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Diversity and conservation of palms in Andaman & Nicobar archipelago

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Abstract The palm resources of Andaman & Nicobar Islands are quite rich and unique with a substantial number of endemic species. Andaman & Nicobar Islands, falling within the Indo-Burma region constitute "hottest hotspot" of global biodiversity with an exceptional concentration of endemic species, but are experiencing alarming loss of habitat. The flora and fauna of Andaman group of islands show striking dissimilarities with that of Nicobar group. Palms such as *Arenga pinnata*, *A. westerhoutii*, *Calamus baratangensis*, *C. basui*, *C. longisetus*, *C. palustris*, *C. viminalis*, *Corypha utan*, *Daemonorops aurea*, *D. kurziana*, *D. manii*, *D. rarispinosa*, *D. wrightmyoensis*, *Korthalsia rogersii*, *Licuala spinosa*, *Phoenix andamanensis*, and *Pinanga andamanensis* which occur in Andaman groups of islands are absent in the Nicobar group of islands. While *Bentinckia nicobarica*, *Calamus dilaceratus*, *C. nicobaricus*, *C. pseudorivalis*, *C. semierectus*, *C. unifarius*, and *Rhopaloblaste augusta* are confined to the Nicobars, but seldom found in the Andamans. *Areca triandra*, *Calamus andamanicus*, *Caryota mitis*, *Korthalsia laciniosa*, *Licuala peltata* and *Pinanga manii* are widely distributed in both the group of islands. There is a considerable reduction in their natural population probably due to habitat destruction, low regeneration, and inability to compete with other plants. In addition, calamities like tsunami caused irrecoverable loss of valuable genetic diversity of palms. If conservation efforts are not undertaken, many of the existing species, if not all, are likely to disappear within a foreseeable future. There is dire need for habitat preservation and for in situ conservation. Appropriate conservation strategies should be taken to prevent further genetic erosion of these species and to protect these invaluable plant resources.

Keywords Archipelago · Arecaceae · Conservation · Diversity · Endemism · Palms

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Introduction

India, one of the 17 mega biodiversity countries, nurtures 8% of the world's biodiversity. It has highest diversity of ecosystems in the form of forests, wetlands, grasslands, marine areas, deserts, glaciers, and mangroves. Henderson (2009) mentions that there are about 18 genera and 88 species of palms known from India, but our KFRI database (unpublished) reveals that there are 21 genera and 105 species of palms occurring in three major geographical regions viz., Peninsular India, North eastern India, and Andaman & Nicobar Islands. A small number of palm species also occur in the Gangetic plains and in the lower hill valleys of Northern India. In addition to indigenous species of palms, several exotics are cultivated as ornamentals.

The Andaman & Nicobar Islands, geologically a continuation of the Arakan Yoma, the largest archipelago system in the Bay of Bengal and consisting of a group of 572 large and small islands and islets, are situated between the latitudes of 6°–14°N and the longitudes of 92° to 94°E, and constitute one of the "hottest hotspots" of biodiversity (Myers et al. 2000). This island complex is unique and being the only habitat of its type on the Indian subcontinent, exhibits a vivid and spectacular biodiversity because of its tropical humid climate and insular nature. Most of the islands are covered with luxuriant vegetation. Although several authors have investigated the flora of the Andaman & Nicobar Islands (Balakrishnan 1977, 1989; Ellis 1989; Mathew and Abraham 1994; Mathew et al. 2007; Parkinson 1923; Rao 1986; Subbarao 1989; Thothathri 1977), very little information exists on the palm wealth, their status, and their conservation. Many parts of the territory are still unexplored or underexplored and therefore our knowledge of palms is inadequate. Moreover, a substantial number of species are endemics.

Methodology

Kerala Forest Research Institute had conducted a field survey for the palms of Andaman & Nicobar Islands during the period 1992–1995 (Renuka 1995). Another field survey was taken up during 2008 by the first two authors, which helped to record the present account on distribution and conservation status of palms in these islands. Identity of the specimens was established by referring to the herbarium material lodged in herbaria of KFRI, Peechi and BSI, Andamans. Earlier works are Beccari (1908, 1911, 1918), Blatter (1926), Brandis (1874), Griffith (1844–1845), Hooker (1872–1897), Parkinson (1923), Renuka (1995), Sasha Barrow (1998), and Uhl and Dransfield (1987). Voucher herbarium specimens prepared for all palms collected are deposited in the Herbarium of Kerala Forest Research Institute, Peechi, Kerala. For knowing distributional status in other parts of the world, Kew check list of palms was consulted (Govaerts et al. 2006). For assessing the diversity status, species richness, geographic rarity or endemism and taxonomic singularity or distinctiveness (number of species within each genus) approach of Ojeda et al. (1995) was followed.

Results and discussion

Andaman & Nicobar Islands with a highly diverse set of biomes comprising 0.03% of the country's landmass are characterized by a distinctive flora and consist of several rare and endemic taxa. This is particularly true of palms, which are represented by 13 genera and

33 species. Of the 13 genera of palms, 5 genera—*Bentinckia*, *Caryota*, *Corypha*, *Nypa*, and *Rhopaloblaste*—are monotypic. The present study has revealed that the islands are rich in rattan flora comprising of three genera viz. *Calamus* (11 species), *Daemonorops* (5 species), and *Korthalsia* (2 species) (Renuka 1995, 1999; Henderson, 2009). Interestingly, palms such as *Arenga pinnata*, *A. westerhoutii*, *Corypha utan*, *Licuala spinosa*, *Phoenix andamanensis*, *Pinanga andamanensis*, *Calamus baratangensis*, *C. basui*, *C. longisetus*, *C. palustris*, *C. viminalis*, *Daemonorops aurea*, *D. kurziana*, *D. manii*, *D. rarispinosa*, *D. wrightmyoensis*, and *Korthalsia rogersii* which are present in Andamans do not occur in the Nicobars. While *Bentinckia nicobarica*, *Rhopaloblaste augusta*, *Calamus dilaceratus*, *C. nicobaricus*, *C. pseudorivalis*, *C. semierectus*, and *C. unifarius* are confined to the Nicobars but seldom found in the Andamans. *Areca triandra*, *Calamus andamanicus*, *Caryota mitis*, *Korthalsia laciniosa*, *Licuala peltata*, and *Pinanga manii* are widely distributed in both the group of islands. However, Henderson (2009) does not agree for the existence of *Pinanga andamanensis*. While the Andamans have more species common to NE India and Burma (viz. *Areca triandra*, *Arenga pinnata*, *A. westerhoutii*, *Licuala peltata*), the Nicobars as reported by Balakrishnan (1989) have more in common with Indonesia and Malaysia (*Licuala* sp., *Nypa* sp.). *Calamus palustris* and *C. longisetus* found in S. Andaman are also reported from Malaysia and S. China. *Calamus viminalis* found in S. Andaman is reported from South Central China and mainland of India.

New reports

Recently, the authors located one more palm namely, *Arenga pinnata* (Wurmb.) Merr. in the vicinity of Austin I & II near Mayabunder of Middle Andamans. Although this taxon is widespread in NE India, it was not recorded from Andaman & Nicobar Islands. The present collection establishes the extended distribution of the taxon in Andaman Islands. Further, the occurrence of this taxon is reported from South China to Central Malaysia depicting its disjunctive distribution. During present collection, we were able to locate *Calamus dilaceratus* from Laful bay which is a protected reserve for Shompen tribes, *Calamus unifarius* from Car Nicobar and *Korthalsia rogersii* in Chidiya Tapu (S. Andaman) and in forest areas of Parnasala near Rangat (Middle Andaman). The present collection establishes the extended distribution of the taxa in Andaman & Nicobar Is. Earlier *Calamus dilaceratus* is reported from East–West Road (Great Nicobar), *Calamus unifarious* from Katachal, Kamorta, Galathea (Nicobar Island) and *Korthalsia rogersii* from Diglipur (N. Andaman) and Havlock Island (S. Andaman). *Phoenix andamanensis* was reported from Saddle peak at 700 m above MSL, in the eastern slope of Mt. Ford, Cinque Island and Rutland Island (Brandis 1906; Parkinson 1923). The authors also found this taxon in Kalighat (Diglipur District) in the vicinity of hydro electric power station.

Endemism

The most remarkable feature of Andaman & Nicobar Islands is the high level of endemism of palms both at generic and species level (Balakrishnan 1977; Balakrishnan and Nair 1977; Ellis 1989; Subbarao 1989). Seven genera with a total of 18 species viz. *Bentinckia nicobarica*, *Phoenix andamanensis*, *Pinanga andamanensis*, *Pinanga manii*, *Rhopaloblaste augusta*, *Calamus andamanicus*, *C. baratangensis*, *C. basui*, *C. dilaceratus*, *C. nicobaricus*, *C. pseudorivalis*, *C. semierectus*, *C. unifarius* var. pentong, *Daemonorops aurea*, *D. manii*, *D. rarispinosa*, *D. wrightmyoensis*, and *Korthaslsia rogersii* are endemic to these islands. Among the non-endemic palms (about 14%), *Calamus longisetus*, *C. palustris*, and

Daemonorops kurziana are not found in the mainland India, but have only extra-Indian distribution in China, Peninsular Malaysia, W. Thailand, and Lesser Sunda. Table 1 gives the analysis of species distribution, number of endemics, and number of taxa occurring in mainland India and elsewhere to assess their percentage. Andamans have one species (*Calamus viminalis*) common to NE India, Bangladesh, and China to Indonesia. Four species are common to SE Asian countries. *Calamus andamanicus* is common to Andaman & Nicobar Islands. Other species of palms show very restricted distribution with approximately 5–10 individuals constituting a population. In addition, there are few palms introduced and grown as ornamentals (Table 2).

Threats to the diversity of palms

The palms in Andaman & Nicobar Islands have been under great threat due to various factors. In recent years, many of the native palm habitats are affected by ecological catastrophe like tsunami and anthropogenic factors placing several species in immediate danger of extinction. The taxa such as *Arenga pinnata*, *Bentinckia nicobarica*, *Calamus basui*, *C. dilaceratus*, *C. semierectus*, *C. unifarius*, *Corypha utan*, *Daemonorops manii*, *D. rarispinosa*, *D. wrightmyoensis*, *Korthalsia rogersii*, *Nypa fruiticans*, *Phoenix andamanensis*, *Pinanga andamanensis*, *P. manii*, and *Rhopaloblaste augusta* show very restricted distribution and their population size is small and places them under high threat of extinction. Some of the taxa like *Bentinckia nicobarica*, *C. dilaceratus*, *Korthalsia rogersii*, *Nypa fruticans*, *Pinanga andamanensis*, and *P. manii* are already mentioned in the *Red Data Book* as vulnerable (Ahmedulla and Nayar 1986). According to Sharma and Bhat (1982), Andaman & Nicobar Islands are referred as the last bastion of useful palms. Renuka (1995) reported that severe pressure from rattan industries in the mainland together with the unscientific extraction and over-exploitation of the raw materials resulted in the depletion of the rattan resources at a faster rate in some of the islands. Recent survey revealed that over-exploitation is continuing and the resource is disappearing rapidly. *C. nicobaricus* reported earlier could not be relocated during later surveys. When compared to the data collected during earlier survey, it is observed that there is considerable reduction in population size in the localities visited during the present study. Further, the massive earthquake followed by tsunami on December 26, 2004, has caused irrepairable damage to biodiversity. All 38 inhabited islands have been affected by this devastating episode. The astounding impact on vegetation loss is more in Nicobar groups of islands than in middle and South Andaman, and there was vast inundation of seawater in the low-lying areas. Middle Andaman, South Andaman, Little Andaman, Car Nicobar, Teressa, Katchal, Kamorta, Nancowry, Little Nicobar, and Great Nicobar islands were severely affected by tsunami. Vast forest areas which form natural habitat of the palms around Galathea bay, Indira Point, Chengappa Bay, and Laful Bay were completely destroyed by tsunami. Further, 5891 ha of damaged land pertain to plantation crops—coconut and arecanut (Official Report for the year 2006 from Andaman & Nicobar Islands Administration). During our field survey, it was found that the swamps and mangrove creeks in Shoal bay (South Andaman) and Austin I & II, and "D"-Sector near Mayabunder, which were once covered with dense population of *Phoenix paludosa*, were badly affected by tsunami (Fig. 1).

Rarity—cause for concern

Nearly half the world's vascular plant species are endemic to 34 "hotspots" of biodiversity, each of which has at least 1500 endemics. None of these hotspots have more than

Table 1 Diversity of palms in Andaman & Nicobar Islands

Taxa	Local name	Andaman	Nicobar	Mainland India	Other places
Areca catechu L.	Supari	Natural populations are found in S. Andaman (Balakrishnan and Nair 1979) and in other places it is under cultivation	Under cultivation in many islands	Under cultivation in many places	Trop. & Sub-trop. Asia
Areca triandra Roxb. ex Buch.-Ham.	Jungly supari	Chidiya Tapu, Baratang Is., Austin I & II, Mayabunder, Rangat, Diglipur	Great Nicobar (E–W & N–S Road), Laful bay, Car Nicobar	Assam	Trop. & Sub-trop. Asia
Arenga pinnata (Wurmb.) Merr.	Jungly narial	Very rare, few plants found in Austin I & II near Mayabunder	–	North East India	S. China to Central Malaysia
Arenga westerhoutii Griff.	–	N. Andaman	–	Arunachal Pradesh, Manipur	Bhutan to S. China and Pen. Malaysia
Bentinckia nicobarica (Kurz) Becc.	–	–	Endemic to Nicobar Is.– Car Nicobar, Nancowry	–	–
Calamus andamanicus Kurz	Motta beth	Widely distributed in Andaman Is.	Widely distributed in Nicobar Is.	–	–
C. baratangensis Renuka and Vijayakumaran	Malay beth/ Rassi beth	Endemic to Andaman Is. Shoal bay, Chidiya Tapu, Baratang Is., Little Andaman, Ross & Smith Is., Rangat	–	–	–
C. basui Renuka and Vijayakumaran	Safed beth	Very rare and endemic to Little Andaman	–	–	–
C. dilaceratus Becc.	Lal beth	–	Rare and endemic found in Great Nicobar (E–W & N–S Road), Laful bay	–	–
C. longisetus Griff.	–	Shoal bay, Chidiya Tapu, Baratang Is., Little Andaman, Ross & Smith Is., Rangat	–	–	China, Pen. Malaysia

Table 1 continued

Taxa	Local name	Andaman	Nicobar	Mainland India	Other places
C. nicobaricus Becc.	Dahya	–	Rare and Endemic to Car Nicobar, Katchal, Great Nicobar	–	–
C. palustris Griff.	Dunda beth	S. Andaman (Shoal bay, Chidiya Tapu, Mount Harriet), Little Andaman	–	–	S. China, Pen. Malaysia, Cambodia, Laos
C. pseudorivalis Becc	–	–	Endemic to Great Nicobar (E–W & N–S Road), Laful bay	–	–
C. semierectus Renuka and Vijayakumaran	–	–	Rare, endemic to Car Nicobar	–	–
C. unifarius H.Wendl. var. Pentong Becc.	–		Endemic to Great Nicobar, Car Nicobar	–	–
C. viminalis Willd.	Jungli beth	Chidiya Tapu, Ross & Smith Is., Rangat	–	Andhra Pradesh, Bihar, Manipur, Orissa, Sikkim, Tripura, W. Bengal	SC. China Chittagong (Bangladesh) Lesser Sunda Is. (Bali)
Caryota mitis Lour.	Madipathy	Mount Harriet, Chidiya Tapu, Ross & Smith Is., Mayabunder, Little Andaman	Great Nicobar, Car Nicobar	–	Indo-China and Malaysia
Corypha utan Lam.	–	Rossland Is., Baratang Is., Mayabunder	–	N-E India	N. Australia
Daemonorops aurea Renuka and Vijayakumaran	–	Endemic to S. Andaman—found in Shoal bay, Chidiya Tapu, Mount Harriet	–	–	–
D. kurziana Hook.f. ex Becc.	Sanka beth	S. Andaman, Wandoor, Tharmugali, Chidiya Tapu, Shoal bay	–	–	W. Thailand
D. manii Becc.	Sanka beth	Wrightmyo (S. Andaman)	–	–	–

Table 1 continued

Taxa	Local name	Andaman	Nicobar	Mainland India	Other places
D. rarispinosa Renuka and Vijayakumaran	–	Endemic to Little Andaman	–	–	–
D. wrightmyoensis Renuka & Vijayakumaran	–	Endemic to S. Andaman—found in Shoal bay and Wrightmyo	–	–	–
Korthalsia laciniosa (Griff.) Mart.	Lal beth/ Burma beth	Shoal bay, Mount Harriet, Chidiya Tapu, Ross & Smith Is., Mayabunder, Little Andaman, Baratang Is., Rutland Is.	–	–	Indo-China to Philippines
K. rogersii Becc.	–	Endemic to Andaman Is. Chidiya Tapu, Rangat	–	–	–
Licuala peltata Roxb. ex Buch.-Ham.	Salai pathy	Lime stone cave, Mud volcano (Baratang Is.) Rangat (Parnashala), Bakulthala	Laful bay, Great Nicobar, Car Nicobar	Assam, Bihar, Manipur, Tripura	Bhutan to Pen. Malaysia
L. spinosa Wurmb.	Salai pathi	Shoal bay, Chidiya Tapu, Baratang Is., Rutland Is., Ross & Smith Is.	–	–	Indo-China to Philippines
Nypa fruiticans Wurmb.	Dhani ped	Dhanikari, Sippighat	Laful bay, Car Nicobar	West Bengal	Sri Lanka to Caroline Is.
Phoenix andamanensis S. Barrow	Jungly kajur	Endemic to Andaman–Saddle peak, Kalighat, Rutland Is., Cinque Is.	–	–	–
P. paludosa Roxb.	Jungly kajur	Shoal bay, Mud volcano, Lime Stone Cave (Baratang Is.) Sound Is., Interview Is., Ross & Smith Is., "D" sector, Mohanpur, Mayabunder	Nicobar Is.	Orissa, West Bengal	Sumatera
Pinanga andamanensis Becc.	Komba	Endemic to Andaman Is.–Baratang Is., Mount Harriet, Shoal bay	–	–	–

Table 1 continued

Taxa	Local name	Andaman	Nicobar	Mainland India	Other places
P. manii Becc.	Bada komba	Andaman Is.–Chidiya Tapu, Mount Harriet	Car Nicobar, Laful bay	–	–
Rhopaloblaste augusta (Kurz) H.E. Moore	–	–	Endemic to Nicobar Is.–Car Nicobar, Great Nicobar (Galatea, Laful bay)	–	–

Authors of the present study visited all the areas mentioned under Andaman & Nicobar Islands and mainland India

Table 2 Introduced palms

Borassus flabellifer L.
Chrysalidocarpus lutescens H.Wendl.
Cocos nucifera L.
Elaeis guineensis Jacq.
Livistona chinensis (Jacy.) R. Br.ex Mart.
Phoenix sylvestris (L.) Roxb.
Roystonea regia (Kunth) O.F. Cook

Source: "World checklist of palms"—Govaerts and Dransfield (2005)

Fig. 1 Coconut and *Phoenix paludosa* populations affected by tsunami

one-third of their pristine habitat remaining. Historically, they covered 12% of the land's surface, but today their intact habitat covers only 1.4% of the land. As a result of habitat loss, we expect many of the hotspot endemics to have either become extinct or be threatened with extinction (Brooks et al. 2002). Humans are the major cause of habitat alteration, climate change, and species endangerment (Woodruff 2010).

The first notable scientific activity related to palm conservation took place only about three decades ago, when Moore (1979) drew attention to the need for palm conservation which eventually led to formation of the IUCN Palm Specialist Group in 1984. Palm conservation is a complex and challenging task. Endemic island palm species are very important for biodiversity maintenance since many are monotypic. Our observation on the distribution of the species also revealed that most of the endemic species are highly habitat specific occurring in very limited localities and in small populations. Destruction of even a small forest area in these islands may cause complete extinction of the endemics. Apart from this, in most palm species, the seed viability decreases rapidly. Palm seed cannot be dried and kept under low temperature conditions because the embryo will be killed. Major botanic gardens can play a vital role with regard to palm conservation. As far as conservation is concerned, two major obstacles exist with respect to botanic gardens. They can preserve only a few specimens of any given species. They cannot, therefore, represent the range of characteristics found in wild relatives necessary to maintain the biological diversity. This is true with reference to the BSI Botanic Garden at Dhanikari and proposed Biological Park at Chidiya Tapu. Although, they form important biodiversity reservoirs helping in conservation of diverse taxa of plants, they cannot protect the genetic diversity of wild palms.

Most of the palm species are very rare and live at the brink of extinction. Therefore, conservation and sustainable utilization of palm resources assumes great importance in the current context, when forest wealth of the nation as a whole has been on the decline. Unless concrete efforts toward their replenishment are undertaken, some of these wild palms are likely to become extinction. For prevention of further genetic erosion of these species, the development and adoption of appropriate conservational strategies are very much warranted. The safeguarding of hotspots worldwide is the greatest biodiversity challenge of the foreseeable future. The need of the hour is to revive global conservation attention to this biologically rich, important but imperiled region. Comprehensive conservation programme worldwide would be an appropriate step in this direction.

Some strategies for conservation of palms are as follows:

- Establishment of a palmetum with representation of all the species growing in the islands.
- Establishment of gene banks and seed orchards.
- Establishment of large scale palm plantation of commercially important species.
- Understanding the reproductive biology and phenology of palm taxa which are very important for the selection of elite varieties and conservation.
- Control on the exploitation of wild populations.
- Check on the destruction of natural habitats.
- Identifying specific pockets in the natural area of the occurrence of rattans and palms for in situ conservation.
- Introduction of rare and threatened species into Botanic gardens, arboreta and other protected areas.
- Evolving potentially useful methods for the propagation and improving the various existing methods.

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