

Mutualistic Relationships Involving the Endemic *Cycas circinalis* L.: Field Notes from the Appankappu Forests, Nilambur, Kerala, India

Article and Photos by Saneesh C.S.* and Anita Varghese**

The forests of the Nilambur region on the western side of the Nilgiri Biosphere Reserve represent one of the biodiversity hotspots of the world. They harbor several endangered, endemic, and/or unidentified species of flora and fauna. This area also borders the Silent Valley National Park (south side) and the Mukurthi National Park (east side). The area's average rainfall is 3,000 mm (= 120 in). The forests include tropical evergreen, semi-evergreen, and moist deciduous types. The main river, Chaliyar, starts in the Elambileri Hills at 2,000 m (= 6,500 ft) above sea level (masl). The river's important tributaries are the Karimpuzha, Cherupuzha, Talipuzha, Panapuzha, Korampuzha, Karipuzha, and others. The major indigenous groups ('adivasi') of Nilambur whose lives are closely linked to the forests are the Cholanaickan, Pathinaickan, Paniyan, Aranadan and Malamuthan.

Keystone Foundation (www.keystone-foundation.org) is a volunteer agency working on conservation, enterprise, and livelihood issues. Our work in the Nilgiri Biosphere Reserve, Western Ghats, India, focuses on indigenous forest-dependent communities and their use of non-timber forest products. We also monitor the ecological status of the products used by the people. Over the years, we have found a high level of dependence on the endemic cycad, *Cycas circinalis*, by indigenous people and medicinal plant traders.

'Eentha', as it is known locally, is quite abundant with a good representation in all size categories. Cycad populations that we have observed are located in semi-evergreen and moist deciduous forests at elevations ranging from 30-100 masl (= 100-320 feet). Many plants were also found growing within the teak plantations and bamboo thickets of the area.

Humans

Forest gatherers relish 'eentha' seeds, which are harvested in plenty for consumption. The seeds are smoke-dried and leached several times before being powdered into flour and used to make pancakes. An elderly Paniya lady of the Nedumkayam village tells us that "we can make anything with Eenthapodi!" There is a significant demand for processed 'eentha' seeds in the local market, and gatherers often sell a portion of their harvest.

The tender new leaves are also broken off, cut into bits, and left overnight in water before being cooked and eaten, while mature leaves are harvested to decorate temples during festivals. The male cones are also much sought-after by local paddy farmers. The cones are placed in the center of the fields to repel pests that attack especially when the rice grain starts to ripen. The latter practice has also been reported as common among farmers in Karnataka (R. Ganesan, pers. comm.).

Insects

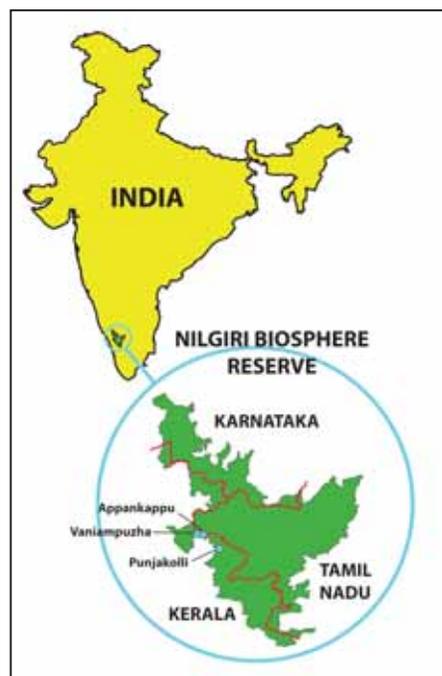
Cycas circinalis is host to the plains cupid butterfly (*Edales pandava*, Family Lycaenidae). In early May 2007, an adult butterfly was observed on young cycad leaves. Within days, the larvae emerged and were feeding on the young shoots. The cycad had also begun producing a new flush of leaves as if in response to the larval needs. When they were finished feeding, the larvae then huddled together at the base of the leaves, pupated, and within a period of 7-9 days emerged in a burst of blue.

Two species of ants were also observed on *Cycas circinalis* plants. One was collecting the secretions found on the hairs of the cycad's emerging leaves, while the other was observed collecting secretions from the bodies of plains cupid butterfly

larvae. Mann (1999) reports that a gland on the back of the caterpillar secretes a liquid containing sugar and amino acids that helps sustain the ants. The ants benefit from this secretion, and the caterpillars are not harmed in any way. The ants repay the caterpillars by protecting them from would-be predators.

Devries and Poinar (1997) discuss an amber fossil of a caterpillar they found that possessed the major organs used by extant caterpillars in relationship with ants: tentacle nectary organs, balloon setae, and vibratory papillae. The fossil was dated at 15-20 million years old. Could this be an example of an ancient symbiosis between butterflies, ants, and cycads?

Dammer bees (*Trigona* spp., Family Meliponidae) were also observed collecting secretions from tender new cycad leaves. Bees make 'propolis'—a powerful natural antibacterial and antiviral food—by collecting resinous sap from cycads and then mixing it with wax back at the hive. This food keeps them resistant to bacterial and viral infections that can otherwise wipe out their colonies (R. Leo, pers. comm.). The dammer bees are often seen taking resinous sap from various extrafloral sources, and secretions on the hairs of newly emerging cycad leaves are quite sticky and resin-like.



Location of three Indian populations of *Cycas circinalis* (blue dots) studied in the Nilambur region, located in the western portion of the Nilgiri Biosphere Reserve in southern India. Map redrawn by Bart Schutzman.



Fig. 2. *Cycas circinalis* in the moist deciduous forest: a) adult; b) sub-adult

*Research Assistant, Bees, Biodiversity, and Livelihoods Project, Keystone Foundation, Nilambur

**Coordinator of Action Research, Keystone Foundation, Kotagiri

Other Mammals

Though no direct observations were made with regard to non-human mammals, indigenous people have often brought us *Cycas circinalis* seeds that had been 'eaten' and discarded by fruit bats. On the banks of the Neerpuzha River, we have observed many bat colonies. The flying fox (*Pteropus giganteus*) is a fruit bat that feeds solely on the juice of fruits extracted by chewing dry the fleshy pulp which is then spat out (Prater, 1971). Coning cycads bear one of the few 'fruits' available in the forest during the monsoon period. They are often foraged on by flying foxes, and the seeds are dispersed in return. According to a local villager, excessive removal of cycad seeds by harvesters often leaves little for the bats to feed on.

The Sambar (*Cervus unicolor*), one of India's largest deer species, is also found in the forests in Nilambur, and often feeds on fallen cycad seeds.

Summary

The *Cycas circinalis* plants that we observed during our research in the Nilambur forests have shed much light on the multi-faceted role of a single 'keystone' species within this unique and endangered ecosystem. Besides the ants, butterflies, and bats, epiphytes have been found growing on the bark, spiders weave their webs across the leaflets, and bamboo seedlings have been observed germinating on the surface of a cut cycad stem.



Fig. 3. Seeds of *Cycas circinalis*: a) on the tree; b) being chopped; c) being smoked

The cycads have survived against all odds, even when their companions, the dinosaurs, lost out. But what lies ahead for this species that has withstood the test of so many millennia? And what, then, will be the fate of the numerous organisms that depend on it?

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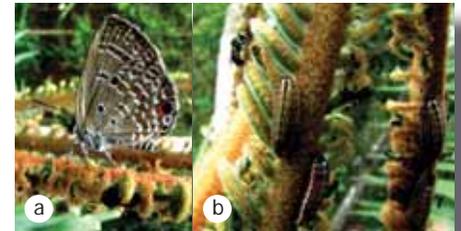


Fig. 5. Plains cupid butterfly (*Edeales pandava*): a) adult; b) caterpillars on new leaves of *Cycas circinalis*



Fig. 6. Ants feeding from the glands of plains cupid caterpillars



Fig. 7. Dammer bee taking resinous sap from newly emerging *Cycas* leaves



Fig. 4. Leaves of *Cycas circinalis*: a) young leaves not yet harvested; b) mature leaves previously cut for decorations

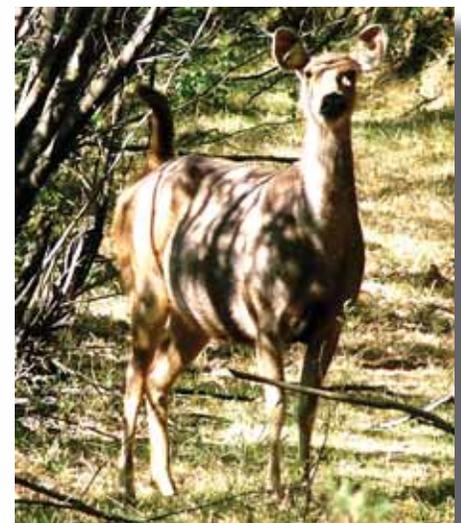


Fig. 8. Sambar deer