DIVERSITY OF FUNGI, LICHENS, ALGAE, NON-FLOWERING AND FLOWERING PLANTS OF TAMIL NADU STATE – AN OVERVIEW

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INTRODUCTION

The state of Tamil Nadu is situated in the eastern part of the southern-most tip of Peninsular India. The state lies between 8°05'–13°34' N and 76°14'–80°21' E, and covers about 1,30,058 km^2 geographical area, constitutes about 4% of the country's total area. The state is bounded by the Bay of Bengal to the east, Indian Ocean to south, and the Arabian Sea on to the southwest and by the states of Kerala to the west, Karnataka to the northwest, and Andhra Pradesh to the north, and parts of Puducherry Union Territory (Puducherry proper and Karaikal) along the north-central coast. The state is administratively subdivided into 32 districts.

PHYSIOGRAPHY

The land mass of the state appears roughly rhomboidal in outline, stretching from Pulicat lake in north to Kanyakumari in south, and from Gudalur in the west to Point Calimere in the east. The western, southern and the north-western parts of the state are hilly and rich in vegetation. The Western Ghats, one of the 34 globally recognised biodiversity hotspots (Mittermeier & al., 2004), also forms a significant part of the state. In fact, Tamil Nadu is the only state with both hill ranges, Western Ghats and Eastern Ghats, both meet at the Nilgiri hills. Almost the entire western border of the state is occupied by the Western Ghats with Kerala. Doddabetta in the Nilgiris district of Western Ghats is the tallest peak (2637 m) in Tamil Nadu. The eastern parts are fertile coastal plains, and northern parts are a mix of low altitude hills/hillocks and plains, and the central and south-central regions are arid plains. Besides, the state has a chain of 20 coral islands, and several reefs extended along the northern shore of Gulf of Mannar, and these are collectively known as Rameswaram and Krusadai group of Islands, and designated as, the Gulf of Mannar Biosphere Reserve, the first Marine Biosphere Reserve in the country. The state has a land

boundary of about 1200 km, and coastline of about 990 km. The inland wetlands of Tamil Nadu comprise lakes, ponds, reservoirs and seasonally waterlogged areas. The state has about 1175 wetlands (including the Point Calimere Wildlife and Bird Sanctuary, the only Ramsar site in Tamil Nadu), covering an area of 1,615.12 km^2 that support luxuriant riparian vegetation and aquatic plants.

CLIMATE

Tamil Nadu has dry sub-humid to semi-arid climatic conditions. At lower elevations and plains, the day temperature ranges from 23° to 40°C (– 45°C) and night temperature from 18° to 29°C, however, at higher altitudes, especially in Western Ghats, the temperature often drops below freezing point and the relative humidity is as high as 75% during winter. The state receives rainfall from Southwest (from June to September), and Northeast monsoons (from October to December), and the dry season prevails from January to May. The average annual rainfall of the state is about 945 mm.

VEGETATION

The state exhibits great plant diversity, due to immense variety of climate, altitude and edaphic factors. Vegetation of the state can broadly be classified into four major categories, namely, (i) Coastal vegetation, (ii) Island vegetation, (iii) Vegetation of the interior plains and (iv) Vegetation of the hills and mountains (Chithra & Nair, 1999), and each vegetation category may be further divided into various forest types based on "A revised survey of forest types of India" by Champion & Seth (1968).

Accordingly, the coastal vegetation is further classified into strand vegetation, estuarine vegetation and coastal tropical dry evergreen forest, whereas the island vegetation is further categorised into foreshore sandy vegetation, inland sandy vegetation, salt marsh, mangrove and maritime vegetation. The vegetation of the interior plains has been recognized as Southern Tropical Thorn Forest, which occurs at the foot hills or on the undulating slopes of hills and hillocks in rocky terrains bordering the Coromandel Coastal plains. This forest type is further differentiated into Southern thorn forest, Carnatic umbrella thorn forest, Southern **Euphorbia** scrubs and Southern thorn scrubs (Champion & Seth, 1968). The vegetation of hills and mountains is categorised into Dry deciduous forest (350 m and above), South Indian moist deciduous forest

(below the zone of semi-evergreen forest), Semi-evergreen forest (up to 1000 m), Wet evergreen forest (1500 m and above) and Shola or Southern montane wet temperate forest (1000–2300 m) and Grasslands, the latter further divided into low altitude grasslands (up to 1000 m) and high altitude grasslands (1500–2300 m).

DIVERSITY OF FUNGI, LICHENS, ALGAE, NON-FLOWERING AND FLOWERING PLANTS

Based on interpretation of satellite data, the forest cover of the state is 23,625 km^2, including 2948 km^2 area under very dense forest, 10,321 km^2 area under moderately dense forest and 10356 km^2 under open forest, altogether representing 18.16% of state's total geographical area (FSI, 2011). The various forest types in the state exhibit great diversity in different plant groups, ranging from primitive non-flowering plant groups to advanced angiosperms.

Out of 3 megacentres and 25 microcenters of endemic plants in India identified by Nayar (1996) based on the diversity and distribution of endemic species, 1 megacentre (Western Ghats) and 5 microcentres (Agasthyamalai hills, Anamalai and High Ranges [Cardamom hills], Palni hills, Nilgiris – Silent Valley, Wyanad, Kodagu and Southern Deccan [Leeward side] are found in Tamil Nadu, either entirely or sharing with neighbouring states. Presence of these endemic centres reflects the significantly high level of endemism in the flora of the state.

Fungi: Tamil Nadu is one of the plant-rich states in the country that shows enormous diversity in various plant groups, and fungi, lichens and algae. A total of 1077 species in about 370 genera have been recorded from Tamil Nadu till 2002 (Natarajan, 2007). Nilgiris, Palni hills and Anamalai hills in Western Ghats are rich in fungal diversity.

Lichens: A total of about 555 lichen species under 128 genera have been reported from the state (Hariharan & Balaji, 2007).

Algae: The algal flora is broadly categorised into fresh water algae and marine algae. As a whole, a total of 1119 species, subspecies, 100 varieties and 42 forma, altogether representing 1263 taxa of

algae (excluding Dinophyceae), belonging to 8 classes are distributed under 432 genera belonging to 115 families under 38 orders are reported to occur in Tamil Nadu (Baluswami, 2007). Of which, 45 taxa are endemic to the state and 187 taxa are rare in distribution. About 625 marine algal taxa and about 475 taxa of fresh water algae are distributed in the state. The algal flora of the state is dominated by Chlorophyceae (419 taxa), followed by Rhodophyceae (267 taxa), Cyanophyceae (235 taxa), Bacillariophyceae (233 taxa), Phaeophyceae (68 taxa) and Charaphyceae (32 taxa).

Bryophytes: There are 712 taxa of bryophytes occurring in Tamil Nadu, comprising 211 taxa in 56 genera and 32 families of liverworts, 8 taxa in 4 genera and 2 families of hornworts, and 493 taxa in 189 genera and 44 families of mosses (Daniels, 2010). Tamil Nadu supports approximately 29 % of the Indian liverwort flora, 22 % of the hornwort flora and 30 % of the moss flora. Indian endemic species are well represented in the state. Of the approximately 152 liverwort taxa endemic to India (including all island groups and Sikkim), 30 liverworts (19%) are known from Tamil Nadu, ten of which are apparently endemic to the state. Of the 19 Indian endemic hornworts, two (10 %) are currently known from Tamil Nadu. About 65 Indian endemic mosses are known from Tamil Nadu, about 48 of these apparently endemic to Tamil Nadu.

Pteridophytes: In Tamil Nadu, the pteridophytes (ferns and fern allies) are represented by about 275 species in 44 families, of which 33 are endemic to the state and about 80 are recognised as threatened taxa (Manickam, 2007). Terrestrial species constitute more than 46% (about 90 species), whereas, lithophytes constitute 19% (67 species) of the pteridophyte flora of the state. Besides, there are several semi-aquatic ferns and fern allies and only five true aquatic ferns, such as **Azolla pinnata**, **Ceratopteris thalictroides** and **Salvinia molesta**, are found in Tamil Nadu.

Gymnosperms: The state has 4 species of indigenous gymnosperms and about 60 introduced species. The Indian conifer, **Podocarpus wallichianus**, distributed in Peninsular India and Andamans, is confined to the Western Ghats of Tamil Nadu. Similarly, **Gnetum ula**, a woody climbing gymnosperm also inhabits evergreen tropical rain forests of Eastern and Western Ghats of Tamil Nadu. **Cycas circinalis**, an Indian

endemic cycad species, occurs in fairly dense, seasonally dry, mixed deciduous forest areas of Western Ghats, and also grown as ornamental in gardens and parks.

Angiosperms: The Flora of Tamil Nadu Analysis by Nair & Henry (1983) and Henry & al. (1987, 1989), revealed that the state harbours about 5640 species and infraspecific taxa of flowering plants including cultivated species. After about two decades the state flora analysis was revised and a checklist of angiosperms in Tamil Nadu as a floral database was prepared by Narasimhan (2007). According to which, the angiosperms in the state are represented by 5547 taxa, comprising 5239 species, 72 subspecies, 548 varieties in 1668 genera and 231 families. However, a recent analysis by Irwin & al. (2014) revealed that there are about 5745 angiospermic taxa in Tamil Nadu state, which include 2757 herbs, 1365 shrubs, 1115 trees and 508 climbers, and are distributed in 233 families, of which 43 families are unigeneric. The family Fabaceae ranks first in possessing the largest number of taxa (547), followed by Poaceae (485 taxa), Asteraceae (307 taxa), Rubiaceae (236 taxa) and Orchidaceae (218 taxa). Out of 1788 genera recorded, about 50% are unispecific. The genus **Crotalaria** with 71 taxa is the largest genus in the state, followed by **Impatiens** (62 taxa), **Fimbristylis** (51 taxa), **Cyperus** (47 taxa), **Acacia** (45 taxa), **Eucalyptus** and **Euphorbia** (44 taxa each) and **Strobilanthes** (43 taxa).

The state possesses about 212 strict endemic taxa, of which 122 are herbs, 51 are shrubs, 36 are trees and 3 are climbers, and around 85% of the endemic taxa are confined to the Western Ghats, 8% from the Eastern Ghats and 6% of the taxa are from coastal regions; families, such as Poaceae (30 taxa), Cyperaceae (24 taxa), Apocynaceae and Acanthaceae (13 taxa each) exhibit high level of endemism (Irwin & al., 2013). There are about 230 Red Listed species, 1559 species of medicinal plants and 260 species of wild relatives of cultivated plants in the state. With 5745 angiosperm taxa, Tamil Nadu ranks first among all the states in the country, and it also constitutes nearly 1/3rd of the total flora of India. Out of 32 districts, Nilgiris is the most species-rich (62%) district, followed by Coimbatore (53%), Dindigul and Tirunelveli (47% each).

The state also has a rich diversity of exotic plant species. According to Narasimhan & al. (2009) a total of 1226 alien or exotic taxa are found in Tamil Nadu, which accounts for 22% of the total flora of the state, and 79% of the exotic flora of Tamil Nadu, exists only under cultivation; around 200 species occur as naturalised weeds and 56 found both in cultivation as well as escapes, which are naturalised. However, a recent analysis by Irwin & al. (2014) revealed that 1274 alien taxa have been recorded from the state, of which 988 occur only under cultivation and 276 either as invasive weeds or naturalized with a potential to become invasive. Dindigul and Nilgiris districts are rich in alien plant diversity.

TRIBAL COMMUNITIES AND THEIR INDIGENOUS KNOWLEDGE

Tribals are predominantly farmers and cultivators or gatherers and they are much dependant on the forest lands, and the biological resources available in the forest. In Tamil Nadu, they are found in all the districts, however, majority of them live in the north, central and western regions of the state, and are especially concentrated in the hill ranges, viz., Western Ghats and Eastern Ghats, and the discontinuous hill tracts adjoining the plains and the hills. There are about 38 tribes and subtribes in Tamil Nadu, of which, Malayali, Toda, Kurumba, Paniya, Irular, Kattunayakkan, Kani, Palliyan, Sholagar, Kadar and Veddar are the major tribal communities of Tamil Nadu (Alphonse, 2000). The Kotas, Todas, Irulas, Kurumbas, and the Badagas are concentrated mainly in the district of Nilgiris, and Eravalars, Kadars, Malasars, Malai-malasars, Muduvars and Pulayars communities inhabit Anamalais of Coimbatore district, whereas the Kanis are confined to the southernmost parts of Western Ghats in Tirunelveli and Kanyakumari districts. The hilly tracts of Eastern Ghats are majorly concentrated by Malayalis. Irulars in Kancheepuram and Thiruvallur districts and Kattunayakans in Vellore, Thiruvannamalai and Villupuram districts form an exception to live in the plains of the state, and utilise the plant resources available in the tropical thorny scrub forests.

Each tribal community has unique traditional uses of plants, and the indigenous knowledge is intact with tribal people for long, and has been orally passed for generations. Majority of the tribes still rely upon their own indigenous plant-based health-seeking practices for various ailments. However, the indigenous

knowledge among the various tribal communities is diminishing significantly. Hence, a comprehensive documentation of indigenous knowledge of all tribal communities is essential.

THREATS TO BIODIVERSITY AND CONSERVATION STRATEGIES

Due to increase in human population, there is a constant need for natural resources, which has ultimately resulted in the over-exploitation of forests in the tropic regions of the world. It is estimated that 2 to 25% of plant species will become extinct or committed to extinction in tropical forests approximately in the next 25 years (Heywood, 1995). The Convention on Biological Diversity, which entered into force in 1993, emphasise the elementary requirement of *in situ* conservation of ecosystems and natural habitats, to conserve the biodiversity on earth, for the present and future welfare of human beings. Protected Areas are one of the most recognised *in situ* conservation methods to protect the biodiversity across the world.

Anthropogenic activities, such as deforestation and destruction or alteration of natural habitats are the main causal factors that pose threat to the biodiversity of the state, especially in forested hill ranges. In order to protect the existing biodiversity in all the states of the country, the respective state and central governments have taken *in situ* conservation measures jointly and identified areas with rich biodiversity and declared them as Protected Areas. There are 5 National Parks, 21 Wildlife Sanctuaries, 3 Tiger Reserves, 4 Elephant Reserves, 3 Biosphere Reserves and 1 Conservation Reserve in Tamil Nadu, for *in situ* conservation of wild fauna and flora (http://www.forests.tn.nic.in; wiienvis.nic.in). The Protected Areas of Tamil Nadu extend to 3305 km^2, constituting 2.54% of the geographic area and 15% of the recorded forest area. Tamil Nadu, ranks 14th among all the states and union territories of India, in terms of Protected Areas. These Protected Areas protect and conserve the rich flora and fauna of the state.

Anthropogenic activities, such as conversion of forested lands to plantations, encroachment (of water bodies, forest and agricultural fields), hydel projects, transportation and tourism and various other developmental activities would pose considerable degree of threat to the biodiversity. Besides, over-exploitation of Non-Timber Forest Produces, collection of fuel woods, illegal felling of trees, invasion of exotic species and natural and man-made forest fires show considerable impact on the biodiversity. These

activities even at minor level have potential to disturb and alter the regime of every sensitive ecosystem, and create ecological imbalance and that would ultimately result in massive destruction of flora and fauna. The Tamil Nadu Forest Department and other competent authorities of the state should enforce strictly the environmental and biodiversity acts/laws to protect the existing biodiversity of the state. Efforts should also be taken to create awareness among the people about the importance of conserving forests and environment and sustainable utilisation of biological resources, for the sustenance and make them involve in conservation activities.

To facilitate researchers to inventorise plant-rich areas and to develop strategies for conservation of existing floral diversity in the state, the ENVIS Centre on Floral Diversity, Botanical Survey of India has recently published the "Bibliography and Abstracts of Papers on Flora of Tamil Nadu" (Lakshminarasimhan & al., 2014), which consists a total of 1482 references with abstract published on general vegetation, diversity of flowering and non-flowering plants, forestry, ecology, ethnobotany, medicinal plants and conservation issues in the state of Tamil Nadu.

a. Wet Evergreen Forests, Annamalais, Western Ghats; **b.** Upper Bhavani, Nilgiris, Western Ghats; **c. Impatiens campanulata** Wight; **d. Impatiens tangachee** Bedd.; **e. Impatiens scapiflora** B. Heyne ex Roxb.; **f. Dendrobium anamalayanum** Chandrab. & al.; **g. Rhododendron arborum** Sm. subsp. **nilagiricum** (Zenk.) Tagg.

Photo Courtesy – a: K. Karthigeyan; b: G. Ganasekharan; c – g: W. Arisdason

REFERENCES

Alphonse, M. (Ed.) 2000. Adivasis in Tamil Nadu. In: *Tamil Nadu Social Development Report 2000*. Tamil Nadu Peoples' Forum for Social Development, Chennai. pp. 195–200.

Baluswami, M. 2007. *Algal Flora of Tamil Nadu*. A database available at http://www.tnenvis.nic.in

Champion, H.G. & Seth, S.K. 1968. *A Revised Survey of Forest Types of India*. Manager of Publications, Delhi.

Chithra, V. & Nair, V.J. 1999. *Tamil Nadu*. In: Mudgal, V. & Hajra, P.K. (Eds.), *Floristic diversity and conservation strategies in India*. Vol. **III**: In the context of states and union territories. Botanical Survey of India, Calcutta. pp. 1451–1510.

Daniels, A.E.D. 2010. Checklist of the bryophytes of Tamil Nadu. *Arch. Bryol.* **65**: 1–118.

FSI, 2011. *State Forest Report*. Forest Survey of India (FSI), Dehra Dun.

Hariharan, G.N. & Balaji, P. 2007. *Checklist of Lichens and Lichenicolous Fungi of Tamil Nadu (India)*. A database available at http://www.tnenvis.nic.in

Henry, A.N., Chithra, V. & Balakrishnan, N.P. 1989. *Flora of Tamil Nadu, India*. Ser. 1: Analysis. Vol. 3. Botanical Survey of India, Coimbatore.

Henry, A.N., Kumari, G.R. & Chithra, V. 1987. *Flora of Tamil Nadu, India*. Ser. 1: Analysis. Vol. 2. Botanical Survey of India, Coimbatore.

Heywood, V.H. 1995. *Global Biodiversity Assessment*. Cambridge University Press, Cambridge.

Irwin, S.J., Gnanasekaran, G. & Narasimhan, D. 2013. Endemic Angiosperms of Tamil Nadu. In: *Souvenir & Abstracts – XXII Ann. Conf. Ind. Assoc. Angiosp. Taxon. & Natl. Sem. Recent Adv. Pl. Taxon. Res.* P.G. Department of Botany, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. p. 100.

Irwin, S.J., Lawrence, L. & Narasimhan, D. 2014. An analysis on flowering plants of Tamil Nadu. In: *Souvenir & Abstracts – XXIV Ann. Conf. Ind. Assoc. Angiosp. Taxon. & Int'l. Conf. Trends Pl. Systemat.* Department of Plant Science, Tiruchirappalli. p. 126.

Lakshminarasimhan, P., Arisdason, W., Gantait, S. & Bandyopadhyay, S. 2014. *Bibliography and Abstracts of Papers on Flora of Tamil Nadu*. ENVIS Centre on Floral Diversity, Botanical Survey of India, Howrah.

Manickam, V.S. 2007. *Checklist of Pteridophyte Species*. A database available at http://www.tnenvis.nic.in

Mittermeier, R.A., Gil, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. da 2004. *Hotspots Revisited: Earth's biologically richest and most threatened terrestrial ecoregions*. CEMEX, Mexico.

Nair, N.C. & Henry, A.N. 1983. *Flora of Tamil Nadu, India*. Ser. 1: Analysis. Vol. 1. Botanical Survey of India, Coimbatore.

Narasimhan, D. 2007. *Checklist of Angiosperms in Tamil Nadu*. A floral database available at http://www.tnenvis.nic.in

Narasimhan, D., Arisdason, W., Irwin, S.J. & Gnanasekaran, G. 2009. Invasive Alien Plant Species of Tamil Nadu. *Proc. Natl. Seminar Invasive Alien Species*. ENVIS Centre, Department of Environment, Government of Tamil Nadu, Chennai. pp. 29–38.

Natarajan, K. 2007. *List of Fungi reported from Tamil Nadu*. A database available at http://www.tnenvis.nic.in

Nayar, M.P. 1996. *Hot Spots of Endemic Plants of India, Nepal and Bhutan*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram.