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Diversity, exploitation, conservation and current status of Indian *Cycas*

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Abstract

Many of the medicinal plants, which were common a century ago, have become uncommon today in the wild due to various anthropogenic activities. The current status of those medicinal plants has been assessed under the following threatened categories: vulnerable, endangered and critically endangered. The international conventions namely CBD (Convention on Biological Diversity) and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) emphasize on the conservation of plant species and plant groups including the genus *Cycas* for posterity by sustainable utilization. The present article highlights the unique characteristic features of the genus *Cycas* and its diversity, exploitation, conservation and current status in India.

Keywords: *Cycas*, endangered, exploitation, CITES, conservation, status

Introduction

Cycas L. is a dioecious genus comprising of *ca* 100 species worldwide. In India, it is represented by 18 species, and are distributed mainly in the Western Ghats, Eastern Ghats and Northeastern regions of India (Lindstrom & Hill, 2007) [2].

The three extant families classified under the order Cycadales are, Cycadaceae, Stangeriaceae and Zamiaceae. In India, *Cycas* is the only genus that occurs in the wild, even though some of the exotic Cycads, mainly *Cycas revoluta* Thunb. (Native to Japan), and several species of *Zamia* (Zamiaceae) have been grown in the gardens/houses. The seeds of Cycads are generally considered as poisonous to livestock as well as to human beings as they contain unique neurotoxic and carcinogenic chemicals.

Nowadays, medicinal plants have been overexploited to meet the demand of the crude drug industries such as pharmaceutical companies, local medicine men and traditional medical practitioners.

Historic perspectives of Cycads

The genus *Cycas* is considered as one of the primitive plant groups (having naked seeds) and is botanically classified under Gymnosperms. All the members of the order Cycadales are commonly and collectively called Cycads.

Cycads show dioecious (unisexual) condition, that is, they produce separate male and female plants. Cycads are considered important plant group phylogenetic point of view. Scientists believe that the Cycads might have been favourite food for the herbivorous giant Dinosaurs, which became extinct during Jurassic Period, about 145 million years ago in the geological time scale. The Jurassic Period is generally considered as the "Age of Cycads", because they had attained their zenith of abundance and diversity during that period. Dinosaurs have completely extinct while some of the Cycads have managed to survive even today, that is why, they are regarded as the "Living Fossils". They are also called "Plant Dinosaurs". Further, the botanists and Paleobotanists believe that Cycads (Gymnosperms) might have evolved from seed-bearing tree ferns (Pteridophytes) and also believe that they were the ancestors for the present day seed-bearing Angiosperms, the flowering plants (Lindstrom & Hill, 2007; Goel, 2012; Selvam, 2016) [2, 1, 7].

Characteristic features of the genus *Cycas*

The genus *Cycas* is very slow in growth and development, which produces a crown of leaves usually once or twice in a year and also produce the male and female cones once in a year. *Cycas* exhibits two types of characters, viz., like-characters and the unique-characters.

Like-characters: *Cycas* species are palm-like in appearance due to the presence of a crown of bird's feather-like leaves and persistent leaf bases all around the stem.

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However, they are not palms in reality, yet, we may call them as Pseudo-palms. They are tree-like in habit due to the presence of arbore scent stems, but they are not trees in veracity, since they lack woody stems (solid secondary xylem), a typical character of the trees, but instead they possess a pithy stem. Therefore, we may call them as False-trees. They are cactus-like in some of the characters such as the presence of spines/thorns in the foliage leaves and scale leaves, presence of the sunken stomata on the lower surface of the foliage leaves and also storing of water in the pith region of stem when the plant is young. As the plants getting matured, the pith region of the plants becomes a storehouse of the starch grains. They are fern-like in circinate vernation, particularly tender leaves of *Cycas* are coiled/curled like that of the fronds of ferns when they emerge (Goel, 2012; Selvam, 2016)^[1, 7].

Unique characters: Species of *Cycas* lack lateral veins in the leaflets/pinnules, which is one of the distinguishing characters of *Cycas*. They produce usually two types of roots, normal underground roots, for anchoring and absorption of water and minerals, and coralloid roots, for nitrogen fixation. With the help of the coralloid roots, they fix atmospheric nitrogen in the roots with the help of blue-green algae like *Anabaena*. Unusually, a very few species of *Cycas* produce aerial roots on the stem. Further, they produce two types of leaves, spiny scale leaves and narrow foliage leaves. They produce two types of cones, male and female cones, which are technically known as micro- and mega-sporophylls, respectively. Nevertheless, *Cycas* produces the largest ovules in the plant kingdom that too naked ovules. Some of the species of *Cycas* show prominent and persistent leaf bases all around the stem, by counting the number of leaf bases, one can tell the age of the plants. Some of the *Cycas* also show pseudo-branching due to the outgrowth of the bulbils. A very few *Cycas* species produce typical dichotomous branching pattern in the stem. The internal structure of the leaflets/pinnules show two types of xylem, viz., centripetal and centrifugal xylem, which are more or less inverted triangular in shape (Goel, 2012; Selvam, 2016)^[1, 7].

Diversity of Indian *Cycas*

So far, a total of 18 species of *Cycas* have been reported from the wild. The species of Indian *Cycas* were named after places (type locality of the species), eminent persons and shape of the plant parts.

Most of the species of *Cycas* found in India are endemic. *C. andamanica* is endemic to Andaman Islands, *C. annakailensis* is endemic to Kerala; *C. beddomei* is endemic to Andhra Pradesh; *C. circinalis* is endemic to Western Ghats of Kerala; *C. indica* is endemic to Western Ghats of Karnataka; *C. nayagarhensis* and *C. orixensis* are endemic to Eastern Ghats of Odysa; *C. sphaerica* is endemic to Eastern Ghats of Andhra Pradesh, *C. swamyi* is endemic to Karnataka (Singh & Radha, 2006; Lindstrom & Hill, 2007; Reddy *et al.*, 2007; Singh & Radha, 2008; Saneesh, 2009; Prasad *et al.*, 2015; Rao *et al.*, 2015; Singh *et al.*, 2015)^[8, 2, 5, 9, 6, 3, 4, 10].

In addition to these wild species, an exotic species, namely *Cycas revoluta* Thunb. has been introduced into India from Japan long back, which is now commonly grown as an ornamental in almost all gardens and office premises and occasionally in houses, across the country due to its attractive miniature nature of the plants and its sustainability in variety of climatic conditions.

Exploitations of Indian *Cycas*

The most commonly exploited *Cycas* species in the wild are, *C. beddomei* and *C. circinalis* for medicinal and edible purposes. The male cones have medicinal properties (aphrodisiac and narcotic properties) due to that reason they are illegally cut and sold for Rs. 1,500/- per cone in the vegetable crude drug markets of South India. The seeds of *Cycas* are considered toxic to livestock and also human beings as they contain neurotoxic and carcinogenic (causes cancer) chemicals, still they are being harvested, processed and used as food by the tribal and local people mainly in the state of Kerala. It is to be noted that from the state of Kerala, the seeds of *C. circinalis* are illegally traded in large quantities. The male cones of *Cycas* are considered as anticancerous (cures cancer). In addition to the male and female cones, the leaves are exploited by the tribal and local people for ornamental and ceremonial purposes (Saneesh, 2009; Selvam, 2016)^[6, 7].

Conservation of Indian *Cycas*

Apart from *C. revoluta*, another *Cycas* species namely *C. circinalis* is commonly conserved in some of the botanic gardens of colleges, universities and research institutions in India. It is suggested that the Government of India and the concerned State governments should come forward to propagate some of the Indian *Cycas*, particularly *C. beddomei* (Indian miniature *Cycas*) in large quantities using tissue culture methods, which may be supplied to government and private gardens for ex situ conservation.

Once upon a time, the genus *Cycas* was common in occurrence, but now, they have become uncommon (endangered) in their natural habitats. Fortunately, the Government of India has taken legal steps to protect/conservate this unique plant group from further depletion in the wild, by placing them in the Negative list of Exports in 1998, which bans its illegal trade/exports collected from wild populations.

Current status of Indian *Cycas*

The present status of *Cycas andamanica* and *C. nayagarhensis* in the wild is Critically Endangered. The current status of *C. beddomei*, *C. circinalis*, *C. orixensis* and *C. pectinata* is endangered. The recent status of *C. nathorstii* and *C. zeylanica* is Vulnerable. *Cycas swamyi* is currently categorized as Threatened species. *Cycas annaikalensis*, *C. indica* and *C. sphaerica* are presently placed under Data Deficient category according to the IUCN/SSC guidelines. The current status of the remaining Indian species of *Cycas* is not evaluated (Singh & Radha, 2006; Reddy *et al.*, 2007; Singh & Radha, 2008; Saneesh, 2009; Prasad *et al.*, 2015; Rao *et al.*, 2015; Singh *et al.*, 2015)^[8, 5, 9, 6, 3, 4, 10].

Conclusion

Nowadays, so much of talk is going on regarding the conservation of biodiversity. However, conservation of biodiversity could not be achieved practically due to lack of awareness among the people concerned. Effective conservation of rare and endangered medicinal plants (including the genus *Cycas*) is possible only when the concerned State Governments come forward to create awareness among the common public (particularly among the traders, tribals and locals, where those plants growing naturally in the wild) about the rarity of the species and the importance to conserve them for posterity by sustainable utilization. In addition to *in situ* conservation measures, *ex*

situ conservation measures are extremely important due to overexploitation of such plants in the wild. To conclude, if the present generation does not come forward to conserve these plants in the wild, the future generation would see them only in the museum as exhibits.

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