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## Indian *Cycas* under severe threat

Cycads are an ancient group of plants which have survived three mass extinctions. They are dioecious, perennial, palm-like trees or shrubs with woody trunk above the ground or subterranean. They are a relict group of seed plants that evolved in the late Carboniferous or early Permian around 300 million years ago<sup>1</sup>. With the ever-increasing interest in cycad taxonomy over last two decades, the number of new species of cycad has increased significantly. At present around 340 species belonging to 10 genera in 3 families are found naturally in tropical and subtropical regions. They are distributed in at least 60 countries in South and North America, Africa, Asia and Australia<sup>2-4</sup>. All the surviving cycads are under threat due to various abiotic and biotic pressures. They are listed amongst the most threatened plant families in the world in the 1997 IUCN Red List of Threatened Plants<sup>5</sup>. Nearly 64% of cycads are threatened, which is the highest value of risk of extinction given to any group of organism<sup>6,7</sup>.

Taxonomy of cycads had its origin in India. Van Rheede gave the first description of a cycad, ‘Todda panna’, the Malayalam name of *Cycas circinalis*. Linnaeus<sup>8</sup> used the illustrations of Van Rheede for naming the genus *Cycas*. In India, cycads are represented by only one genus, *Cycas*. Out of the 12 species (Table 1) of Indian *Cycas* reported so far, 5 species, viz. *Cycas andamanica*, *Cycas annaikalensis*, *Cycas indica*, *Cycas nayarhensis* and *Cycas swamyi* have been described in the last 10 years<sup>9-13</sup>. They grow naturally in open forests or under canopy in the Western Ghats, Eastern Ghats, North East India, and Andaman and Nicobar Islands.

Indian cycads are extensively used as food, traditional medicine, cultural and religious rituals wherever they grow naturally. In South India, *Cycas* fronds are used to decorate temples and churches<sup>14</sup>. In remote areas of the Western and Eastern Ghats, seeds of *Cycas* are extensively used as food as an alternative for starch<sup>15,16</sup>. Male cones are

used as pest repellent in Kerala and Odisha. In NE India, the young circinate leaves are commonly used as green vegetables and for making special dips and chutneys. Decoction of mature leaves is used to cure cystolithiasis and stomach-ache<sup>17</sup>. In urban areas, cycads are extensively grown in gardens as ornamental plant and the leaves are used in flower arrangement.

All the habitats of Indian *Cycas* species are threatened and have suffered severe reduction and degradation. These ever-increasing pressures are mainly due to clearing of forest, increase in human population, urbanization and unsustainable harvesting of seeds and male cones. Populations located at the vicinity of human settlements are more prone to anthropogenic activities, especially clearing of forest for agriculture. Illegal mining in forest areas and unsustainable harvesting of seeds are some of the main causes for reduction of cycad populations in the Eastern Ghats. All species of Indian *Cycas* are threatened (Table 1). Little

**Table 1.** Indian *Cycas* species and their conservation status (according to IUCN Red List)

Species	Distribution	Conservation status
<i>Cycas andamanica</i> Prasad, Ramana, Sanjappa & Rao	Andaman and Nicobar Islands	Critically endangered
<i>Cycas annaikalensis</i> Singh & Radha	Kerala	Critically endangered
<i>Cycas beddomei</i> Dyer	Andhra Pradesh	Endangered
<i>Cycas circinalis</i> L.	Kerala, Tamil Nadu	Endangered
<i>Cycas indica</i> Linstrom & Hill	Karnataka	Data deficient
<i>Cycas nathorstii</i> Schust.	Tamil Nadu	Vulnerable
<i>Cycas nayagarhensis</i> Singh, Radha & Khuraijam	Odisha	Critically endangered
<i>Cycas orixensis</i> (Haines) Singh & Khuraijam	Odisha	Endangered
<i>Cycas pectinata</i> Buch.-Ham.	Assam, Bihar, Manipur, Meghalaya, Sikkim, West Bengal	Vulnerable
<i>Cycas sphaerica</i> Roxb.	Andhra Pradesh	Data deficient
<i>Cycas swamyi</i> Singh & Radha	Karnataka	Data deficient
<i>Cycas zeylanica</i> (Schust.) Lindstrom & Hill	Andaman and Nicobar Islands	Vulnerable

**Figure 1.** *Cycas beddomei* in natural habitat at Tirumala Hills, Andhra Pradesh, India.**Figure 2.** Conservation of cycads at Cycad House, CSIR-NBRI Botanic Garden, Lucknow, India.

attention has been paid towards preservation and conservation of the endemic cycads<sup>18</sup>. Till now, habitat of only one species, i.e. *Cycas beddomei* is protected using stringent laws (Figure 1). However, the remaining 11 species are prone to habitat destruction and illegal trade. Enactment of appropriate laws and cooperation of forest-dwellers will play an important role in successful *in situ* conservation of Indian *Cycas*. A successful long-term conservation of cycads can be achieved through combination of *in situ* and *ex situ* conservation. *Ex situ* conservation is a boon for cycads in restoring their natural populations, and protection from other biotic and abiotic factors, including natural calamities, climate change and habitat destruction. In India, only few botanic gardens carry out *ex situ* conservation of cycads. CSIR-NBRI Botanic Garden in Lucknow, Lalbagh Botanic Garden in Bengaluru and Acharya Jagadish Chandra Bose Indian Botanic Garden in Kolkata house some magnificent living specimens of cycads.

Cycad Conservation Centre at CSIR-NBRI Botanic Garden is the only Centre in India for *ex situ* conservation for this endangered and threatened group of plants. The centre houses 56 species of cycads (Figure 2). Out of the 12 species of *Cycas* found in India, 9 are conserved in this Centre, viz. *C. annaikalensis*, *C. circinalis*, *C. beddomei*, *C. nayagarhensis*, *C. orixensis*, *C. pectinata*, *C. sphaerica*, *C. swamyi* and *C. zeylanica*. The major activities of the Conservation Centre are collection, conservation, multiplication and study of reproductive biology. Propagation technique of Indian *Cycas* has also been developed at the Centre<sup>19</sup>. Here, the species are multiplied through vegetative

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propagation and seeds for raising sufficient number of seedlings for *ex situ* conservation and reintroduction in future.

Considering the present threat to Indian *Cycas* species and their habitats, *ex situ* conservation in various botanic gardens is important. Propagation of the species at different botanic gardens and reintroduction could reduce the pressure of over-collection from the natural habitats. All the natural cycad localities should be designated as Cycad Conservation Sites by the respective Forest Departments of the states in order to protect habitats and reduce over-exploitation. Botanic gardens in India especially the lead gardens identified by the Ministry of Environment, Forest and Climate Change, Government of India should collaborate and frame a strategy for joint efforts to conserve these threatened species, besides making them available for sustainable horticultural use.

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