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# PALM RESOURCES OF KERALA AND THEIR UTILISATION

C. Renuka
K.V. Bhat
S. Chand Basha

KERALA FOREST RESEARCH INSTITUTE
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# ABSTRACT

Palms are an important group among monocots which are of immense service to mankind. They form a vital component of forest and agricultural ecosystems, providing a wide range of economic products necessary for daily life. Besides the common cultivated palms like coconut, arecanut and oil palm; and over a dozen introduced ornamental palms and rattans (canes); there are seven species of wild and semi-wild palms presently found in Kerala State. Of these seven species, a few, namely, *Borassus flabellifer Corypha umbraculifera* and *Caryota urens* are widely exploited in the State. They are sometimes cultivated in farmlands and homesteads. Whereas the remaining, namely, *Arenga wightii, Bentinckia condapanna, Phoenix humilis* and *Pinanga dicksonii* which are confined to certain remote forest localities are little - known for their utility. This report highlights the botanical, ecological and utilisation aspects of the above-said seven species of palms, mainly based on field studies and literature survey, and discusses appropriate conservation measures to be adopted to augment the palm resources of the State.

# INTRODUCTION

The family Palmae (Arecaceae) is one of the most useful groups of flowering plants confined to the tropics. Among the plant families, Palmae ranks third in utility to humankind, next to the grasses and legumes. Palmae consists of about 200 genera and 2600 species. Wherever they occur, native palms represent valuable forest resources and are used by local population

Palms can be regarded as a gift of nature as they contribute a wide range of indispensable products for human diet and subsistence. A sizable proportion of population in tropics depend on palms, palm products and related industries for livelihood. Besides food and edible products, palms provide raw material for cottage industries, handicrafts and other utility items. Food and allied products from palms are acclaimed for their nutritional value and have gained much popularity. The palm fibre is exceptionally, strong and finds diverse applications. Similarly the strong timber serves as a constructional material in rural areas and as a fuel for brick kilns Palm leaves serve as cheaper thatching material in rural areas

Despite this indisputable utility, with the exception of coconut, arecanut, date and oil palm, somewhat less attention has been given to the improvement of palms as compared to other tree crops. Palm resource as sources of income, employment and export potential form a vital component of the economy of Kerala as in a few other states. Therefore, proper management and sustainable use of these resources has great significance in the long term perspectives of the State's economic development. Improved management of natural palm population has the potential to ensure sustainable supplies of their products (Davis and Johnson, 1987).

The botanical study on palms of India began with Henrick Van Rheede's (1678) Hortus Malabaricus. He described 9 palms under their local names, with figures. Later on they were included in Species Plantarum (1753). Martius in his Historia Naturalis Palmarum (1832-1853) included 15 Indian species. Griffith's 'Palms of British East India' (1880) describes indigenous as well as several introduced and cultivated palms.

In India 21 genera and about 100 species of palms occur in three major geographical regions namely Peninsular lndia, Eastern and North Eastern India and Andaman and Nicobar islands. A small number of palm species also occur elsewhere in India, especially in the Gangetic plains and in the lower hill valleys of North India.

Peninsular India is represented with 11 genera and about 32 species. Most of the genera are represented by one species with the exception of *Calamus*, the only rattan genus in South India, with a representation of 19 reported species.

Palm resources and their conservation is relatively a new area of investigation. Moore in 1977 directed plant taxonomists' attention to the World's most threatened palm species. In 1984 the Palm Specialist Group was constituted as a part of the IUCN Species Survival Commission. This group provided the framework for specific activities (Johnson, 1991).

Due to destruction of habitats resulting from forest clearance, over-exploitation of commercially important palms and lack of serious efforts for conservation, the palm resources of the country are generally on a decline. Nayar and Sastry (1990) record 13 species of palms in India as endangered. Kerala is no exception to this trend. Some potentially useful species of wild and semi-wild palms found in this region such as *Pinanga dicksonii and Bentinckia condapanna* are gradually diminishing in number.

Further, protection of wild palm genetic resources has practical application in genetic improvement of both wild as well as cultivated palm varieties. It is worthwhile to note that a number of semi-wild palms have high potential for domestication and there is ample scope to improve upon the product range and commercial exploitation.

## Present study

Recognising the importance of the palm flora and its conservation, Kerala Forest Research Institute (KFRI) initiated a project in this field with the financial aid from the State Committee on Science. Technology and Environment (STEC), Kerala, in 1992. The main objectives of the project were (1) to gather detailed information on the biology, distribution and utilisation status of palm species of Kerala and (2) to identify appropriate course of action for conservation and maintenance of maximum biodiversity of palm species and their sustainable use

The results of our field surveys make it possible to suggest ways in which the palms can be more efficiently managed and utilised to benefit local population and to ensure that this renewable resource is available to future generations.

## MATERIALS AND METHODS

Frequent visits were made to the forest areas of Western Ghats and other palm growing habitats. Representative herbarium specimens were prepared according to the method suggested by Dransfield (1979). Characters such as growth habit, nature of flowering, regeneration aspects, ecological conditions, etc. were studied by making field observations. Detailed enquiries were made with the local people during field trips regarding products and processing methods of these palms. Additional data on utilisation were also gathered from the available literature.

A taxonomic key is given for the identification of these palms. Photographs are given wherever necessary which will help in the easy identification of the species.

# PALM RESOURCES OF KERALA

Kerala is very rich in its palm wealth with 10 genera *(Areca, Arenga, Bentinckia, Borassus, Calamus, Caryota, Cocos, Corypha, Phoenix* and *Pinanga)* and 21 species (Table 1). Of these *Cocos nucifera* (coconut) and *Areca catechu* (arecanut) are widely cultivated. *Elaeis guineensis* (oil palm) is also cultivated currently on a large scale. In addition to these, another 13 different genera are cultivated as ornamental palms

*Areca catechu* and *Cocos nucifera* are the most important palms from the viewpoint of the State's economy. A large amount of research work has been carried out in these two species. The sole rattan genus in Kerala, *Calamus,* ranks next in the order and is widely used in furniture industry. Recently, detailed information has been generated on this genus through studies conducted at KFRI (Bhat, 1992; Renuka *et al.,* 1987; Renuka, 1992). Hence, the above genera, namely *Areca, Cocos* and *Calamus* are not covered in this report. Even though the remaining 7 genera, *Arenga, Bentinckia, Borassus, Caryota, Corypha, Phoenix* and *Pinanga* are not widely used, they are utilised in various ways by the local community. Taxonomy, distribution, ecology, utilisation and conservation aspects of these 7 palm genera are discussed here.

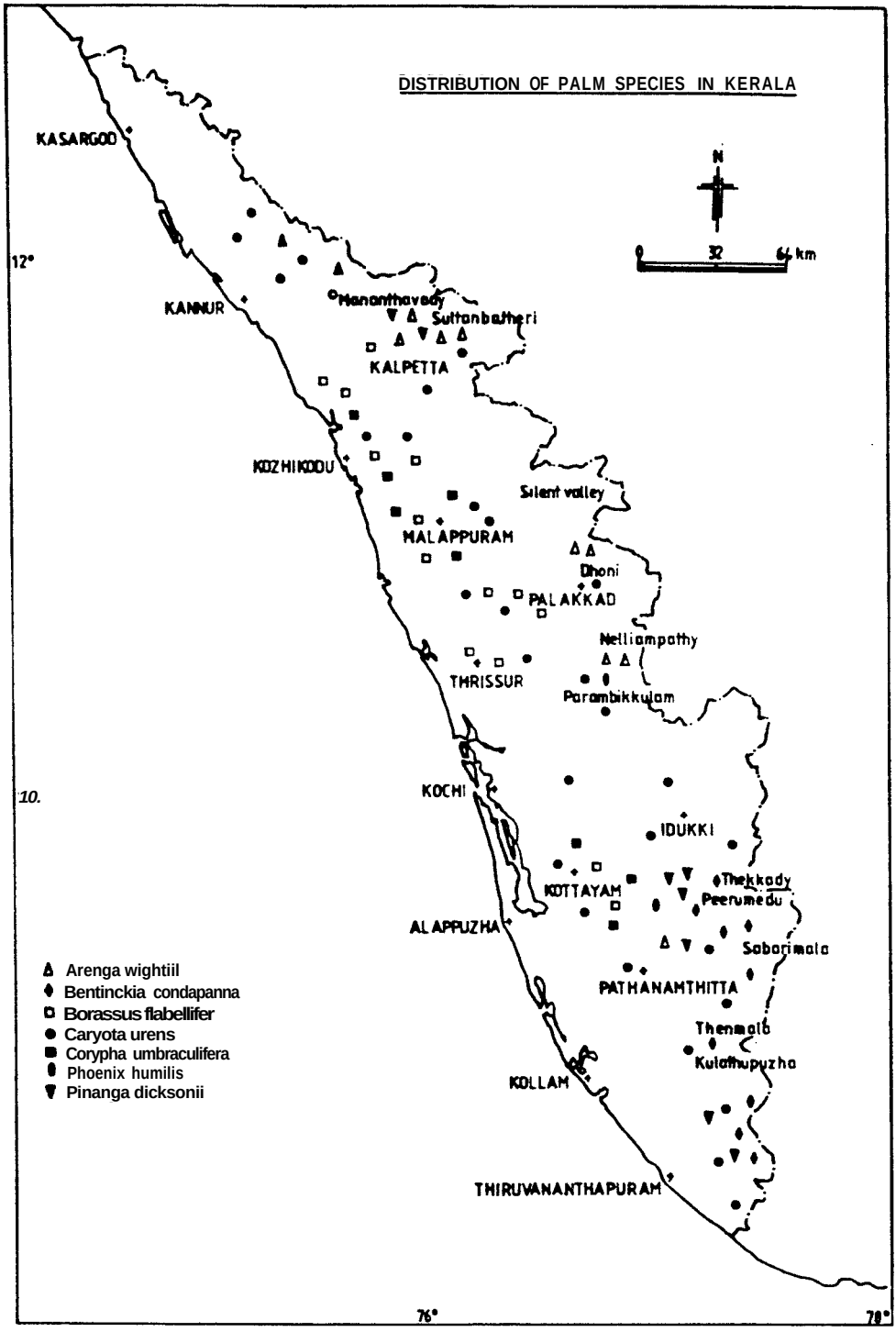
**Table 1. Palm resources of Kerala**

| No. | Name | Status |
|---|---|---|
| 1. | *Areca catechu* Linn. | Cultivated |
| 2. | *Arenga wightii* Griff. | Wild |
| 3. | *Bentinckia condapanna* Berry | Wild |
| 4. | *Borassus flabellifer* Linn. | Semi-wild as welll as cultivated |
| 5. | *Calamus brandisii* Becc. | Wild |
| 6. | *C. delessertianus* Becc. | Wild |
| 7. | *C. dransfieldii* Renuka | Wild |
| 8. | *C. gamblei* Becc. ex Becc. *et* Hook.f. | Wild |
| 9. | *C. hookerianus* Becc. | Wild |
| 10. | *C. metzianus* Schlecht | Wild |
| 11. | *C. pseudotenuis* Becc. *ex* Becc. *et* Hook.f. | Wild |
| 12. | *C. rheedii* Griff. | Wild |
| 13. | *C. rotang* Linn. | Wild |
| 14. | *C. thwaitesii* Becc. *et* Hook.f. | Wild |
| 15. | *C. travancoricus* Bedd. *ex* Becc. *et* Hook.f. | Wild |
| 16. | *C. vattayila* Renuka | Wild |
| 17. | *Caryota urens* Linn. | Wild as well as cultivated |
| 18. | *Cocos nucifera* Linn. | Cultivated |
| 19. | *Corypha umbraculifera* Linn | Semi-wild as well as cultivated |
| 20, | *Phoenix humilis* Royle var. *pedunculata* Becc. | Wild |
| 21. | *Pinanga dicksonii* Bl. | Wild |

**DISTRIBUTION**

In Kerala, palms occur naturally in wild or semi-wild conditions. *Arenga*, *Bentinckia* and *Pinanga* occur in evergreen forests. *Phoenix* is seen in grasslands at high elevation. *Borassus* and *Corypha* are semi-wild palms seen in open areas and are often cultivated. *Caryota* has a wider distribution and is seen in evergreen, semievergreen and moist deciduous forests. This species is also cultivated to some extent.

*Bentinckia* and *Pinanga* have a very restricted distribution when compared to other genera (Table 2). *Bentinckia* is usually seen on the hill tops along steep slopes in the evergreen forests in the southern region of Western Ghats (Map 1). In Konni and Ranni Forest Divisions this palm is seen as pure patches in many areas especially in Moozhiyar near Kakki dam. This occurs, sporadically in Peermedu and Thiruvananthapuram Forest Division and also in the border areas between the states of Kerala and Tamil Nadu (Manilal and Renuka, 1983).


DISTRIBUTION OF PALM SPECIES IN KERALA
N
0
32
64 km
KASARGOD
12°
KANNUR
Mananthavady
Sultanbathery
KALPETTA
KOZHIKODU
Silent valley
MALAPPURAM
Dhoni
PALAKKAD
Nelliampathy
THRISSUR
Parambikkulam
10.
KOCHI
IDUKKI
Thekkady
KOTTAYAM
Peerumedu
ALAPPUZHA
Sabarimala
PATHANAMTHITTA
Thenmala
Kulathupuzha
KOLLAM
THIRUVANANTHAPURAM
Arenga wightiil
Bentinckia condapanna
Borassus flabellifer
Caryota urens
Corypha umbraculifera
Phoenix humilis
Pinanga dicksonii
76°
78°

*Pinanga* is seen in isolated patches in forests of Wynad, Nilambur, Silent Valley, Attappady, Kulathupuzha and Agasthyamala. In Pooyamkutty, however, this palm occurs as a small pure patch. *Arenga* occurs in evergreen forests especially in Nelliampathy, Attappady, Silent Valley, Wynad and Peermedu. In Muthikkulam this species occurs almost in pure patches. *Borassus flabellifer* is seen in the northern districts of Kerala like Palakkad, Malappuram and Kozhikode. *Corypha* occurs naturally in Kozhikode, Malappuram, Palakkad and Kottayam districts.

**Table 2. Palms of Kerala; their distribution and conservation status.**

| Name | Local name | Common name | Distribution | Conservation status | Cultivation status |
|---|---|---|---|---|---|
| *Arenga wightii* | Kattuthengu | - | Restricted to a few areas in W. Ghats such as Wynad. Neriamangalam. Nelliampathy. Dhoni. Peermedu. Attappady. Muthikkulam | Vulnerable | Nil |
| *Bentinckia condapanna* | Kattadakka Kattukamuku | – | Restricted to a fen areas in the southern parts of W Ghats, Agastiamala Kulathupuzha. Pacchakkanam. Peermedu. Moozhiy ar. Kakki | Highly vulnerable | Nil |
| *Borassus flabellifer* | Karimpana | Palmyra palm | Natural and cultivated populations in the plains of North Kerala | Vulnerable | Cultivated in homesteads in North Kerala |
| ***Caryota urens*** | Chundapana Aana pana Olattipana | Fish tail palm. Toddy palm Kittul palm | Seen in evergreen. semievergreen and moist deciduous forests | — | Cultivated in homesteads |
| ***Corypha umbraculifera*** | Kudapana | Talipot palm | Restricted to a few areas in Central and North Kerala | Vulnerable | Nil |
| ***Phoenix humilis*** var.***pedunculata*** | Chittinthal | - | Restricted ***to*** grasslands at higher elevation | Vulnerable | Nil |
| ***Pinanga dicksonii*** | Kattukamuku Kanakamuku | - | Evergreen forests at Wynad. Nilambur. Pooyamkutty, Silent Attappadi and southern parts of W. Ghats | Endangered | Nil |

## ECOLOGY

Palms have a wide range of ecological adaptations based on their morphological diversity and they occur as components of evergreen, semievergreen and moist deciduous forests. Palms such as *Borassus, Caryota* and *Corypha* are also found in plains, agricultural areas and homesteads.

### Growth forms

Except *Phoenix* and *Pinanga* all other palms are single stemmed. *Phoenix humilis* var. *pedunculata* is a cluster forming species and *Pinanga dicksonii* is stoloniferous. In the field *Pinanga* appears as a single stemmed palm, but the upright stems actually arise from an underground stolon.

*Borassus, Corypha, Caryota* and *Arenga* grow more than 10 m high. *Bentinckia* attains 6-10 m height. *Phoenix* is only 2-3 m high. When compared to other palms, *Phoenix* is very slow growing and it takes 50-60 years to attain 3 m height (Basu and Chakraverty, 1994)

Leaf bases adhere to stem in *Corypha, Arenga* and *Phoenix* during the younger stages providing protection to the growing stem.

*Piinanga dicksonii* is a very slender palm around 2 to 5 cm in diameter, but the stem is hard and sturdy.

### Habitat

*Arenga wightii* is generally found in evergreen forests at altitudes ranging from 300 to 1000m. It isusually seen in valleys where moisture and humus are~. Under fkvourable conditions it forms colonies.

*Bentinckia condapanna* is usually found in rocky areas on hill tops and along steep slopes in evergreen forests at 1000-2000m altitude. Not much regeneration is seen near the mother trees in most of the localities. Generally three or four trees are seen in one locality. But it also occurs as continuous patches in some hills in Ranni Forest Division in the Goodrical Reserve. Outside its natural habitat this palm does not thrive well.

*Borassus flabellifer* is one of the most widespread palms in India. It can occur at an elevation of 500-800 m (Uhl and Dransfield, 1987). It is most abundant on low sandy plains. In Kerala it occurs naturally in open areas and secondary forests. When compared to other palms this palm *can* withstand drier climates.

*Caryota urens* occurs between 50-1000m elevations. It is fiequently associated with human settlements

*Corypha umbraculifera* is found in open areas and secondary forests. This palm is also cultivated to some extent.

*Phoenix humilis* var *pedunculata* generally occurs in grasslands at high elevations (nearly 1000m) like Peermedu and Parambikulam (Karimalagopuram), Attappady, Silent Valley, Eravikulam, Chinnar, Agasthya Malai etc. So far this is not cultivated. This is a fire hardy species.

*Pinanga dicksonii* is a coloniser under favourable conditions. It is found in the evergreen forests as an understory palm between 350-1000m elevation. In most of the localities only two or three individuals are seen.

## Flowering

Among the species studied, *Corypha* is monocarpic. The palm produces a terminal inflorescence and dies after flowering and fruiting. The flowers are bisexual. All other palms are pleonanthic having axillary inflorescences. *Arenga, Pinanga* and *Caryota* are monoecious, male and female flowers being separate. In *Arenga* and *Caryota* the emergence of inflorescence is basipetal. ie., after a period of vegetative growth, the palm produces a terminal inflorescence followed by the development of axillary inflorescences in the descending order and the tree dies after the lowermost axillary inflorescence has developed.

## Seed viability and germination

Palm seeds do not remain viable for a long time and they need suitable environment for gemination. Seeds do not have a distinct dormancy period. They cannot withstand desiccation.

Germination in all the species studied is the remote tubular type except for *Pinanga* where it is adjacent ligular. In *Bentinckia* the type of germination is not known. Under experimental conditions, in the present study, the seeds did not germinate at all. Germination percentage varies from species to species. *Borassus* and *Caryota* are having 90% germination. In *Arenga* and *Corypha* only 50% germination is noted. *Phoenix* and *Pinanga* take longer time to commence germination but 80% of the seeds germinate.

**Secdlings**

The seedlings of palms are shade loving in the early stages. Altitude seems to play a major role in the distribution of palms. The high altitudinal palms like *Bentinckia* and *Phoenix* do not establish well in low altitudes. The seedlings are found in crevices and cracks of rocks harbouring a layer of soil. A mat of fibrous roots anchors the palm firmly to the substratum besides acting as a medium for the retention of soil with associated mosses and grasses. Entire slopes of hilly terrain often show pure formations of these palms.

In *Borassus* and *Corypha*, once germinated the seedlings are firmly anchored to the ground and it is difficult to take them out from the ground without damage. In natural conditions a number of seedlings are seen around *Corypha*, *Borassus* and *Caryota* palms after seeding. But in *Bentinckia, Arenga* and *Pinanga* the seedlings found in the vicinity of the mother tree are very few.

# SYSTEMATICS

## FAMILY PALMAE (ARECACEAE)

The family Palmae (Arecaceae) is divided into 6 subfamilies (Uhl and Dransfiled, 1987) viz Coryphoideae , Ca1amoideae, Nypoideae , CeroxyIoideae, Arecoideae and Phytelephantoideae. The subfamily Coryphoideae is further divided into three tribes, Corypheae, Phoeniceae and Borasseae. The subfamily Calamoideae is divided into two tribes, Calameae and Lepidocaryeae. The subfamily Ceroxyloideae is divided into three tribes, Cyclospatheae, Ceroxyleae and Hyophorbeae. The subfamily Arecoideae is divided into five tribes, Caryoteae, Iriarteae, Areceae, Cocoeae and Geonomeae. The subfamilies Nypoideae and Phytelephantoideae are monotypic.

Of these, only three subfamilies are represented in Kerala; Coryphoideae, Calamoideae and Arecoideae.

### Key to the subfamilies

1a. Leaves palmate or costapalmate, rarely entire, induplicate, rarely reduplicate or pinnate but induplicate and the leaflets with entire tips, flowers solitary or clustered, never in triads of a central pistillate and 2 lateral staminate ..... **Coryphoideae**

1b. Leaves pinnate, bipinnate, or entire and pinnately ribbed, or rarely palmate but then reduplicate and flowers syncarpus, reduplicate or rarely induplicate but then leaflets with praemorse tips, flowers solitary or clustered, frequently in triads ....2

2a. Ovary and fruit covered in imbricate scales, flowers hermaphroditic or unisexual but rarely dimorphic, arranged singly or in dyads or rarely in cincinni .....**Calamoideae**

2b. Ovary and fruit not covered in imbricate scales, flowers always unisexual, borne in triads or in pairs derived from triads, very rarely staminate flowers above the pistillate ..... **Arecoideae**

### Subfamily Coryphoideae

#### Key to the tribes

1a. Leaves palmate, costapalmate or entire, acanthophyll absent .....

1b. Leaves pinnate, acanthophyll present ..... **Phoeniceae**

2a. Hermaphroditic, rarely dioecious; if dioecious, not dimorphic, rachillae lacking deep pits, endocarp usually thin..... **Corypheae**

2b. Dioecious, flowers dimorphic, borne in deep pits, endocarp very thick and hard ..... **Borasseae**

In Kerala, each tribe is represented by a single genus and a single species. Corypheae is represented by *Corypha umbraculifera,* Borasseae by *Borassus flabellifer* and Phoeniceae by *Phoenix humilis* var. *pedunculata.*

**Corypha umbraculifera** L., Sp. Pl. 1187. 1753; Mart., Hist. Nat. Palm. 3: 232, t. 108, 127. 1823-1853; Griff., Calcutta J. Nat. Hist. 5: 319. 1845; Palms Brit. India 116. 1850; Becc. & Hook. f., in Hook. f, F l . Brit. India 6: 428. 1892; Fischer in Gamble, Fl. Madras. 561. 1931. Coddapana Rheede, Hort. Mal. 3: t. 1-12. 1693. (Figs. 1-2).

Local Name : Kudapana

Monocarpic, hepaxanthic, solitary, hermaphroditic palm. Stem 10-20m high, 50 cm diameter, with distinct leaf scars. Leaves very large, orbicular, 3-8 m diameter, cleft to the middle into 80-100 linear lanceolate 2 fid lobes, sheath with lateral lobes, later with conspicuous triangular cleft below the petiole, petioles about 3 m long, massive, covered with caducous indumentum, adaxially deeply channelled, abaxially rounded, margins with well defined teeth. Inflorescence terminal, about 6 m long, the first order branches subtended by leaves with reduced blades and tubular bracts, emerging through an abaxial split, branched to the 4th order, all branches ending as rachillae; rachillae bearing spirally arranged, adnate cincinni of upto 10 flowers; sepals fleshy, petals connate at the base, ovate, acute, imbricate; stamens 6, the 3 antisepalous free, the 3 antipetalous adnate basally to the petals, filaments subulate, anthers dorsifixed; ovary syncarpus, triovulate, ovule hemianatropus, style elongate, stigma scarcely differentiated. Fruits globose, 3 cm in diameter, usually only one carpel develops with two abortive ones at its base; seeds smooth, polished, very hard.

Occur in semi-wild condition in Malappuram, Kozhikodu, Palakkad and Kottayam Districts. Cultivated in other districts.

Distribution : Peninsular India, .Sri Lanka.

Specimens examined : Kottayam, 22.7.93. fl., Vijayakumaran 7048 (KFRI)

**Borassus flabellifer** L.. Sp PI 1187 1753, Mart . Hist Nat Palm 3: 221, t 108, 121, 102 1823-1853, Becc & Hook f in Hook f , FI Brit India 6: 482 1892, Fischer in Gamble, Fl Madras 1562 1931, Moore & Dransfield, Taxon 28: 60 I979 *Ampana* Rheede, Hort Mal 1 13-14, t 10 1678, *Carimpana* Rheede, Hort Mal 1 11-12, t 9 1678 (Fig 3)

Local name : Karimpana

Dioecious. solitary fan palm Stem 10-30m in height and to 60 cm in diameter, deep grey or black in colour with distinct annulate leaf scars, young trees with persistent leaf bases, older trees smooth and bear only narrow petiole scars, base of the stem swollen, sometimes with exposed superficial roots Leaves costapalmate, rigid, crown more or less roundish with evenly projectingleaves, leaf base splits at base, petiole about 1 m long, stout, semi-terete, the edges armed with hard, horny spines Inflorescence, simple branched, peduncle sheathed with open bracts, males with stout cylindric branches, densely clothed with closely imbricating bracts, enclosing spikelets offlowers, male flowers 6 mm long, mixed with scaly bracts, in two series in a small spikelet, sepals narrowly cuneate, tip inflexed, imbricate, petals shorter than the sepals, imbricate, stamens 6, anthers linear, female inflorescence sparinglybranched, bearing 4-10 solitary flowers. female flowers, globose, 2 cm in diameter, sepals reniform, imbricate, petals smaller, staminodes 6, ovary globose, subtrigonous, entire, 3-4 celled, ovules basilar, erect, stigmas 3, sessile, recurved Fruits subglobose, 15-20 cm in diameter, green when immature, dark purple when ripe, turning black, mesocarp fibrous, with thick pulp, young endospermjuicy and edible

Occur in semi-wild condition in Palakkad and Malappuram districts. Cultivated in other districts also

Flow ering March-April Fruiting . July-September

Distribution: India, Myanmar, Sri Lanka

Specimen examined : Shornur,15.7.96, fr. Anto 7091 (KFRI)

**Phoenix humilis** Royle ex Becc. var. **pedunculata** Becc., Males. 3: 379, 387, t. 44. f. 13-15, 18-21, 25-27. 1890, Becc. & Hook. f. in Hook. f , Fl. Brit. India 6:427. 1892; Fischer in Gamble, Fl. Madras 1560 1931.(Figs. 4-7).

Local name : Chittinthal

Dwarf, clump forming. pleonanthic, dioecious palm Stem 2-3m high, to 23 cm in diameter, closely packed with persistent leaf bases, more or less spirally arranged Root suckers develop frequently when the primary stem is burnt or injured Leaves 1-2 m long, leaflets pliable, 25-50 x 0.5-1 cm, fasicled, more or less quadrifarious, the uppermost sometimes confluent, pale green to bluish green, often bearing scales, emergent leaves frequently with brown indumentum. Inflorescence interfoliar, peduncle to 80 cm long rachis flattened, rachillae unbranched, numerous, in groups in a spiral along the rachis, staminate flowers with sepals connate in a low cupule, petals valvate, rounded, much exceeding the sepals, stamens 6, filaments short, erect, the anthers linear, latrorse, pistillode absent, pistillate flowers globose, sepals connate in a 3 lobed cupule, petals imbricate, strongly nerved, about twice as long as the sepals, staminodes 6, connate in a low cupule; carpels 3, distinct, ovule attached adaxially at the base, anatropus, stigma short Fruit orange red to black, usually developing from 1 carpel. ovoid to oblong with apical stigmatic remains, 1 x 0.5 cm, seed elongate and deeply grooved, endosperm homogeneous, embryo lateral

Usually seen in grasslands at higher elevation around 1000-2000m. Silent Valley, Attappady, Thekkady, Muthikkulam, Eravikulam slopes, Chinnar, Peermedu, Parambikulam (Karimalagopuram).

Flowering : January-March. Fruiting : October-December.

Distribution: India - Western Ghats.

Specimens examined : Peermedu, 25.11.82, fr., Nambiar & Renuka 2626 (KFRI), Peermedu, 20.1I .96, fr., Anto 6663 (KFRI), Near Mangala Devi temple, Thekkady, 23.3 90, fl , Renuka 6615 (KFRI).

## Subfamily Calamoideae

In Kerala. this subfamily is represented by a single genus Calamus and 12 reported species. Very detailed taxonomic account is already published (Renuka, 1992) and hence it is not repeated here.

## Subfamily Arecoideae

### Key to the tribes

1a Leaves pinnate or bipinnate, induplicate; inflorescence hapaxanthic or pleonanthic, monoecious. rarely dioecious. peduncular bracts many.....**Caryoteae.**

11) Leaves pinnate or pinnately ribbed, reduplicate, inflorescence pluonanthic, unisexual or bisexual, peduncular bract one, large. ..... 2

2a. Endocarp bony with 3 distinct pores below or above the middle. ...**Cocoeae**

2b. Endocarp not bony, pores absent. ..... **Areceae**

## Tribe Caryoteae

### Key to the genera

1a. Leaves bipinnate, endosperm ruminate. ..... ***Caryota***

1b. Leaves simply pinnate, endosperm homogeneous. ..... ***Arenga***

Each genus is represented with single species, *Caryota urens* and *Arenga wightii*

**Arenga wightii** Griff, Calcutta J. Nat. Hist. 5: 475. 1845; Becc. & Hook. f in Hook. f., Fl. Writ. India 6.322. 1892; Fischer in Gamble, Fl Madras 1558. 1931. (Figs 8-9).

Local names. Kattuthengu, Malanthengu, Njettipana

Monoecious, solitary palm. Trunk upto 10 m high and to 30 cm diameter, densely clothed above with fibrous remains of leaf sheaths. Sheaths covered with black hairs often extended beyond the petiole to form a ligule eventually disintegrating into a mass of black fibres. Leaves 4-7 m long; petiole 1-1.15m long; leaflets dark green above, white beneath, 100 x 5 cm, linear ensiform, apical ones often unequally 2 lobed, toothed in the upper half, confluent and obconic, bases 2 auricled, the lower lobe upto 5 cm long, obliquely overlying the midrib, the upper shorter. Inflorescences pleonanthic, interfoliar, bursting through the leaf sheaths, basipetal in emergence, pendulous, about 1.2 m long, peduncle to 60 cm long, quite concealed by the sheathing lacerate spathes rachillae pendulous, massive; flowers unisexual, triad of two male and a middle female flowers; male flowers sepals and petals rounded, imbricate, coriaceous; stamens numerous, filaments short, anther linear, connective prolonged in to a point; pistillode absent; female flowers solitary in a shallow bi-lobed cup, sepals distinct, rounded, coriaceous, imbricate; petals connate basally, valvate, triangular distally, staminodes 0; ovary globose, trilocular, ovule one in each cell, inserted adaxially at the base, hemianatropus, stigmas 3. Fruits depressed globose, 2.5 cm long, 3.8 cm wide, seed with apical stigmatic remains, epicarp smooth. dull coloured, mesocarp fleshy, filled with irritant needle crystals, endocarp not differentiated; endosperm homogeneous, embryo lateral.

Evergreen forests at 800-l000m elevation On the way to Peermedu, on the way to Wynad, Dhoni, Nelliampathy, Neriamangalam, Muthikulam, Attappady valley, Kottiyur, Sholayar.

Distribution Peninsular India (W. Ghats)

Specimens examined : Nelliampathy, 15.2.95,fl., Mohandas 6659 (KFIR); Sholayar, 18.8.89, fr , Sasidharan 5476 (KFRI).

**Caryota urens** L., Sp. PI. 1189. 1753; Griff., Calcutta J. Nat. Hist. 5: 479. 1845; Mart., Hist. Nat. Palm. 3: 193t. 107,108, 162. 1823-1853; Becc. & Hook. f, in Hook. f. Fl. Brit. India 6: 422. 1892; Fischer in Gamble, Fl. Madras 1560. 1931; Moore & Dransfield, Taxon 28: 70. 1979. (Figs. 10-11).

Local names: Aanapana, Chundapana, Olattipana

Solitary hepaxanthic monoecious palms. Stem 16-20m high and to 60 cm in diameter, leaf sears annular Leaves 3-4 m long, induplicately bipinnate; sheath triangular, eroding opposite the petiole into a mass of strong black fibers, sheath surface covered with indumentum and brown scales; petiole well developed bearing indumentum; secondary rachis similar to the primary rachis; leaflets very numerous, borne on the secondary rachis, obliquely wedge shaped with no distinct midrib, but several major veins diverging from the swollen base, upper margin deeply praemorse with broad bands of caducous, chocolate brown scales adaxially. Inflorescence 3-4 m long, bracts about 45 cm long, produced in basipetal sequence, infradoliar, pendulous, peduncle densely scaly, curved, stout, rachillae simple, very long, pendulous, level topped resembling a huge docked horse tail; staminate flowers elongate, symmetrical, sepals coriaceous, rounded, imbricate; petals valvate, conaceous, connate basally, considerably exceeding the sepals; stamens many (40-45), fdaments short, anthers linear, connective sometimes prolonged in to a point; pistillate flowers globular, sepals coriaceous, rounded, imbricate, connate basally; petals coriaceous, valvate, connate into a tube in the basal half staminodes 6; ovary trilocular with 1-2 fertile locules, ovule hemianatropus, septal glands basal; stigma trilobed. Fruit globose, 1.8-2cm in diameter, red at maturity, mesocarp fleshy, with irritant needle like crystals, endocarp not differentiated; seeds hemispherical, smooth, endosperm ruminate.

Throughout the Western Ghats at altitudes of 50- 1000m. Cultivated in homesteads also.

Distribution: India, Myanmar, Sri Lanka, Malaysia

Specimens examined : Thrissur, 20.12.96, fl, Anto 6667 (KFRI)

## Tribe Cocoeae

*Cocos nucifera* and *Elaeis guineensis* belong to this tribe. Since these are cultivated species and not occurring naturally in Kerala these are not dealt with in this study.

## Tribe Areceae

This tribe is represented by 3 genera, *Areca, Pinanga* and *Bentinckia* of which *Areca* with a single species is cultivated. *Pinanga dicksonii* and *Bentinckia condapanna* are the species seen naturally in Kerala.

## Key to the genera

1a Stem single or clustered, below 10 cm in diameter; leaflets often jointed; endosperm ruminate ..... .2

1b Stem always solitary, 15-20 cm in diameter; leaves regularly pinnate; endosperm in seed homogeneous. ..... ***Bentinckia***

2a. Stem solitary. 8-10 cm in diameter; female flowers larger than males, situated mostly from base to middle of the rachilla. ..... ***Areca***

2b Stem stoloniferous, 2-5 cm in diameter; female flowers smaller than males or equal to males, not restricted to basal portion of the rachilla. ...***Pinanga.***

Each genus is represented with a single species, *Areca catechu* (Arecanut) *Pinanga dicksonii* and *Bentinckia condapanna, Areca catechu* is cultivated hence not included here.

***Pinanga dicksonii*** (Roxb.) Bl., Rumph. 2: 85. 1838; Scheffer, Naturk. Tijdschr. Nederl. lnd. 32: 174. 1879; Becc. & Hook. f. in Hook. f., Fl. Brit. India 6: 409. 1892; Fischer in Gamble. Fl Madras 1556. 1931. Areca dicksonii Roxb., Fl. Ind. 3: 616. 1832. (Figs. 12-15).

Local names: Kattu kamuku, Kanakamuku

4 slender. stoloniferous monoecious palm Stem solitary, erect, to 6 m long, 3- 12 cm in diam, soboliferous without well developed crown shaft Leaf pinnate, forked, about I 7 m long, 2 5 to 7 cm broad. sessile. light green. with numerous parallel veins, broadly linear to falcate, cuminate or praemorsed, uppennost leaflets confluent Inflorescence infrafoliar, peduncle about 4-10 cm Iong flower branches 4 to 5, simple, rigid compressed, densely covered with flower

clusters, flowers in triads of 2 males and a central female, male flowers pinkish, sepals subulate. nearly as long as the petals; petals ovate, cordate, tapering; stamens 20-30, filaments very short, anthers linear, pistillode 0, female flowers sapals and petals 3 each, staminodes 6, clavate, penicillate, style short, stigma 3 lobed. Fruits oblong, dry, fibrous, 1.2to 2 cm long 0 8- I cm in diameter; embryo basilar

Evergreen forests at 350 - 1000m elevation. Wynad, Nilambur, Pooyamkutty, Shendumi, Silent Valley., Attappady and Muthikkulam forests.

Flowering : August-September. Fruiting : February-March

Distribution: Peninsular India (W. Ghats).

Specimens examined : Kottiyur, 4.12.96, fr., Renuka & Anto 6664 (KFRI); Wynad, 5.12.96, fr , Renuka & Anto 6666 (KFRI); Pooyamkutty, 3.10.96, fl., Anto 6661 (KFRI).

**Bentinckia condapanna** Berry in Roxb., Fl. Ind. 3: 621. 1832; Griff., Calcutta J. Nat. Hist. 5 467. 1845; Palms Brit. India 160 Append. XXVI, 1850; Mart., Hist. Nat. Palm. 3: 165, 228. t. 1-39. 1823-1853; Becc. & Hook. f. in Hook. f., Fl. Brit. India 6: 418. 1892; Fischer in Gamble. Fl. Madras. 1555-1556. 1931. (Figs. 16-19).

Local Names : Kattukamuku, Varei kamuku, Kanthakamuku, Parapaku

Solitary, unarmed. pleonanthic, monoecious palm Stem annulate, 6- 10m high, I 5 cm diameter, leaf scars brown, annular Leaves 1- 1 5 m long, pinnate, somewhat arching to spreading, becoming pendulous, neatly abscising, sheaths thick, striate, tubular forming a conspicuous crownshaft. petiole stout, short, adaxially channelled, rachis elongate, angled adaxially, leaflets 30-40 pairs, 60 x 25 - 4 cm, basal leaflets sometimes united, alternate, lanceolate acute, tips bifid with small brown scales on both surfaces, long pale ramenta near the base adaxially, along ribs adaxially Inflorescence infrafoliar, completely covered with two bracts, branched to 3 orders basally, fewer distally, somewhat pendulous at anthesis, peduncle very short, dorsiventrally flattened, rachillae rather stiff tapering, bearing spirally arranged triads of flowers, flowers borne in vertical, laterally compressed pits, inner surface of pits densely hairy, staminate flowers slightly) asymmetrical, sepals distinct, scarcely imbricate, petals asymmetrical, stamens 6. those opposite the sepals usually shorter than those opposite the petals, the filaments awl-shaped. inflexed at the apex in bud, the inflexed portion very slender; anthers elliptic to oblong basifixed, the connective very short, pistillate flowers symmetrical, sepals distinct, imbricate. petals broadly imbricate with very briefly valvate tips, staminodes 6, minute, awl-shaped. gynoecium ellipsoidal. asymmetrical unilocular but vestigial locules evident. uniovulate, stigmas 3 recurved papillose Fruit globose - ovoid. bright chocolate coloured when ripe.

1.3-1 5 cm in diameter; seed shining brown, conspicuously grooved adaxially and laterally, endosperm homogeneous, embryo basal.

Evergreen forests at 1000 - 1400m elevation. Agastiamala, Kulathupuzha, Peerniedu, Moozhiyar, Kakki.

Flowering and fruiting: September-December.

Distribution: Peninsular India (Southern parts of W. Ghats).

Specimens examined : Vallakkadavu, Peermedu, 19.10.96, fl. & fr., Anto 6662 (KFRI).

# UTILISATION

Palms are important for a wide range of products essential for our day-to-day life and comfort The various products from palms such as food, beverages, thatch, fibre, timber, medicines and useful chemicals can be broadly divided into two categories namely materials derived from structural parts, and substances that result from metabolic processes (Dahlgren, 1944). Products of the former category are more distinctive since they generally reflect the particular structural features common to the group.

## Gross structure of palms

Probably the most striking anatomical feature of palms is the arrangement of their vascular tissues as numerous discrete strands called fibro-vascular bundles Each fibro-vascular strand consists of xylem and phloem surrounded by a sclerenchymatous bundle sheath (Parthasarathy and Klotz 1976. Tonilinson, 1961) The strands run longitudinally and are held together by the parenchymatous ground tissue At intervals the strands may deviate slightly from their vertical course and branch out providing interconnections, traces, commissures, etc (Tomlinson, 1970) T his basic pattern of structure remains the same for all palms and their different parts like stem. petiole, rachis, inflorescence stalks, etc although there is considerable variation in the shape. size, arrangement, frequency and cellular composition of the bundles between different parts

## Woody constructional material

In stem and petioles the proportion of sclerified tissue and crowding of vascular strands is greater near the periphery as compared to inner regions. This makes the peripheral part woody, rigid. denser and harder (Parthasarathy and Klotz, 1976) In palms such as *Borassus flabellifer*. this peripheral part of the stem provides strong timber material useful for construction (Sekhar *et al*.. 1968, Davis and Johnson , 1987, Jagadish *et al.*, 1993) However, not all palms are useful for timber since the stem size. thickness of the harder part and mechanical properties of the material act as limiting factors In some palms like *Crayota urens* or *Corypha umbraculifera* even though the stem has greater size and thickness the peripheral denser part is very narrow and the bulk of the stem is constituted by softer, lighter tissue, thus making it less useful for timber applications Nevertheless, in these palms the softer core consisting rnostly of parenchyma and very less fibrous strands serves as a storage tissue for reserve food like starch which is often extracted for edible purposes Rattans (canes) which have long slender stems provide a strong flexible material valuable for furniture making, wickenwork and handicrafts

## Fibre

The fibro-vascular tissue of the palms is valuable not only for woody constructional material but also for the cordage or brush fibre it provides The fibre is obtained mainly from leaf stalks, leafbases, rachis, loose strands surrounding leaf bases, inflorescence axes and so on Fibre is also often extracted fiom leaflet veins, fruit pericarp or stems of certain palms (Blatter, 1926) The quality of brush fibre obtained from various species and parts of palms is usually variable depending upon its origin or source, essentially reflecting the difference in the structure or cellular composition of the strands Some palms like *Caryota urens* are well-known for the excellent quality of its brush fibre (known as kittul fibre) which is known even in the international market (Blatter, 1926; Anonymous, 1950). However, the quality of 'kittul' fibre obtained from leaf base, rachis or stem is found to be different in quality. Even the same part or organ of the palm may show great difference in its fibre quality. In palmyra palm it has been found that the fibre obtained from adaxial face and margins of leaf stalk is superior in strength as compared to that obtained fiom the abaxial face (Davis and Johnson, 1987) The leaf stalk fibre of *Borassus flabellifer* and *Corypha umbraculifera* has also got potential for pulping and paper making applications

## Leaf material

The tough leathery leaf blades of a number of palms find a variety of applications like thatching, basket weaving, plaiting and wickerwork, handicrafts, fodder and green manure. Leaflet blades of some palmate species like *Borassus flabellifer* and *Corypha umbraculifera* had been popular for writing manuscripts in ancient times The leaflets of most palms are generally less permeable due to their cuticular surface layers. The parallel veins and fibrous strands connected to each other by transverse commissures provide a rigid framework for the leaflet lamina The leaves are fairly resistant to biological degradation also. Thus they form a cheap waterproof thatching material for huts (Davis and Johnson, 1987) The leaves are also suitable for making mats, umbrellas, plaited articles, toys and other utility products Besides these uses. the leaves are used as fodder for livestock Leaves of *Caryota urens* are commonly used for feeding domesticated elephants in Kerala.

## Food products

The main edible products obtained fiom palms include parts of fruits and seed, the tender apical portions of stem and storage products and secretions such as starch, fats or sugars from other parts. The fruits and seeds of all palms are not edible In species with edible seeds it is the endosperm that is often eaten. This part which stores abundant reserve metabolites like sugars or fats is consumed at different stages of seed development.. In some

Palms the edible endnsperm may be in the form of a sugary liquid in initial stages which gradually solidifies into ajelly-like substance as in palmyra fruits (Anonymous, 1988) With maturation the endosperm may further harden which in some species is edible even at this stage and in others it may become hard and sclerified Endosperm of some species like talipot palm *(Corypha umbruculifera)* and *Borassus flabellifer* is so hard that it is used for making buttons, beads etc. The former is popularly known as vegetable ivory. The hard endosperm of some species (e.g . *Pinanga dicksonii)* yields masticatories and in a few palms the endosperm provides edible oil. Irrespective of its nature or appearance, the endospermi is a storehouse of abundant metabolites required for nourishing the germinating embryo. Due to this, the germinating seedlings which draw their nourishments from endosperm are rich in starch as in palmyra palm which are used for edible purpose.

The edible portion of the fruits is the fleshy pericarp, particularly the mesocarp which is rich in sugars. carbohydrates or fats The mesocarp of these fruits either lacks appreciable fibrous tissue as in dates (including the locally available *Phoenix humilis)* or it may contain few fibres intermingled with the pulpy tissue as in palmyra fruits. The endocarp is often hard and stony with abundant sclereids or it may be thin and papery. The pericarp ofnon-edible h i t s is predominantly fibrous or densely woody without appreciable amount of sugars or other storage products In some palms like *Caryota urens* even though the pericarp is soft and fleshy it is acrid in taste causing irritation of tongue or skin (Blatter, 1926)Immature fruits of *Arenga wightii* are also said to show similar character.

**Toddy and related products**

Palminflorescences are commonly conspicuous spadices with numerous sessile flowers. Some palms like *Corypha umbraculifera* produce massive terminal inflorescence only once in their lifetime For development of inflorescence, a large quantity of reserve metabolites are drawn from the stem which are transported as sugars through the vascular tissues Thus the inflorescence stalks exude the sugary sap if injured and the sap is collected as sweet toddy which is mainly the sugar-rich phloem sap The sweet toddy is consumed fresh as a beverage or converted into various useful products such as palm-sugar, arrack, candy, vinegar etc. by further processing During tapping the inflorescence stalks are subjected to injury by crushing, beating and twisting them in order to encourage continuous sap flow and good yield. This is the less destructive method for extraction of sap as compared to direct tapping of the trunk w hich ultimately kills the palm. The wild palms that are commonly tapped for toddy in Kerala are *Borassus Flabellifera* and *Caryota urens* The yield of toddy and the tapping season differ for these species and also between localities

Other uses

Besides providing several essential products a number of palms are useful as ornamentals They are used for landscaping and agroforestry purposes However, the intensive use or dependence on palms is restricted only to popular, cultivated species and most of the wild species are still being under-utilised since their products and uses are not widely known The utilisation potential and the known uses of palm species found in Kerala are discussed in the following paragraphs

## Present and Potential uses

### Arenga wightii

The main products from this species of palm are sweet toddy, thatch and food However, its use is limited to more remote localities or hilly forest areas where the palm commonly grows The hill tribals tap the palm for toddy which is consumed locally For collection of toddy, the inflorescence stalks are cut and the sap is collected in pots as commonly done for toddy palms Jaggery and vinegar are some potential products of toddy although presently not used for the purpose due to small supply The inflorescences are also used by the tribals in religious ceremonies The leaves which superficially resemble the coconut palm leaves are used as thatching material for huts and pandals in hilly areas

The fruits measure about 2-4 cm in diameter. The ripe fruits are dehusked and boiled several times in water to make them suitable for consumption This repeated boiling is said to remove harmful constituents Dried kernels are later pounded and used to make a variety of eatables either by mixing with rice flour or otherwise However, currently the practice is diminishing Similarly, the terminal bud (cabbage) of the palm which is sweet and edible is seldom collected now-a-days for food purposes The softer, inner part of the trunk is believed to be suitable for extraction of starch as in *Arenga saccharifera*, an allied species. However, the starch is to be collected before the initiation of flowering

*Arenga wightii* produces about 6 to 10 m tall unbranched trunks ranging from 10-30 cm in diameter The trunks are conspicuously tapered The peripheral wood is greyish brown, hard and fibrous The harder part is 2 to 4 cm thick However, it is unlikely to yield appreciable quantity of usable dimensions of sawn timber Shorter straight lengths in round form may, however, be useful as posts for huts and fencing

**Bentinckia condapanna**

This palm with its highly restricted distribution is not much known for its utility It is generally found in less accessible hilly-forest areas and thus its utilisation is restricted to such remote localities.

The terminal bud (cabbage) of the palm is edible and is said to have a nutty flavour (Bourdillon, 1908). It is eaten either raw or in cooked form. The hill tribals use the inflorescences in religious ceremonies. The leaves are used locally as thatch for pandals and huts. The young leaves are eaten by elephants. The straight, narrow stem (I 5 to 20 cm diameter) grows to a height of 8 to 10 m and produces a greyish coloured, moderately hard woody material. The wood is not much used except rarely for huts and fences. *Bentinckia* palm has been considered suitable for avenue planting in large gardens (Anonymous, 1988).

**Borassus flabellifer**

The palmyra palm is best known for its multifarious products and uses. This gigantic palm has been held in high esteem since ancient times as evident from verses composed in its praise (see Blatter, 1926) The oldest known use of palmyra is probably the use of its leaves for writing manuscripts Besides, other products like its edible fruits, sugary sap (toddy) and jaggery have been known from time immemorial. The wide variety of uses of palmyra have also been well documented in the scientific literature (Davis and Johnson, 1987, Kovoor, 1983).

The palmyra is extensively tapped in South India for toddy Both male and female palms are tapped although female palms are reported to yield 33 to 50% more sap than males (Anonymous, 1988) The tapping season varies from December to June in different localities For tapping, the inflorescence axis is injured on successive days by beating and crushing to encourage sap flow Later the tip of the axis is sliced off and the sap oozing out is allowed to collect in containers. The mildly acidic sugary sap rich in sucrose, ferments in a short time and to prevent this, preservatives like lime are added. Usually a layer of lime is coated on the inner side of the collecting pot The unfermented sap is a nutritious and refreshing beverage It is also found to have certain medicinal properties (Anonymous, 1988).

Palmyra jaggery is obtained by boiling the fresh sap after removal of lime added into it. Palm candy and sugar are also made from the sap through minor variations in the boiling procedure and subsequent treatments Both jaggery and candy are rich in carbohydrates, minerals and vitamin B (Anonymous, 1988). The sweet sap, if allowed to ferment, gives rise to toddy which contains a small amount of alcohol. The toddy is often distilled into arrack or used for

making vinegar. The molasses from the sugary sap is used to make syrups, arrack, alcohol, vinegar and other useful biochemical products.

The soft,jelly-like endosperm of tender fruits is edible and is sold in the market The hardened endosperm of mature fruits is unsuitable for consumption However, the fleshy mesocarp of such ripe fruits which yields a soft pulp is eaten in several forms in many parts of Kerala, Tamil Nadu and Andhra Pradesh It is eaten raw or after roasting the h i t s The pulp is mixed with flour and used to make several edible preparations It is also made into a dry preserve The pulp is rich in carbohydrates,proteins and minerals It is also found to have medicinal properties.

Other edible products from palmyra palm are the tender apical bud (the palm cabbage) and seedlings The young seedlings and roots are fleshy and farinaceous. They contain abundant starch The seedlings are baked, cooked or made into flour. The seedling material is found to possess medicinal properties.

Several kinds of fibre is obtained from palmyra palm which is useful for broom and brush-making the most important of these is the one extracted from leafstalks which has considerable export market The chief use of the leaf stalk fibre is for the manufacture of brushes, brooms, mats. baskets and similar products The leaf stalk fibre is also a potential raw material for pulping and paper making. Strips of the leaf stalk being strong are used for tying the leaves while thatching Dried leaf stalks are also used as fuel in rural areas The leaf midribs are used for making brooms and have export market. The leaf lamina is used for making a variety of fancy and utility item like fans. mats; hats, baskets and toys. Leaves are also used as thatching material. green manure etc. In the ordinary course the thatched leaves last for an year after which they are used as fuel

The timber obtained from palmyra trunks is used for constructional and agricultural uses in rural areas Palmyra stem grows to a height of 20 m and a diameter of nearly a metre The stein is felled at an age of 50-60 years after the most productive tapping period The peripheral wood (outer 5 to 10 cm thick part) is found to have adequate strength and hardness as compared to some commercial woods but is rather poor in toughness (Sekhar et al., 1968) The inner core part of the trunk is soft and weak The timber is fairly durable and moderately easy to treat with preservative chemicals It is found that for efficient processing of the timber, carbide tools are necessary. Production of glued laminated timber has been suggested as a viable approach to use both harder and softer parts of the stem wood (Jagadish et al., 1993). With proper processing techniques palmyra wood is likely to be useful for furniture, panelling, curios and other fancy and utility items Rejects from stem and stump are used as fuel in

## Caryota urens

Fish-tail palm or kittul palm is useful mainly for toddy tapping, brush fibre and to a lesser extent. for edible starch and forage

The palm is extensively tapped in Kerala for toddy As usual the juice is obtained from the spadices before they are fully developed The most productive period for tapping is found to be 4 to 7 years after the palm begins to flower. The sap from the chopped inflorescence stalks ferments into a cloudy, sour toddy in 24 hours. In order to prevent the fermentation, the collecting pots are smoked or coated with lime. The sweet toddy which is rich in sucrose is boiled on slow fire in copper or clay pots to make jaggery. The fermented toddy, on the other hand, is unsuitable for jaggery It is boiled down to a thick syrup and preserved by adding sodium benzoate and is used for confectionary It may be allowed to crystallise into a candy. The fermented toddy is also distilled for arrack or used for the preparation of vinegar

Other edible products from fish tail palm are the terminal bud (palm cabbage) and the starch extracted from the stem The cabbage is eaten raw, cooked as vegetable or pickled. From the stem core a starch similar to sago starch in quality is obtained. The starchy flour is made into bread or other edible preparations Yield of starch is low from the palms tapped for toddy

The fruits are not edible The fruit pulp which is acrid in taste causes irritation. The fruits and seeds are said to possess medicinal properties The hard seeds are used for making buttons, beads etc

A strong and durable fibre suitable for making a variety of brushes, brooms and strong cordage is obtained from the loose fibre surrounding the leaf bases and from leaf stalks, sheaths, petioles and flowering stalks The fibre is extracted in large quantities for brushes and brooms in Sri Lanka In a few parts of India it is used as a raw material for brush making The fibre extracted from petioles is used for cordage, although less extensively, in rural areas of South India The most common use of the leaves is as a fodder for domesticated elephants in Kerala The leaves are also used for making pandals, temporary huts and as green manure. The leaves are widely used in Kerala and Tamil Nadu for making pandals, decorating the houses etc during festivals

The inner part of the trunk stores large amount of starch which is extracted after felling the stems The starch is said to be equal to sago in quality (Anonymous, 1950) The flour is utilised for making bread and other edible preparations.

The unbranched fish-tail palm produces 16to 20 m long trunh about 40-60 cm wide. The peripheral part ofthe trunh wood (about 2 to 4 cm thick) is strong and durable. It is used to a lesser extent for construction of houses in rural areas However, it is mainly used for agricultural and domestic uses like water conduits, pipes, containers. plough shafts etc. The harder timber has potential for better uses Iike panelling, flooring and other constructional uses However, since a greater proportion ofthe stem is constituted by softer fibrous tissue, the trunks are generally not exploited for timber purposes at present

**Corypha umbraculifera**

The umbrella palm (talipot palm) is known for its large palmate leaves having several uses and large amount of edible starch stored in its stem Since the palm is monocarpic it is not suitable for toddy tapping

The palm flowers once in its lifetime when 30-40 years old Prior to flowering the palm stores in its massive trunk (10 to 20 m high and 30 to 50 cm diam ) large quantity of reserve metabolites as starch which is finally utilised for the development of a massive terminal inflorescence This stored starch is extracted from the trunks after felling them which is to be done prior to the initiation of flowering The starch is similar to sago starch and is used to make bread and other edible preparations The starchy pith is also used for feeding the ducks. The peripheral part ofthe trunk wood (2 to 5cm) is rather hard and fibrous but rarely used for timber- purposes After scooping out the softer interior parts the harder portion ofthe stem is used for drums, containers etc

The broad palmate leaves of talipot palm are used for umbrellas, fans, mats. baskets, fancy articles and toys. The leaves are also used for thatching and partitioning like palmyra leaves. The strips oftalipot palm leaves have been used in the past for writing manuscripts. The thick, fibrous leafstalks are useful for extracting rough cordage fibre The stalks are also found to be suitable raw material for strong wrapping paper

Seeds of talipot palm are similar to ivory in colour and hardness They are used for making beads, buttons and other ornamental articles The button-nuts are prone to insect attack and require effective chemical treatment to enhance their durability (Tewari. 1954) The seeds pounded into a paste are said to be used for stupefying fish (Bourdillon. 1908)

**Phoenix humilis**

This short-statured palm grows only upto a height of 2-3 m. As such the palm has only limited uses.

The fruits have a fleshy mesocarp and are edible. They resemble dates but are smaller in size. Other edible product from this palm is the terminal bud (cabbage) which is eaten mostly in the raw form

The leaves are traditionally woven into mats. They are also used as brooms. In Tamil Nadu broom industry based on *Phoenix* leaves is a major threat to the survival of the species (Padmanabhan and Sudersan, 1988). The leaves are used for providing shade to newly planted tea plants. They are also said to be utilised for packing red pepper in certain parts of Karnataka (Blatter, 1926).

The short stem cannot provide usable sizes of timber. The peripheral wood from the trunk is hard and fibrous but is seldom used.

**Pinanga dicksonii**

This species of palm with a short narrow stem (2 to 6 m high with 3 to 12 cm diam.) is not known for any use in particular. The nut is chewed by the tribals as a substitute for betel nut (Blatter, 1926; Bourdillon, 1908). The narrow stem is sometimes used in round form for construction of huts and fencing like bamboo and as walking sticks. The wood material is pale reddish brown and moderately hard but liable to warping, thus having little value for any use.

## CONSERVATION

In India many palms are considered endangered (Nayar and Sastry, 1990). Loss of habitat and over-exploitation are the major threats to the survival of many species of palms. The prospects of certain species are extremely poor and they are really endangered.

In Kerala, the palm populations in the wild are decreasing. *Arenga wightii, Bentinckia condapanna* and *Pinanga dicksonii* are much restricted in distribution and the destruction of evergreen forests is affecting the growth of their population. Now *Bentinckia* is seen only as isolated trees left in totally unapproachable steep slopes and ravines. *Pinanga* is very sensitive to exposure. When population size at one locality is considered, *Pinanga* is the most endangered palm followed by *Bentinckia* and *Arenga.*

*Borssus, Corypha* and *Phoenix* are also threatened because of their constant and increasing utilisation (Davis, I 985; Davis and Johnson, 1987; Padmanabhan and Sudersan, 1988) Human disturbances and the monocarpic nature of the palm contribute to decline in the natural population of

The trunk of *Corypha* is usually cut down before it flowers, to utilise the starch content. Even when it is allowed to flower, the whole inflorescence is cut down at the fruiting stage and the young fruits are used as a fish poison. This has affected the regeneration to a considerable extent.

*Borassus* is reported to be highly endangered in Tamil Nadu (Davis, 1985). In Kerala also the trees are being cut down for the stem. The cabbage, the fruits, and especially young seedlings and roots are edible. This makes this palm more vulnerable. Because of its increasing utilisation and the scarcity in the adjacent state make it a threatened species

**Distinctive characteristics of palms in relation to their conservation**

Palms possess several distinctive botanical characteristics which are important from the conservation point of view.

**a) Habit**

Palms are solitary *(Borassus, Corypha, Caryota, Bentinckia)* or clump forming *(Phoenix)* depending on the species. In some species underground stolon is present *(Pinanga).* Suckering and clumping palms have multiple growing tips, therefore damage to one of the tips is not fatal to the plant. But in the case of solitary palms, damage to the single growing tip can kill the palm. Thus solitary palms are more vulnerable than multistemmed palms.

**b) Stem**

The trunk of the palm differs in structure from that of other trees. Palms have no bark, however, from an anatomical standpoint, palm trunks are less vulnerable to fire damage. Adhering leaf bases on certain palms, e.g.. *Corypha* and *Arenga* provide further protection to the trunk. The fire resistance of wild palms in savannas has been noted by ecologists (Walter, 1973). *Phoenix* is an example for this condition. Fire resistance helps this palm to overcome fire damage during the summer season when the surrounding grassland succumbs to fire.

**c) Propagation**

Most palms are propagated by seed. But a few produce suckers e.g.. *Phoenix,* which may be transplanted. This is a plus point for the species from the conservation point of view.

**d) Flowering**

Flowering is yet another palm characteristic to bc considered as vital. Some palms (e g *Borassus)* are dioecious, bearing male and female flowers on different palms. The sex of the plant cannot be identified till flowering Hence, while some conservation activities are being done, a large number of plants should be raised to avoid the probability of all the plants developing into a single sex; either male or female.

Some species are terminal flowering or hapaxanthic, e.g . *Corypha* This is a disadvantage because after flowering the palm dies. But it is this very characteristic which gives the palm its economic value, for the tree accumulates large quantities of starch in the trunk before the terminal flowering This starch is invariably extracted, before the onset of flowering, by felling the tree In such species also more number of plants should be raised to minimise the disadvantages of trees being cut before flowering and hapaxanthic flowering

**e) Germination**

The gemination percentage of seeds of some palms is very low, e.g , *Betinckia, Corypha* For these species large number of seeds should be put to gemination in order to get sufficient number of seedlings

## RECOMMENDATIONS

Palms are an important forest resource from ecological, social and economic viewpoints Therefore consewation and sustainable utilisation of this resource assumes great importance in the current context when forest wealth of the State as a whole has been on a decline It has been found that natural populations of some wild palms have been affected severely due to habitat destruction and over-exploitation. Some inherent characteristics of palms such as monocarpic flowering, poor germination and establishment of seeds etc. have also contributed to retard natural regeneration of palm population In the absence of concrete efforts towards their replenishment, some of these wild palms are likely to face the threat of extinction. Therefore the following broad recommendations are made for consenation of palm genetic resources and their optimum utilisation.

1 For conservation of palm genetic resources of the State it is necessary to establish *ex situ* conservation centres in different parts of the state e g ,

a Palmata in the northern, central and southern pans of Kerala
b. Germplasm conservation plots in Northern and Southern Kerala

2 For ecologically sensitive palms like *Arenga, Pinanga* and *Bentinckia, in situ* conservation should be adopted by protecting their habitats Enrichnient planting may also be carried out in such areas

3. Plantations of presently over-exploited species like *Borassus* and potentially useful species like *Catyota* and *Corypha* should be established on a large scale to boost their population for sustainable exploitation Large scale plantations of *Caryota* may be profitable since they yield the most favoured elephant feed.

4. It is necessary to focus on efforts towards popularisation and commercial exploitation of certain palm products which are currently being underutilised e.g.,

a Jaggery and vinegar fiom *Arenga*
b. Seedlings and seedling roots of Borasstus for food
c. Fibre from *Borassus*, *Caryota* and *Phoenix*
d. Sago from *Corypha*
e. Beads, buttons and other ornamental articles from *Corypha* seeds.

5. Greater attention needs to be given for developing improved processing techniques for utilisation of useful palm woods like *Borassus* for timber applications.

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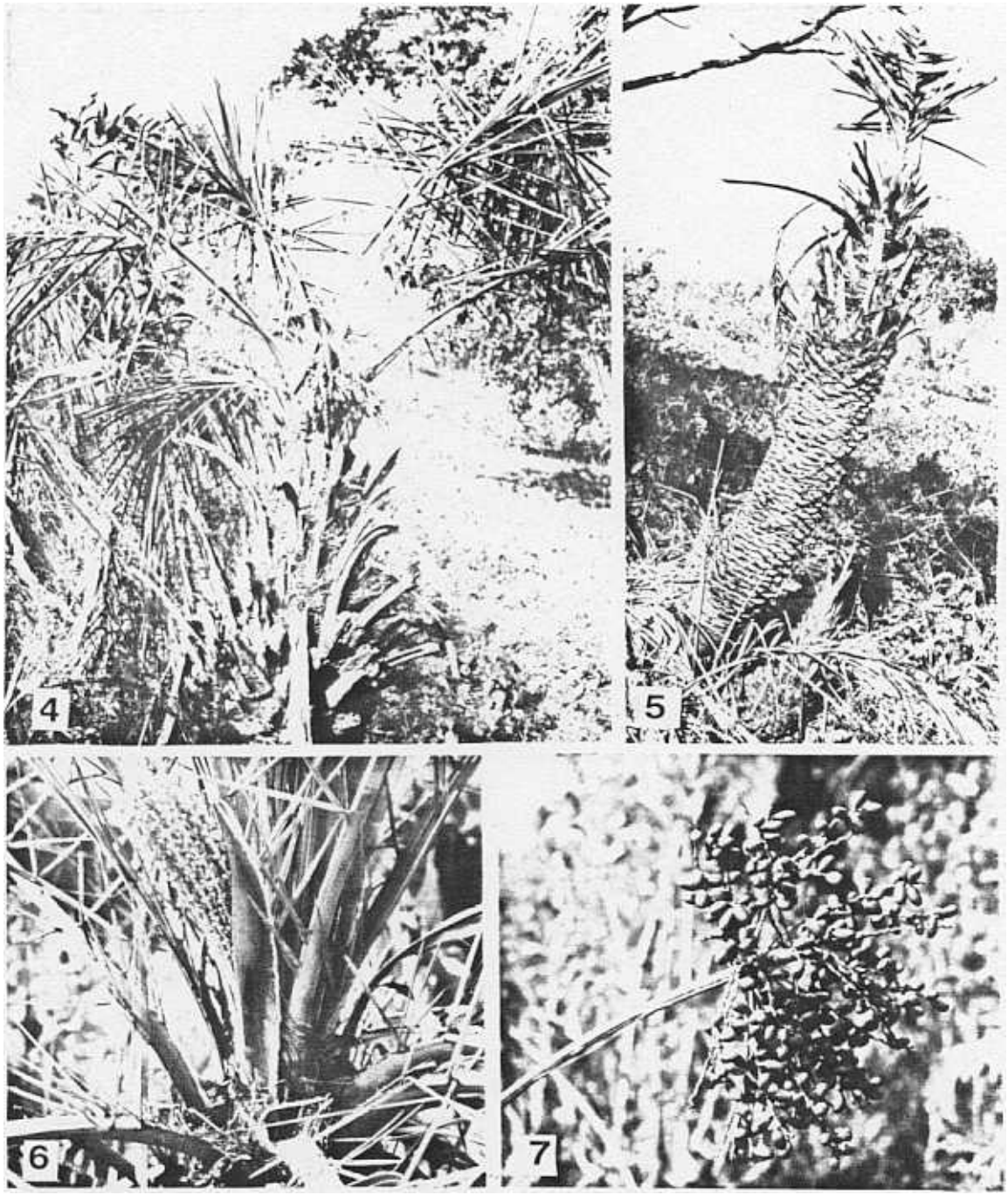
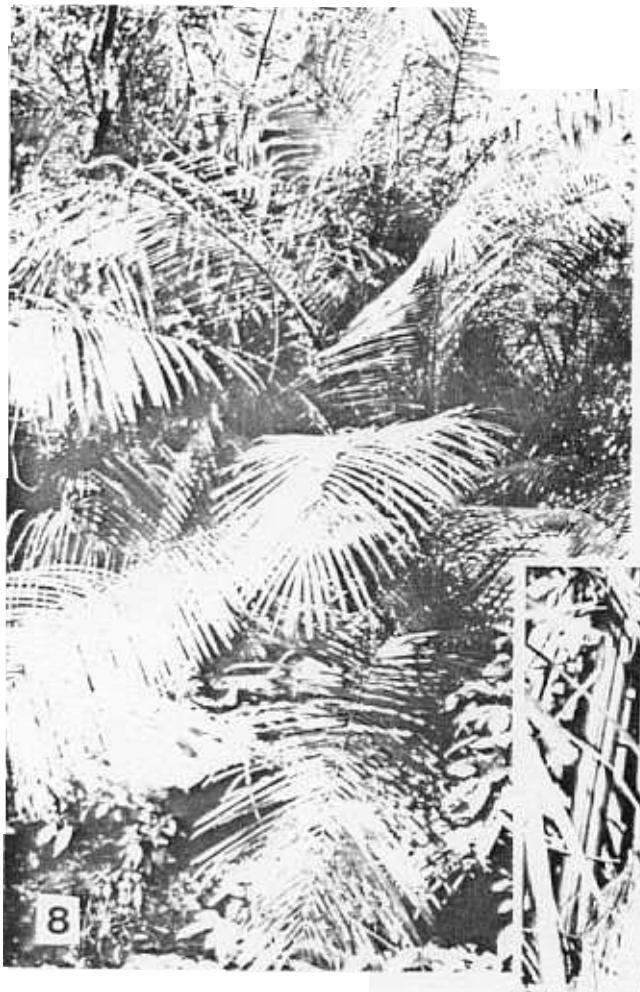
*Corypha umbraculifera*. 1. A tree with the terminal inflorescence. 2. Trunk with persistant leaf sheaths.

*Borassus flabellifer*. 3. The tree at the extreme right is female and others are male.




*Phoenix humilis* var. *pedunculata*. 4. Habit. 5. Mature palm with sucker. 6. A male tree. 7. Fruits.

*Arenga wightii*



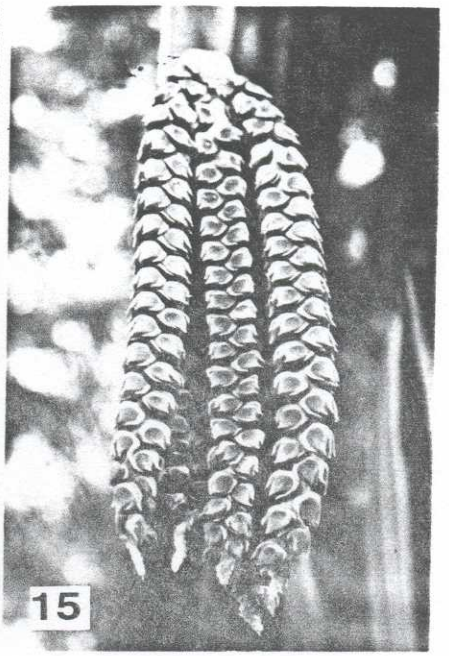

8. Habit.


Young fruits.

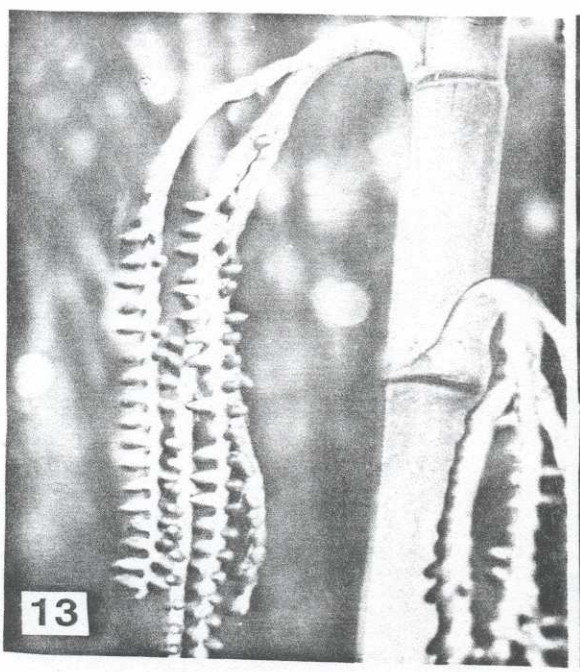
*Caryota urens*


10. Habit.


A tree in fruits.

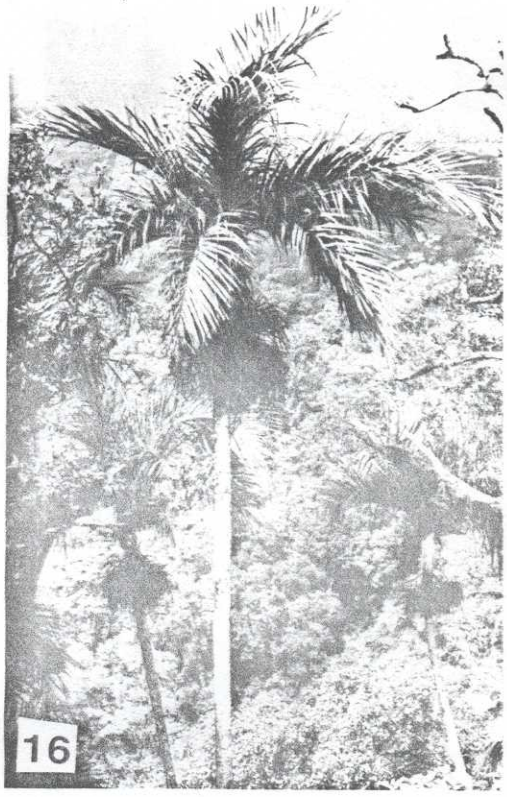



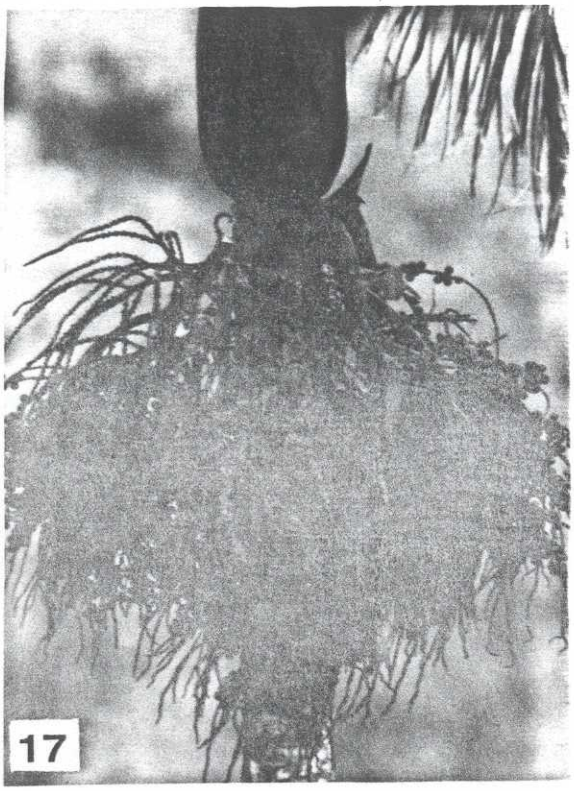

*Pinanga dicksonii*. 12. Habit. 15. Male inflorcesence.



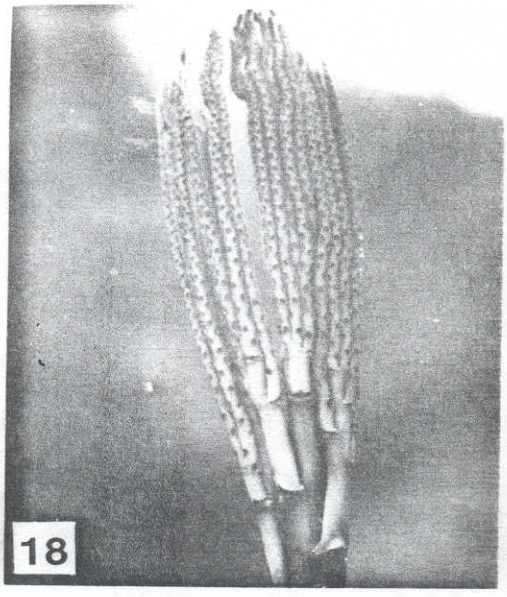


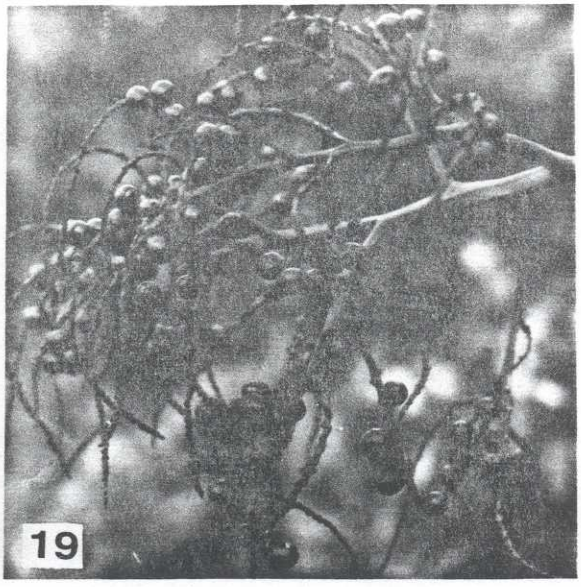
13. Young fruits. 14. A tree with two very young inflorescences, one unopened.




*Bentinckia condapanna*. 16. Habit. 17. Fruits.




18. Male inflorescence. 19. Fruits. A close up view.