Pers.

*Saribus* Blume

*Saribus* Rumph

*Saribus australis* (R.Br.) Kuntze

*S. bissula* Blume ex Pfister

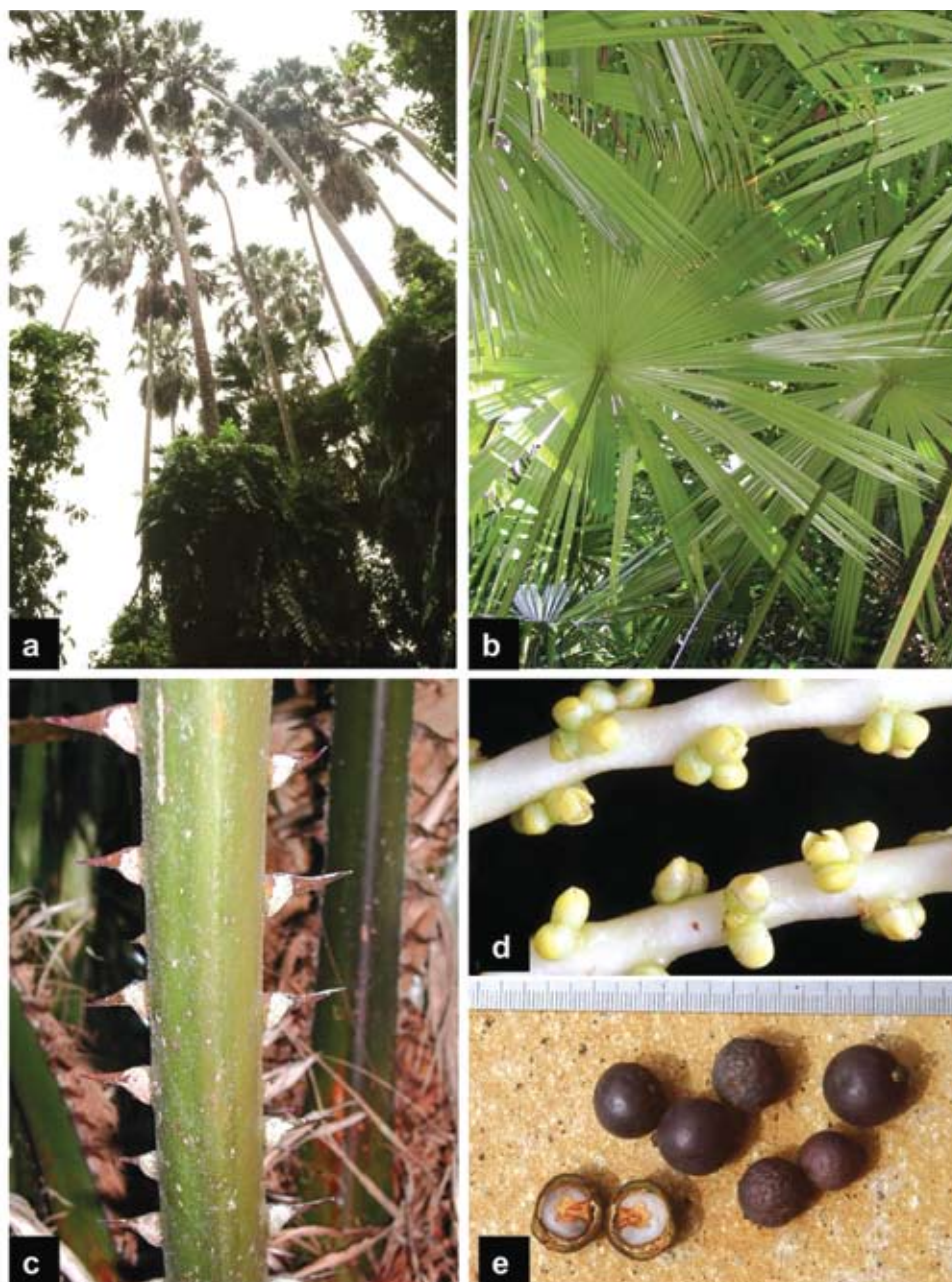
*S. chinensis* (Jacq.) Blume

*S. cochinchinensis* Blume

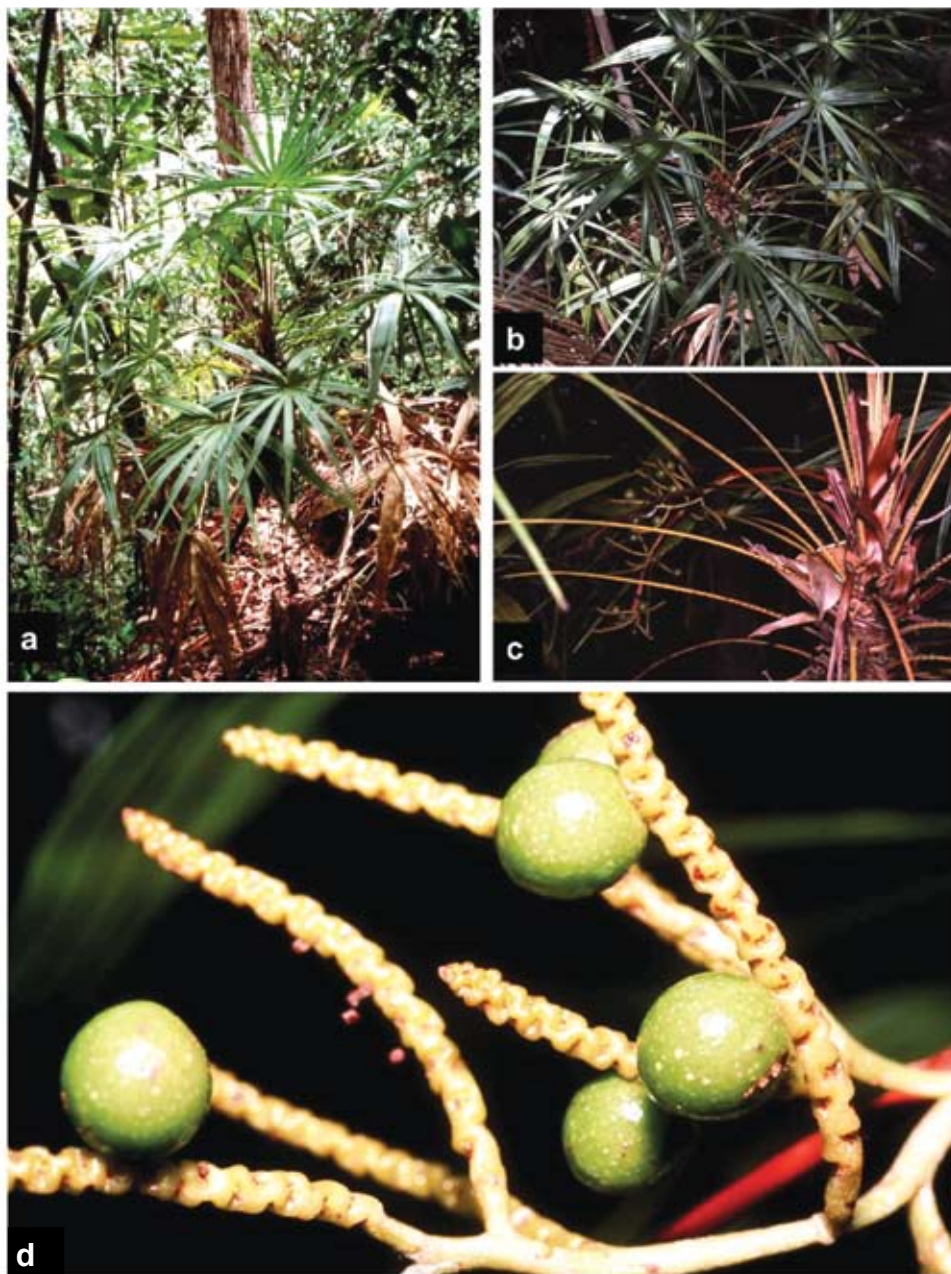
S. hasseltii Hassk.  
S. hoogendorpii (Hort. ex Teysm. & Binn. ex Miq.) Kuntze  
S. humilis (R.Br.) Kuntze  
S. inermis (R.Br.) Kuntze  
S. jenkinsii (Griff.) Kuntze  
S. mariae (F.Muell.) Kuntze  
S. olivaeformis Hassk.  
S. papuanus (Becc.) Kuntze  
S. rotundifolius (Lam.) Blume  
S. speciosus (Kurz) Kuntze  
S. subglobosus Hassk.  
S. zollingerianus Hassk.

Thrinax tunicata Hort. ex Verschaff.

***Washingtonia filifera*** (Linden ex André) H.Wendl. ex de Bary  
Wissmannia Burret  
Wissmannia carinensis (Chiov.) Burret



**Plate 1.** *Livistona saribus*: a. In habitat, palm swamp forest, Khum Cha-not, northeast Thailand; b. Leaf detail; c. Petiole with armature, cultivated plant, Cairns Botanic Gardens, Queensland, Australia; d. Portion of rachilla with mature flowers; e. Fruit, whole and one dissected to reveal seed coat intrusion [photos by J.L.Dowe; 1b, 1d and 1e from cultivated plant, Townsville Botanic Gardens, Queensland, Australia].

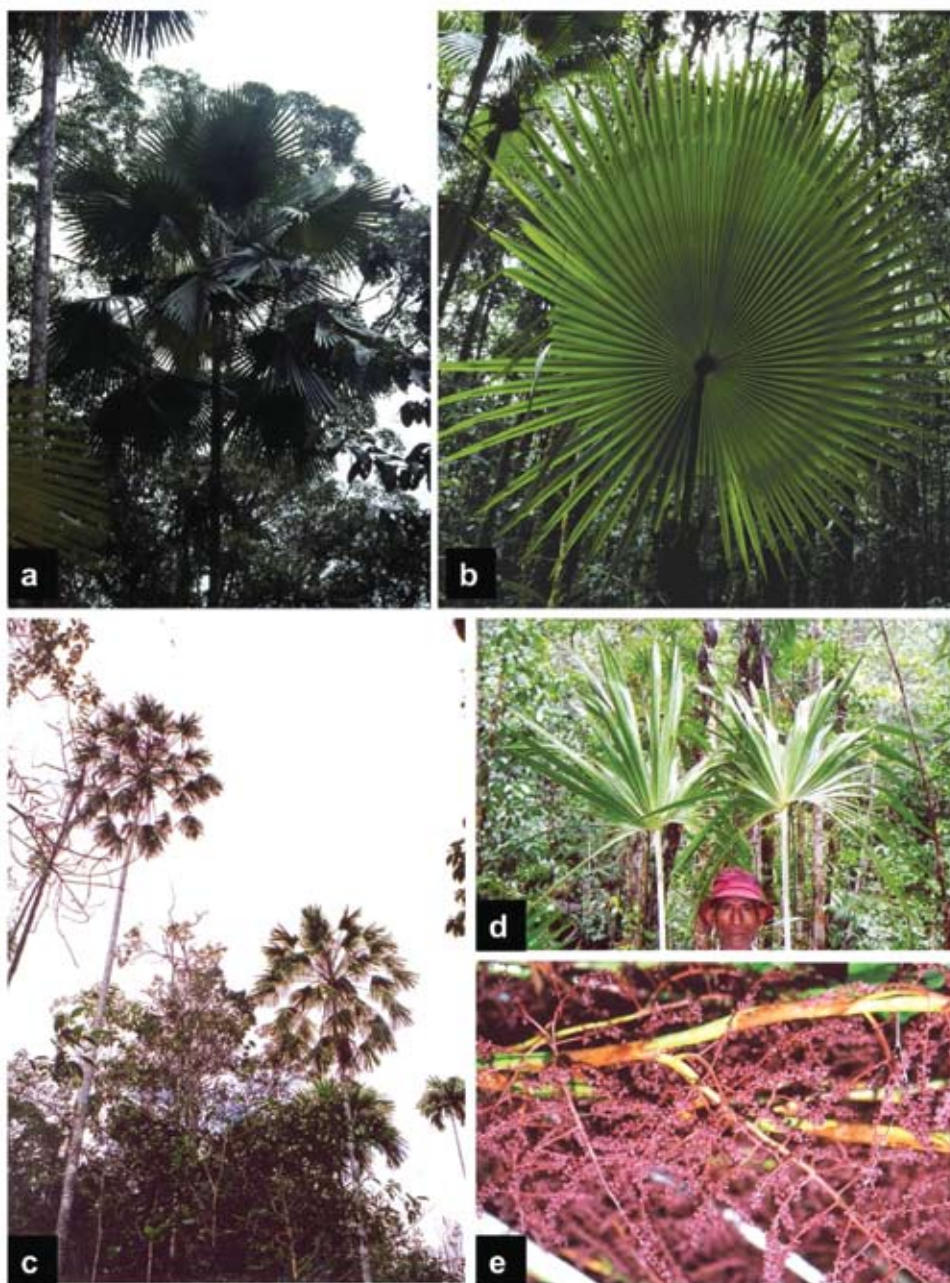


**Plate 2.** *Livistona exigua*: a. In habitat, at ridge top kerangas forest at 150 m alt.; b. Crown detail; c. Inflorescence and leaf-base fibres; d. Rachillae and immature but full-size fruit [photos by J. Dransfield; voucher specimen, *Dransfield et al.* 6568, from Bukit Batu Patam, Ulu Ingei, Brunei Darassalam].





**Plate 3.** *Livistona rotundifolia*: a. Habit, avenue in Bogor Botanic Gardens, Indonesia; b. Crown with infructescence, cultivated plant, Florida, USA; c. Crown with petiole bases and leaf-base fibres, cultivated plant, Townsville Botanic Gardens, Queensland, Australia; d. Fruit, whole and with one dissected, cultivated plant, Florida, USA [photos by J.L.Dowe].



**Plate 4.** *Livistona papuana*: a. In habitat, rainforest at 540 m alt.; b. Leaf detail [photos by W.J.Baker; voucher specimen, *Baker WJB851*, from Fakfak, Timika, Papua, Indonesia]. *Livistona brevifolia*: c. In habitat, coastal forest; d. Leaf; E. Inflorescence with mature flowers [photos by C.D.Heatubun, from Gag Island, Raja Ampat, Papua, Indonesia].





**Plate 5.** *Livistona merrillii*: a. Habit; b. View into crown; c. Fruit [photos by J.L.Dowe, cultivated plant at Bogor Botanic Gardens, Indonesia]. *Livistona woodfordii*: d. In habitat, in coastal forest at sea-level, West Point, Rossel Island, Milne Bay Province, Papua New Guinea; e. Crown with infructescence (voucher specimen, *Banka et al. 2015*, from 50 m alt. at Yeleamba, Rossel Island, Milne Bay Province, PNG); f. Fruit (voucher specimen, *Banka et al. 2019*, from East Point, Sudest Island, Milne Bay Province, PNG). [All photos by J.L.Dowe].

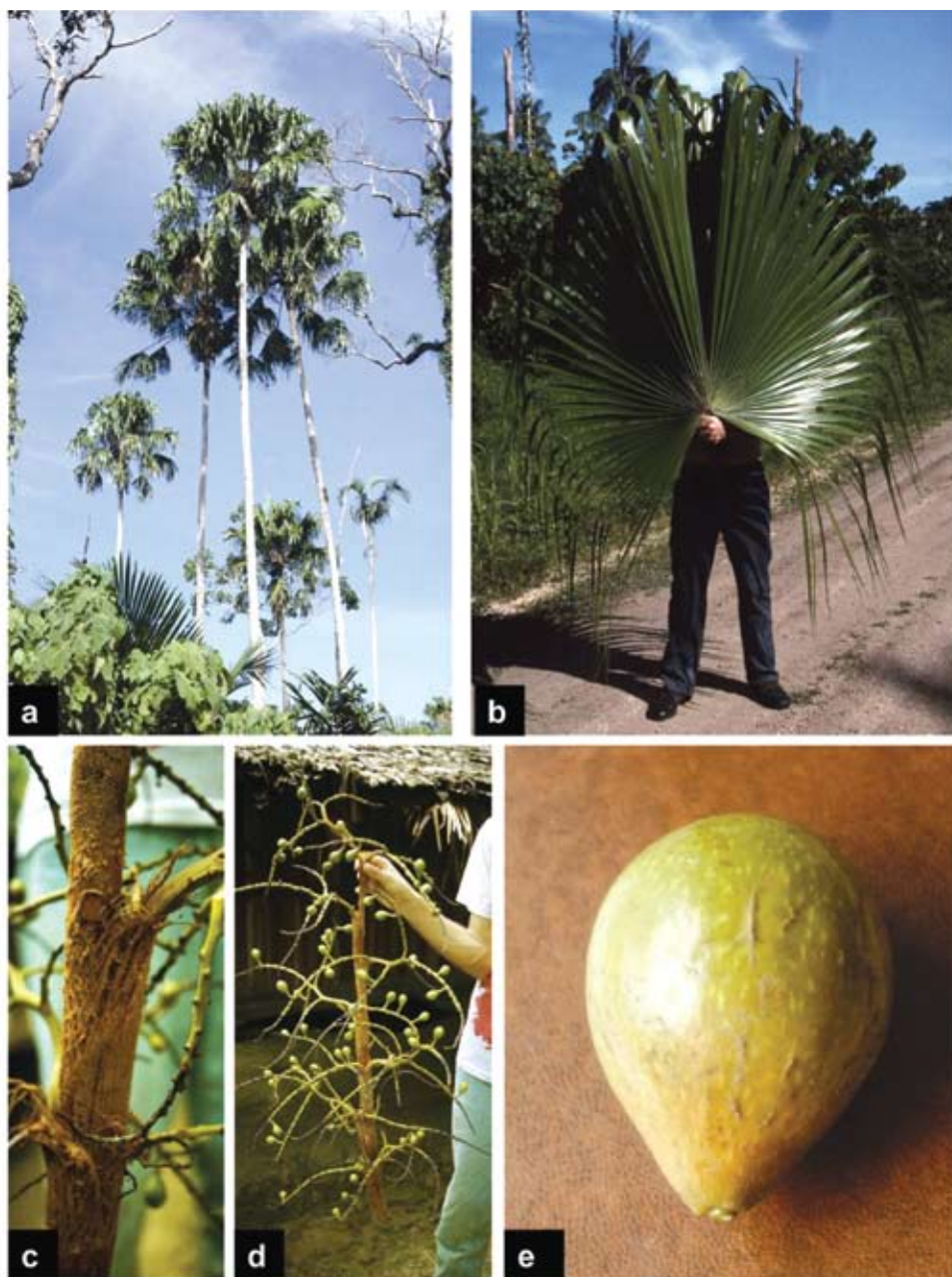


**Plate 6.** *Livistona chocolatina*: a. In habitat, rainforest [photo by J.L.Dowe, taken at 300 m alt., Kuriva, Central Province, Papua New Guinea; voucher specimen, *Barfod et al.* 466 (holotype)]; b. Leaf and inflorescence [photo by A.Kjaer, taken at 400 m alt., Bulili Ridge, Lababia, Morobe Province, PNG; voucher specimen, *Barfod et al.* 514]; c. Inflorescence [photo by J.L.Dowe, from Kuriva, Central Province, PNG; voucher specimen, *Barfod et al.* 466]. *Livistona tothur*: d. Leaf, adaxial view; e. Leaf, abaxial view [photos by A.Damborg, taken at 500 m alt., Oenake Mts, West Sepik Province, PNG; voucher specimen, *Damborg et al.* 418 (holotype)].





**Plate 7.** *Livistona tothur*: a. Inflorescence with mature flowers; b. Flowers; c. Infructescence [photos by A.S.Barfod, taken at 500 m alt., Niau Kono, Oenake Mts, West Sepik Province, PNG; voucher specimen, *Barfod et al. 510*]; d. Fruit [photo by J.L.Dowe, taken at 500 m alt., Niau Kono, Ampol, Oenake Mts, West Sepik Province, PNG; voucher specimen, *Dowe et al. 516*].

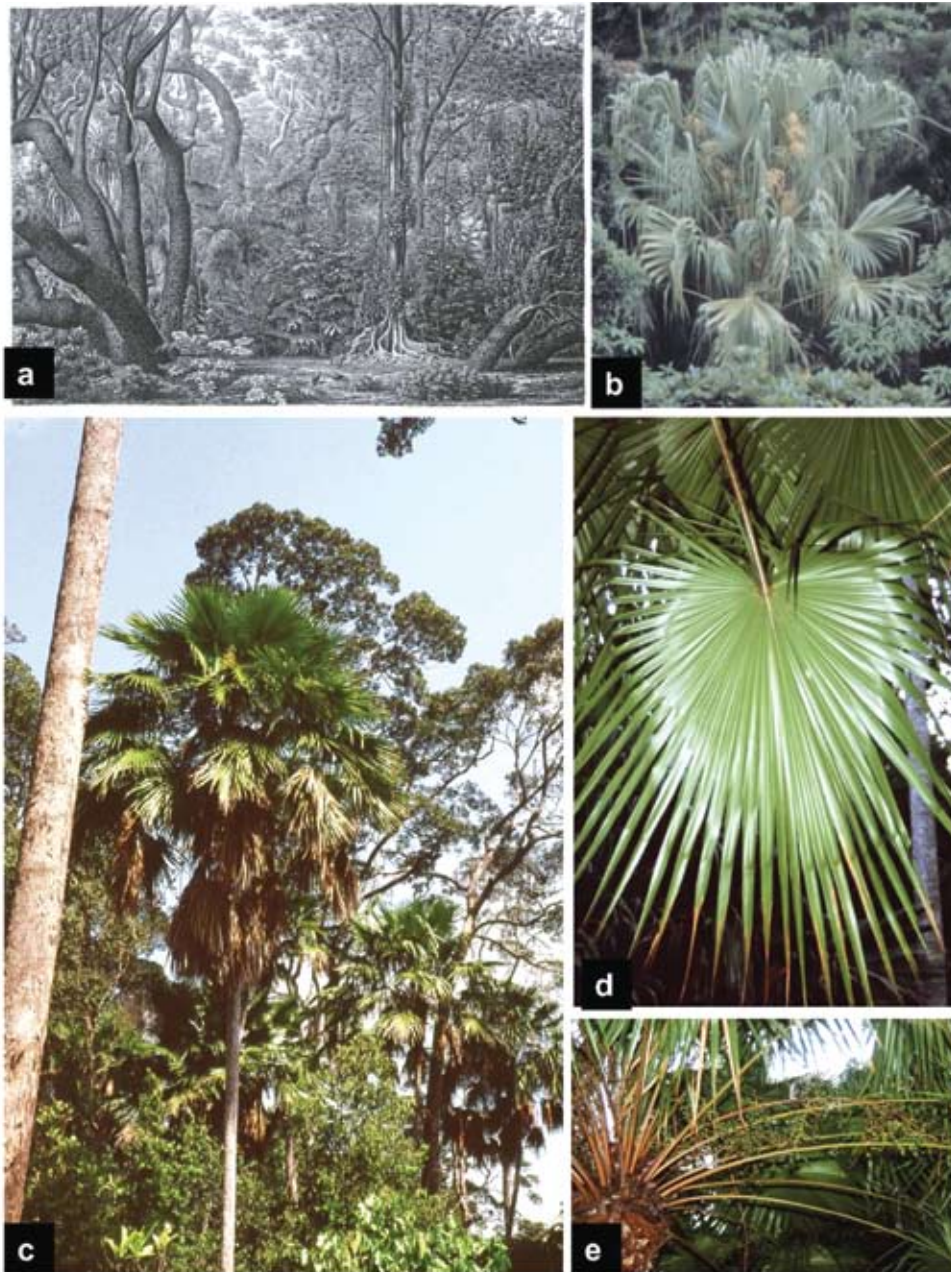


**Plate 8.** *Livistona surru*: a. In habitat, rainforest; b. Leaf; c. Inflorescence with rachis bract detail and immature fruit [photos by W.J.Baker, taken from Bosmun, Ramu River, Madang Province, PNG; voucher specimen, *Baker et al.* 582]; d. Infructescence with immature fruit; e. Fruit [photos by A.S.Barfod, taken at 950 m alt., Miwaute, West Sepik Province; voucher specimen, *Barfod et al.* 390 (holotype)].



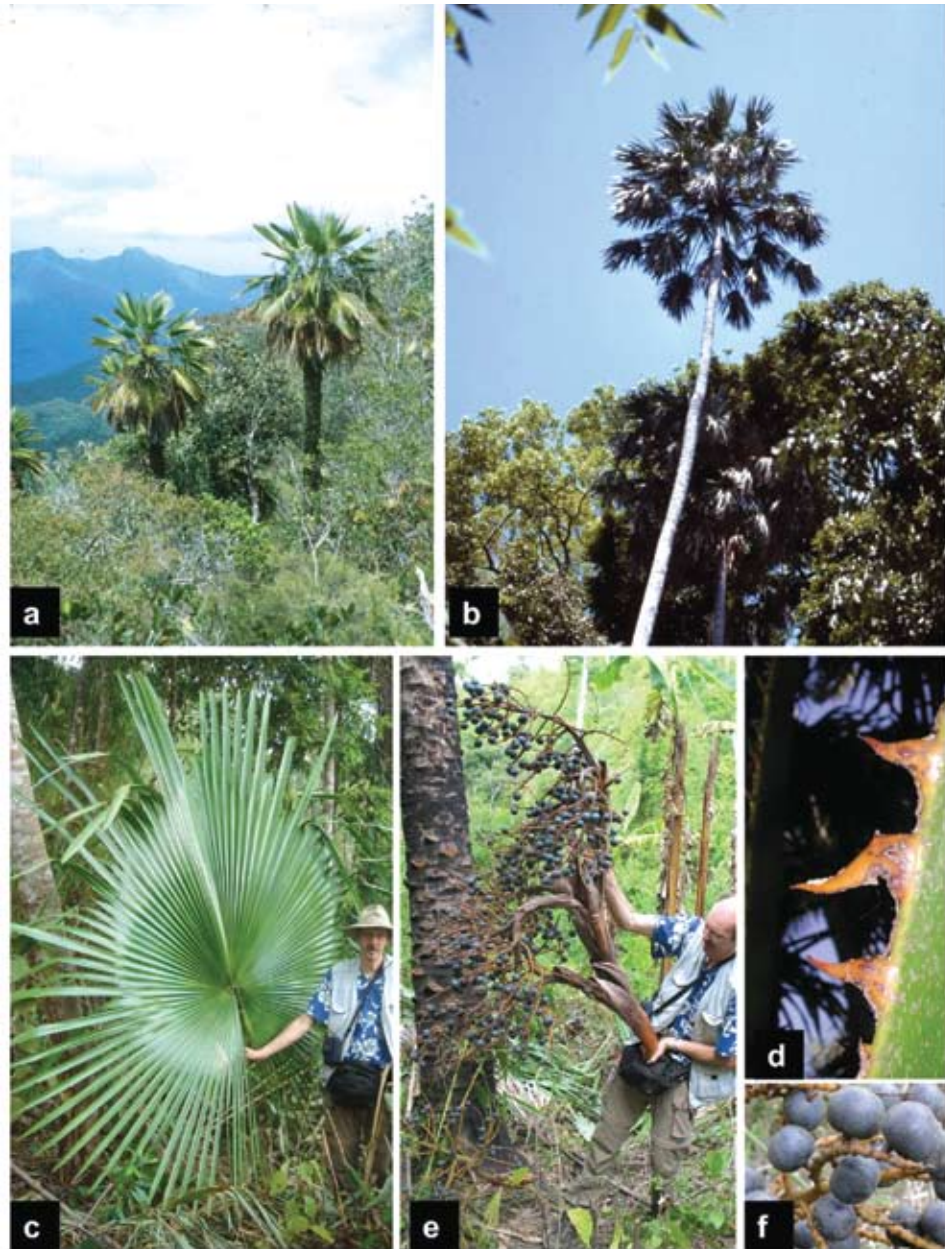


**Plate 9.** *Livistona halongensis*: a. In habitat, forest on limestone; b. Leaf [photos by G. Dahme, from Cat Ba Island, Halong Bay, Vietnam]. *Livistona chinensis*: c. Habit, cultivated plants, Townsville Botanic Gardens, Queensland, Australia; d. Leaf detail, cultivated plants, Cairns Botanic Gardens, Queensland, Australia [photos by J.L.Dowe]; e. Flowers, cultivated plant, Peninsula Botanical Garden, Khao Chong, Trang, Thailand [photo by A.S.Barfod]; f. Infructescence with mature fruit, cultivated plants, Townsville Botanic Gardens, Queensland, Australia [photo by J.L.Dowe].

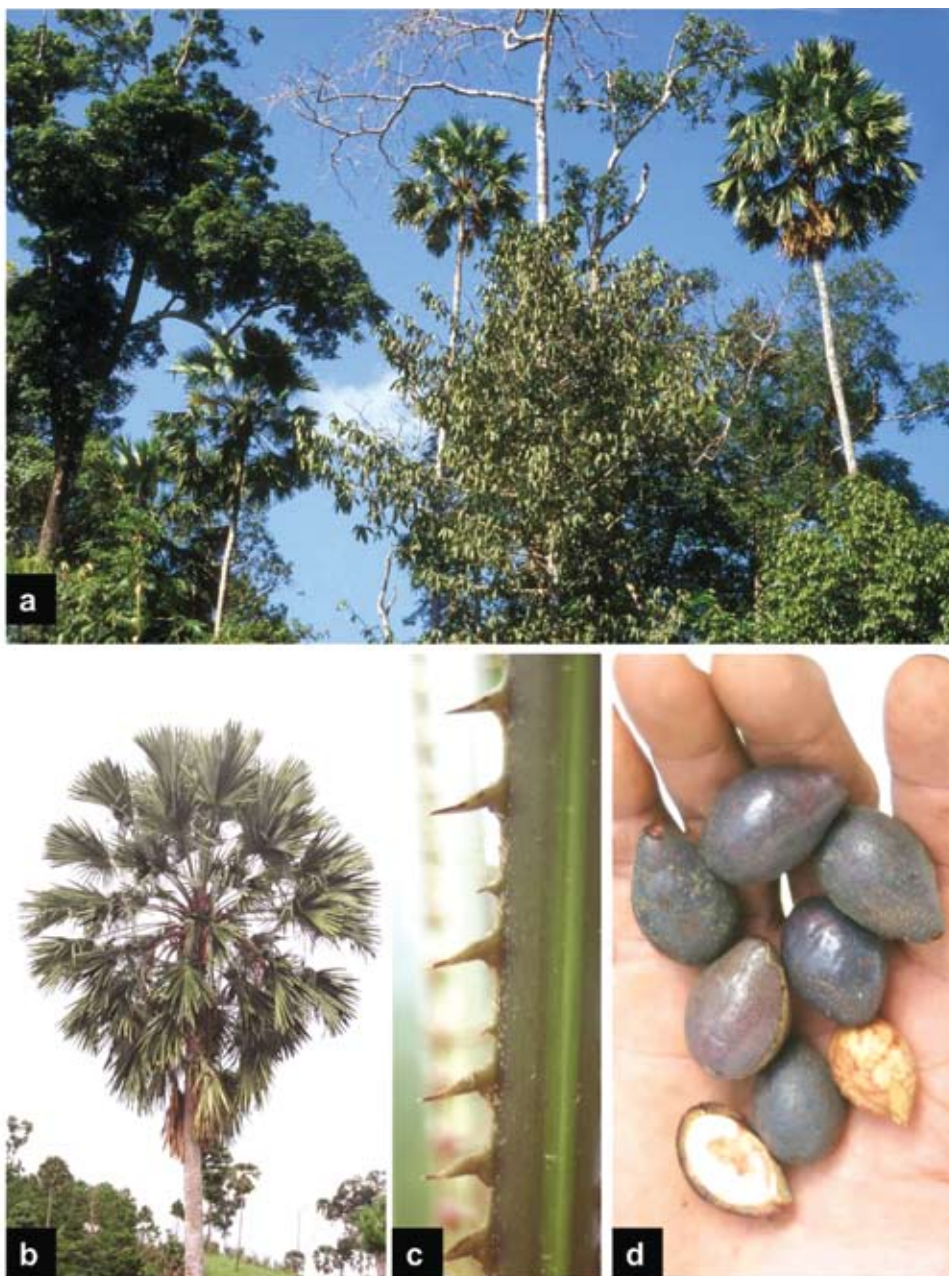


**Plate 10.** *Livistona boninensis*: a. Illustrated in habitat [as *Corypha japonica*] in Kittlitz, F.H. (1844), *Veg.-Ansicht*. t.15; b. In habitat, remnant forest, Chichi-jima, Bonin Islands, Japan [photo by H.Kato]. *Livistona endauensis*: c. In habitat, rainforest at Bukit Bauk, Trengganu, Malaysia; d. Leaf detail, cultivated plant, Singapore Botanic Gardens; e. Inflorescence with mature fruit, cultivated plant, Singapore Botanic Gardens [photos by J.L.Dowe].





**Plate 11.** *Livistona tahanensis*: a. In habitat, submontane forest, near Wrays Camp, Gunung Tahan, Pahang, Malaysia (voucher specimen, *Dransfield 659*) [photo by J.Dransfield]. *Livistona jenkinsiana*: b. In habitat, rainforest, Khao Chong, Thailand [photo by J. Dransfield]; c. Leaf detail [photo by K.Anker]; d. Armature, from cultivated plant at Cairns Botanic Gardens, Queensland, Australia [photo by J.L.Dowe]; e. Infructescence with mature fruit; f. Mature fruit [photos 11c, 11e, and 11f by K.Anker are based on specimen (*Barfod et al. 710*) at Doi Phu Ka National Park, Thailand].



**Plate 12.** *Livistona speciosa*: a. In habitat, rainforest [photo A.S. Barfod, from 900 m alt., Doi Chiang Dao, Thailand]; b. Crown; c. Armature, cultivated plant, Thailand; d. Mature fruit [photos 12b, 12c and 12d by J.L.Dowe, based on *Dowe 560* at Khao Ko, 600-700 m alt., Thailand].





**Plate 13.** *Livistona carinensis*: a. In habitat, wadi in semi-desert, Tôha, Djibouti [photo by G. & H. Welch]; b. Armature, cultivated plant, Nong Nooch, Thailand, [photo by J.L.Dowe]; c. Crown with mature inflorescences, cultivated plant, Florida, USA [photo by H.Ford]; d. Diagnostic illustration: a. flowers on rachilla; b. flower from above; c. flower side view; d. flower, longitudinal section; e. sepal; f. fruit; g. seed, longitudinal section. Scale bar: a = 2.5 mm; b, c, d, e = 1 mm; f, g = 4 mm. Figs. a-e based on Dowe *s.n.* collected from Townsville Palmetum, Queensland, Australia, dated 18 Mar 2000; Figs. f and g based on cultivated plant at Miami, Florida, USA [line illustrations by L.T.Smith].

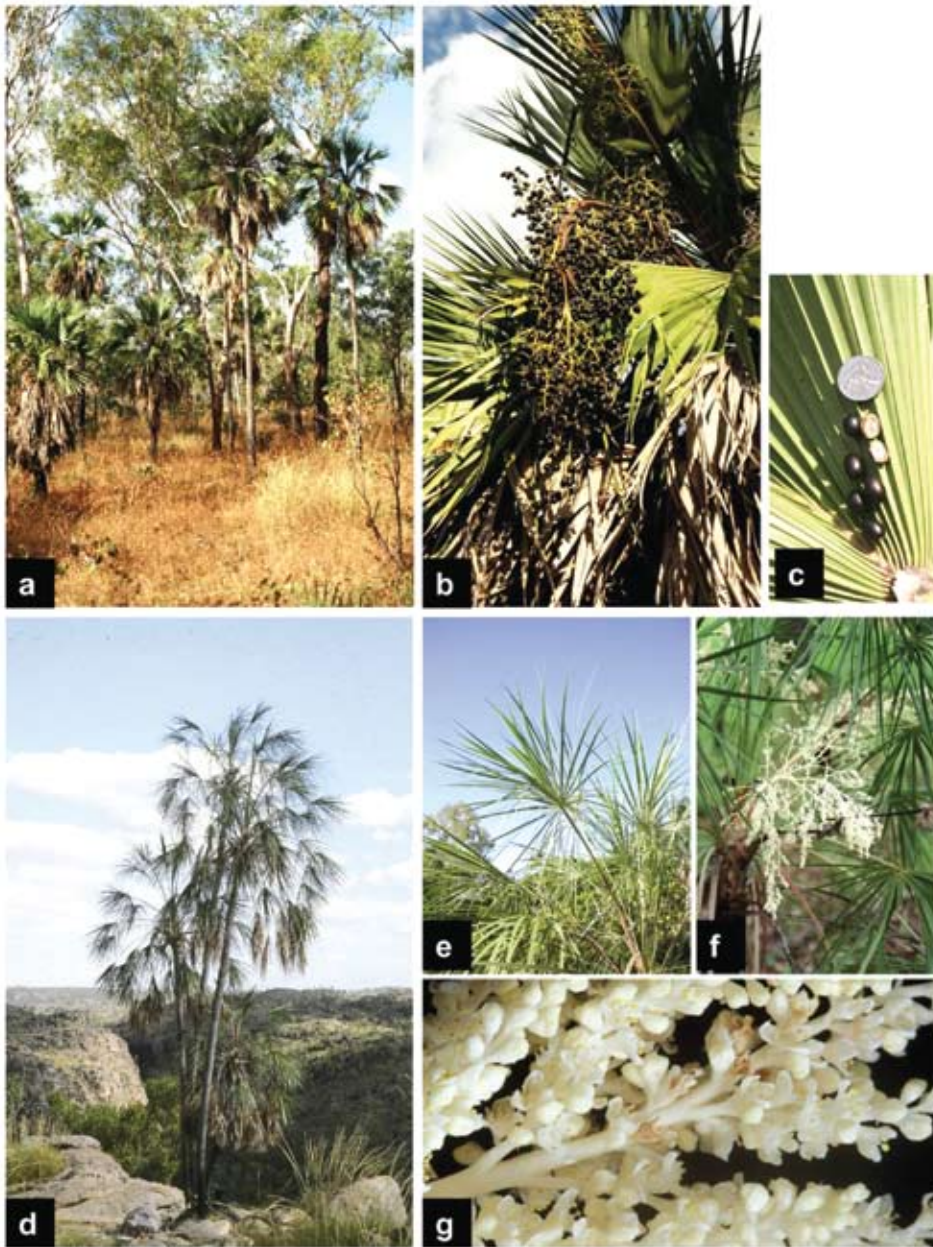


**Plate 14.** *Livistona humilis*: a. In habitat, open tropical woodland; b. Male plant with mature inflorescence; c. Female plant with infructescence and mature fruit; d. Fruit, [photos by J.L. Dowe; voucher specimen (*Dowe 203*) from Kakadu National Park, Northern Territory, Australia].



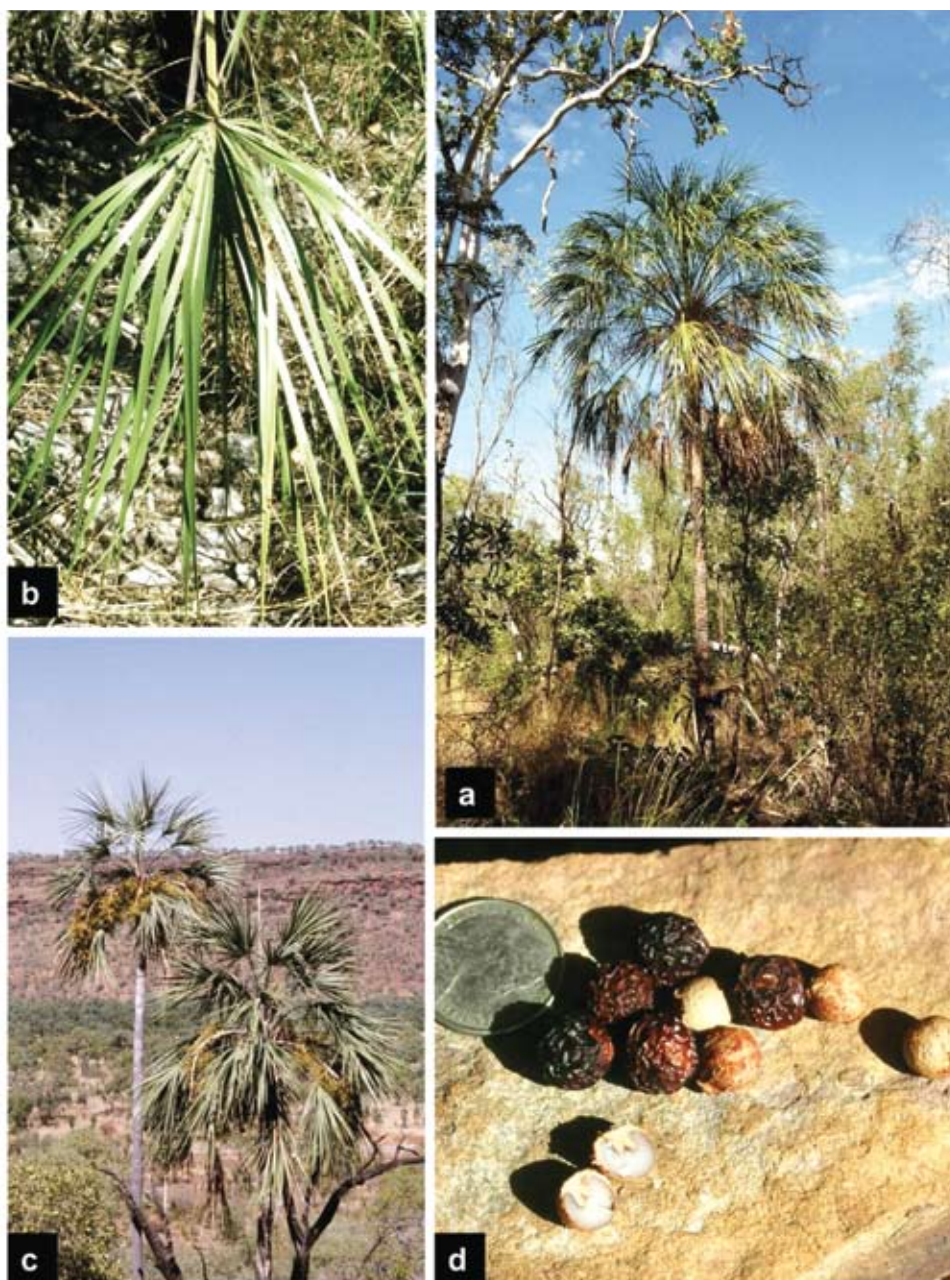


**Plate 15.** *Livistona muelleri*: a. In habitat, from coastal moist forest at Smithfield, Cairns, Queensland, Australia; b. Leaf detail; c. Crown with inflorescence and mature flower; d. Flowers; e. Inflorescence with full size but slightly immature fruit; f. Mature fruit, and seed in longitudinal section to reveal seed coat intrusion and embryo [photos by J.L. Dowe, 15b-15e from Barrett Creek, Cooktown, Queensland, Australia; 15f from Lockerbie Scrub, Cape York Peninsula, Queensland, Australia].

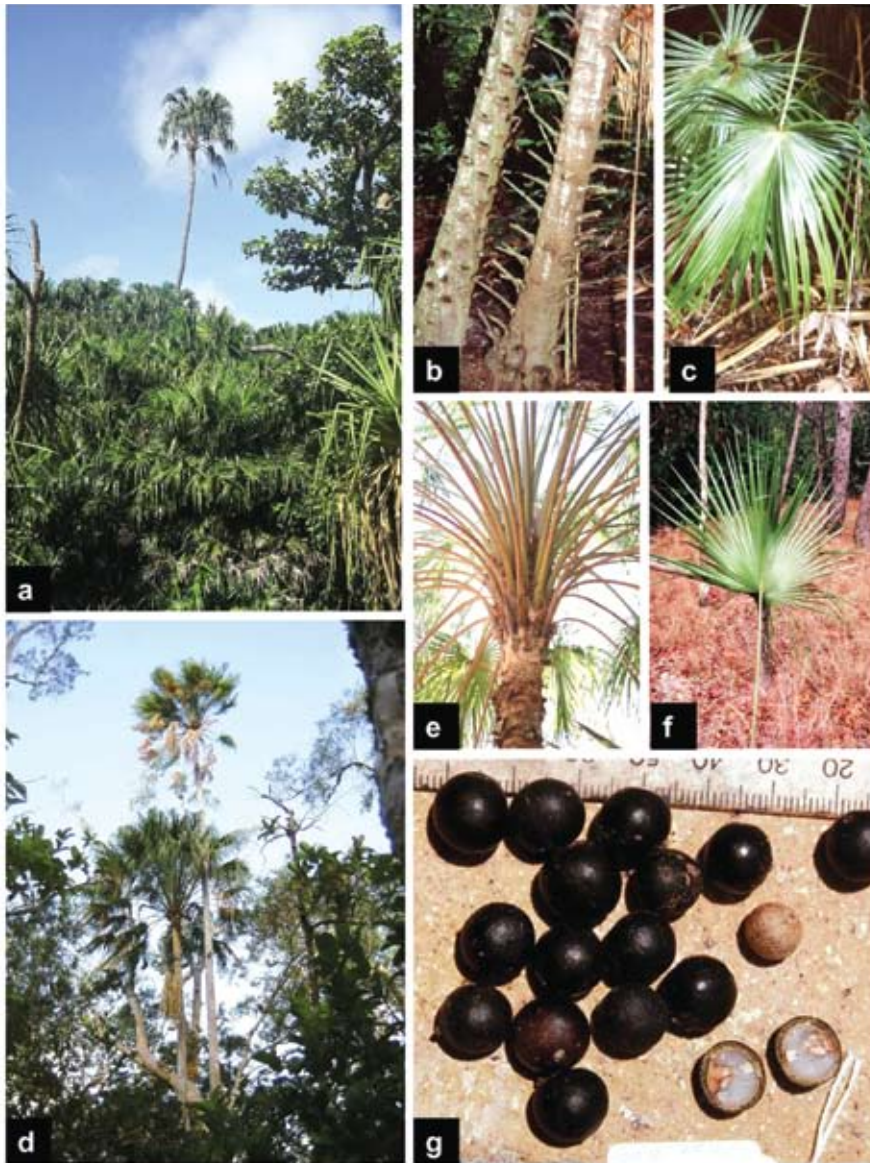


**Plate 16.** *Livistona eastonii*: a. In habitat, open tropical woodland; b. Inflorescence with mature fruit; c. Fruit [photos by J.L.Dowe; voucher specimen, *Dowe 360*, from Kimberley Plateau, Western Australia]. *Livistona inermis*: d. In habitat, open woodland at Nitmiluk, Katherine Gorge, Northern Territory, Australia [photo by D. Gorton]; e. Leaf detail, cultivated plant, Townsville Botanic Gardens, Queensland, Australia; f. Inflorescence with mature flowers; g. Flowers [photos by J.L.Dowe, 16f and 16g from Mt Bundy, Northern Territory, Australia; voucher specimen, *Dowe 200*].





**Plate 17.** *Livistona lorophylla*: a. In habitat, open woodland; b. Leaf detail [photos by J.L.Dowe; voucher specimen, *Dowe 362*, from Pentecost River, Western Australia]. *Livistona victoriae*: c. In habitat, monsoonal open woodland, Victoria River, Northern Territory, Australia [photo by D.Gorton]; d. Fruit and seed in longitudinal section to reveal seed coat intrusion and embryo [photo J.L.Dowe; voucher specimen, *Dowe 208*, from Charles Crossing, Jasper Gorge, Northern Territory, Australia].



**Plate 18.** *Livistona benthamii*: a. In habitat, seasonally inundated riparian forest, Home Billabong, Cooinda, Northern Territory, Australia (voucher specimen, Dowe 206); b. Trunk detail; c. Leaf detail [photos by J.L.Dowe; voucher specimen, Dowe *et al.* 406, 18b and 18c from Lockerbie Scrub, Cape York Peninsula, Queensland, Australia]. *Livistona concinna*: d. In habitat, upper mangrove forest at 5 m alt.; e. Crown detail with petiole bases and leaf-base fibres (voucher specimen, Dowe *et al.* 606, from Kennedy River, Twelve Mile Waterhole, Lakefield National Park, Queensland, Australia); f. Leaf; g. Fruit, and seed in longitudinal section to reveal seed coat intrusion and embryo [photos by J.L.Dowe; 18d, 18f, 18g based on Dowe 607 (holotype) from Barrett Creek, Cooktown, Queensland, Australia].



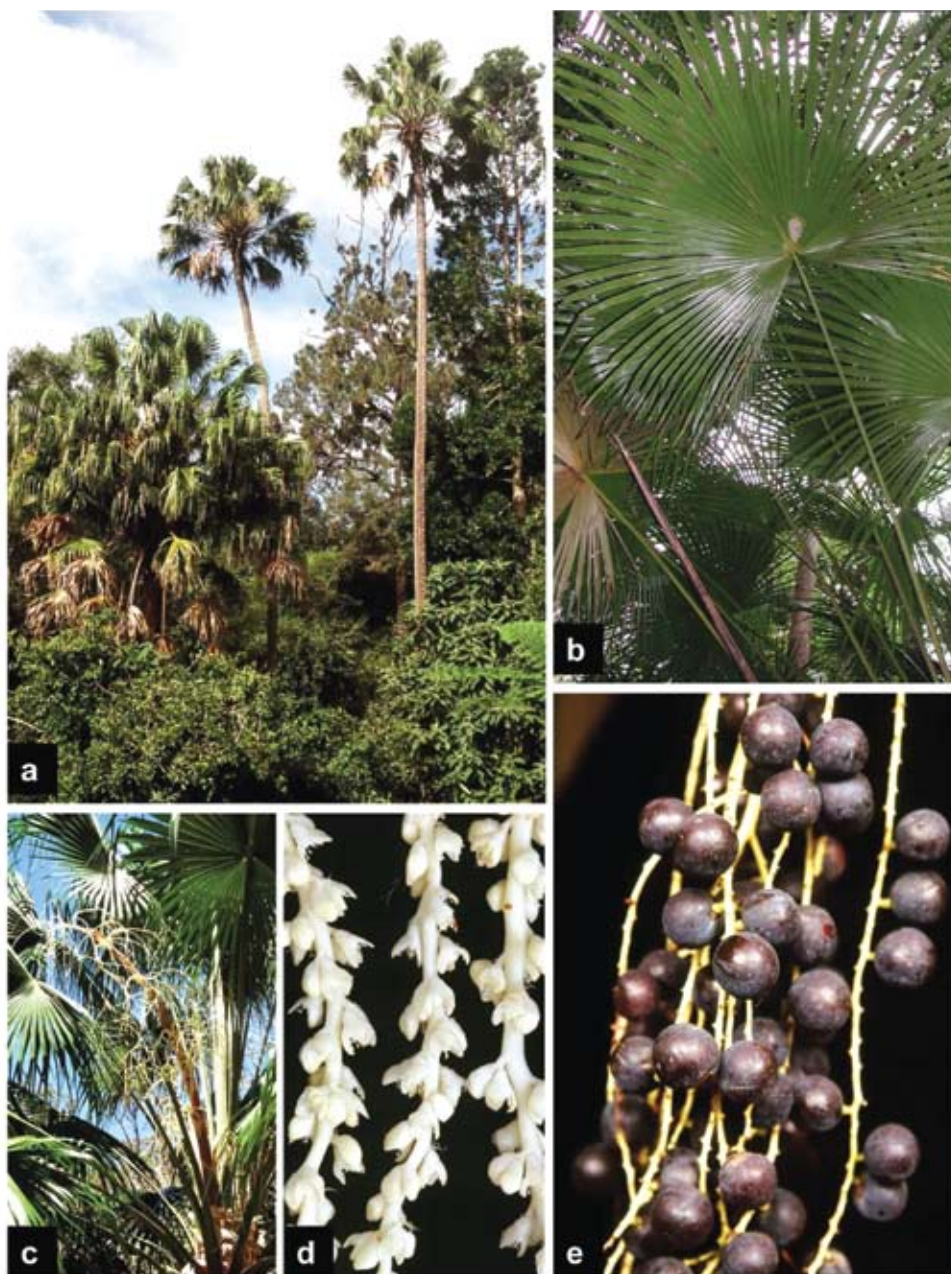


**Plate 19.** *Livistona drudei*: a. In habitat, coastal semi-open forest, Clemant State Forest, Queensland, Australia; b. Crown, Balgal Beach, Queensland, Australia; c. Petiole bases and leaf-base fibres; d. Fruit and endocarps [photos J.L.Dowe; 19c & 19d from plant at Hen Camp Creek, Queensland, Australia].



**Plate 20.** *Livistona decora*: a. In habitat, riparian forest at Black Gully, Haughton River, Queensland, Australia; b. Leaf detail; c. Flowers, Cape Cleveland, Queensland, Australia; d. Fruit [photos by J.L.Dowe; 20b & 20d from plant at Cocoa Creek, Cape Cleveland, Queensland, Australia].





**Plate 21.** *Livistona australis*: a. In habitat, rainforest at Eungella Range, Mt McCartney, Queensland, Australia; b. Leaf detail (voucher specimen, *Dowe 520*, at Bluewater Range, Queensland, Australia); c. Inflorescence with mature flowers; d. Flowers; e. Fruit (voucher specimen, *Dowe 171*, from Seaview Range, Queensland, Australia [photos by J.L.Dowe; 21c & 21d from plant (*Dowe 313*) at 800 m alt., Clarke Range, Cathu State Forest, Queensland, Australia].





**Plate 22.** *Livistona nitida*: a. In habitat, riparian forest; b. Leaf; c. Crown with inflorescence and mature flowers [photos by J.L.Dowe, from Robinson Creek, Queensland, Australia]. *Livistona fulva*: d. In habitat, semi-open woodland at base of sandstone escarpment; e. Leaf abaxial view [photos by J.L.Dowe; voucher specimen, *Dowe 300*, from Blackdown Tableland, Queensland, Australia].



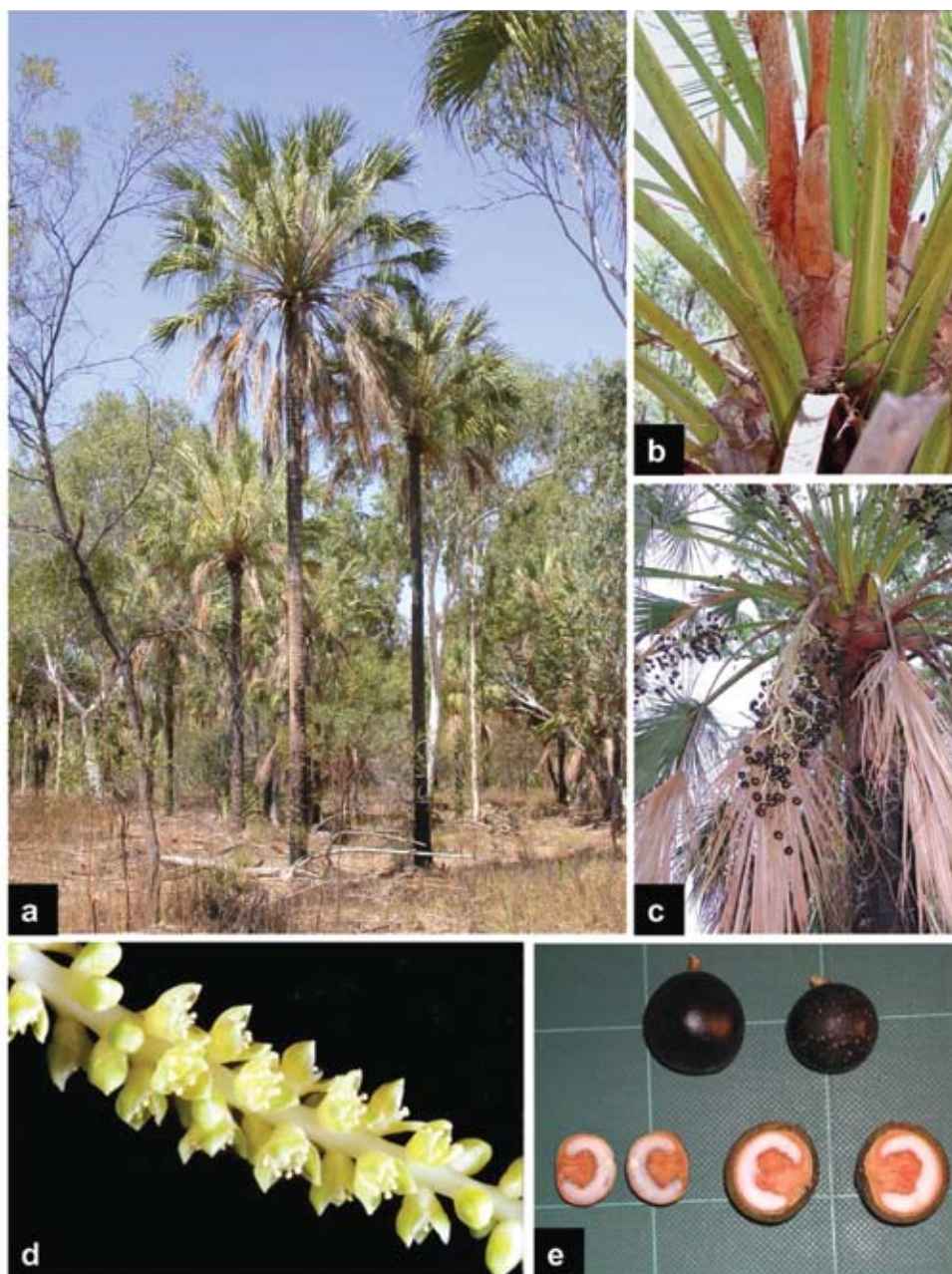


**Plate 23.** *Livistona alfredii*: a. In habitat, riparian forest with scribbly gums; b. Juvenile with petiole bases and leaf-base fibres [photos by J.L.Dowe; voucher specimen, *Dowe* 354, from Millstream-Chichester National Park, Crossing Pool, Fortescue River, Western Australia]. *Livistona nasmophila*: c. In habitat, permanent spring; d. Crown with mature inflorescence; e. Leaf detail [photos by J.L.Dowe; voucher specimen, *Dowe* 363, from Zebedee Springs, Western Australia].



**Plate 24.** *Livistona mariae*: a. In habitat, open woodland in semi-arid zone at Finke Gorge National Park, Palm Creek, Northern Territory, Australia [photo by J.L.Dowe]. *Livistona rigida*: b. In habitat, riparian semi-closed forest at Lawn Hill Gorge, Queensland, Australia; c. Crown detail with petiole bases and leaf-base fibres (voucher specimen, *Dowe et al.* 630, from Adels Grove, Lawn Hill Creek, Queensland, Australia); d. Fruit, and seed in longitudinal section to reveal seed coat intrusion, (voucher specimen, *Dowe* 210, from Roper River, Mataranka, Northern Territory, Australia); e. Seedling, with distinctive red colouration (voucher specimen, *Dowe* 209, from Salt Creek, Roper River, Northern Territory, Australia) [photos by J.L.Dowe].





**Plate 25.** *Livistona lanuginosa*. a. In habitat, semi-open riparian forest at Deep Creek; b. Crown with petiole bases, leaf-base fibres and peduncular bracts; c. Flowers; d. Inflorescence with mature fruit; e. Fruit, with longitudinal sections of entire fruit, and seed to reveal seed coat intrusion and embryo (voucher specimen, *Dowe 292*, from Glenroy Creek, Queensland, Australia) [photos by J.L.Dowe, 25a-25d from Campaspe River, Queensland, Australia].