RED LISTED THREATENED TREE SPECIES IN KERALA: A REVIEW

N. Sasidharan
Kerala Forest Research Institute Peechi Kerala

Abstract

Situated along the west coast of India and bordered by the Lakshadweep, the State of Kerala enjoys a tropical Climate. It is estimated that about 27 per cent of the area of the State is under forests. The tropical rain forests along the windward side of the Western Ghats are remarkable for their species diversity and endemism. The Western Ghats, one of the megadiversity centres in the world is also a biodiversity hotspot. The State of Kerala has an area of 38,864 km², which is only 1.18 per cent of India, yet support about 25 per cent of the flora of the country. Among the 4,050 indigenous flowering plants recorded from Kerala, 812 are trees. There are 1387 Peninsular Indian endemic species and 218 among them are restricted to Kerala. Among the 822 tree species, 327 are Peninsular Indian endemics and 26 are so far known only from Kerala. According to the various publications on threatened plants, 495 species recorded from Kerala belong to the Rare and Threatened (RET) categories, including 151 tree species. The floristic studies carried out during the last three decades resulted in relocating several RET species. However, the status of the populations of these species has not yet been evaluated. Despite the recent floristic studies as many as 23 tree species could not be relocated. As per the IUCN criteria on threatened species, two species are Extinct in the wild (*Ilex gardneriana and Syzygium gambleanum),* 26 Critically Endangered, 63 Endangered, 38 Vulnerable and 22 species are Low Risk/near Threatened.

INTRODUCTION

The Western Ghats, running parallel to the west coast of Peninsular India have a series of hill ranges covering a distance of 1600 km from Thapti Valley in Gujarat to Kanyakumari in Tamil Nadu traversing through the states of Maharastra, Goa, Karnataka and Kerala. Though the average height of the hill ranges is 1000 m, the highest peaks south of Himalayas - the Anamudi (2695 m) and Dodabattai (2637m)- are in the Western Ghats. The western side of the Western Ghats facing the Arabian Sea receives maximum rainfall and the annual precipitation varies from 2000 mm to 7450 mm. The eastern side of the Western Ghats is in the rain shadow region, therefore receives relatively less rainfall. The mean temperature is between 24°C and 20°C however, the temperature will be zero to subzero in the mountain peaks during winter. The major soil types are laterite, red loam, medium black, alluvial, red gravelly and hill soils.

Depending on the amount of rainfall, soil type and altitude, different vegetation types are formed in the Western Ghats. The dominant vegetation types are west coast tropical evergreen forests, west coast semievergreen forests, southern moist mixed deciduous forests, southern dry mixed deciduous forests and scrub jungles (Champion and Seth, 1968). At higher elevations the vegetation becomes southern montane wet temperate forests (sholas) and southern montane wet grasslands

(grasslands). Certain edaphic types such as *Myristica* swamp forests, bamboo breaks, reed breaks, etc. are restricted to some eco-physical regions.

The tropical rain forests, particularly the evergreen, semi-evergreen and shola forests, due to the luxuriant growth of plants of all life forms have the richest biodiversity. The Western Ghats, one of the megadiversity centres in the world is also a biodiversity hotspot. The principal plant communities in the Western Ghats are the Angiosperms. In the Western Ghats, the southern Western Ghats consisting southern parts of Karnataka, Kerala and southern Tamil Nadu are the richest in terms of diversity. Out of the 4000 species of flowering plants estimated, 3,900 occur in the southern Western Ghats and 3,800 in Kerala (Nayar, 1997). The Western Ghat is considered as one of the 18 centres in the world where mega diversity exists. The distribution pattern of the major families in the Westem Ghats and Kerala is almost the same. The State of Kerala with an area of 38,863 km^2, is only 1.18 per cent of the whole of India, yet it supports about 25 per cent of the flora of the country.

There are 4,465 taxa of flowering plants in Kerala belonging to 1,315 genera in 192 families of which, 33 families and 68 genera are represented by one species of each (Sasidharan, personal observation). Among the 4,465 species recorded, 4050 are indigenous and the rest exotics. There are 812 species of trees in Kerala. The families dominated by tree species are Euphorbiaceae, with 67 species under 31 genera, followed by Leguminosae (65 species/35 genera), Lauraceae (55 species /l 0 genera), Rubiaceae (47 species/26 genera), Annonaceae (32 species/11 genera), Ebenaceae (25 species/one genus), Anacardiaceae (24 species/11 genera) and Clusiaceae (21 species/4 genera).

The endemic species in the flora of a geographical region are noteworthy. Among the 812 tree species in Kerala, 327 are endemic to Peninsular India and 26 are restricted to Kerala. Genera such as *Poeciloneuron, Blepharistemma and Otonephelium* are endemic to the Western Ghats. Among the families with arborescent endemic taxa, Lauraceae rank first with 44 endemics (out of the 55 species) followed by Euphorbiaceae (25/67), Rubiaceae (22/47), Myrtaceae (21/41), Annonaceae (17/32), Leguminosae (14/65), Anacardiaceae (13/24), Dipterocarpaceae (11/13), Ebenaceae (10/25) and Clusiaceae (10/21).

The rare and threatened plants of southern India have been documented by Joseph (1977), Henry et al. (1979), Jain and Sastry (1984), Ahmedullah and Nayar (1987) and Nayar and Sastry (1987, 1988, 1990). Nayar (1997) listed 1,272 Western Ghats taxa endemic to Kerala, 483 among them were placed under threatened categories. Based on published literature, there are 497 species recorded from Kerala that belong to the Red Listed categories, including 151 tree species (Table 1). As per the IUCN (1994) criteria the Red Listed tree species are assigned to the following categories: Extinct (2

species), Low Risk/near threatened (22 species) Critically Endangered (26 species), Vulnerable (38 species) and

Table 1. Red Listed threatened tree species recorded in some Protected Areas of Kerala

Protected Area	Total number of angiosperm species recorded	No. of tree sps.	No. of Red Listed tree species
Chinnar Wildlife Sanctuary	965	238 (24.7)	6
Eravikulam National Park	326	69 (21.2)	11
Peechi- Vazhani Wildlife Sanctuary	829	240 (28.9)	18
Silent Valley National Park	966	198 (20.5)	20
Parambikulam Wildlife Sanctuarv	1432	359 (25.0)	36
Neyyar Wildlife Sanctuary	1080	298 (27.5)	53
Periyar Tiger Reserve	1978	434 (22.0)	59
Shenduruny Wildlife Sanctuary	951	327 (34.4)	65

Note: The figures in parentheses indicate the percentage of trees out of the total.

Table 2. Red List of threatened tree species recorded in Kerala

Family	Tree species	Red List Category
ANACARDIACEAE	*Buchanania barberi* Gamble	CR
	Gluta travancorica Bedd.	LR/nt
	Holigarna beddomei Hook. f.	VU
	Holigarna grahamii (Wight) Kurz	LR/ nt
	Nothopegia aureo-flllva Bedd. ex Hook. f.	CR
	Nothopegia beddomei Gamble var. *wlfnaedica* Ellis & Chandra.	CR
	Nothopegia heyneana (Hook. f.) Gamble	LR/ nt
	Semecarpus auriculata Bedd.	LR/nt
	Semecarpus travancorica Bedd.	LR/nt
	Solenocarpus indicus Wight & Arn.	LR/nt
ANNONACEAE	*Goniothalamus rhynchantherus* Dunn	EN
	Goniothalamus. wynaadensis (Bedd.) Bedd.	LR/nt
	Mitrephora grandiflora Bedd.	VU
	Orophea uniflora Hook. f. & Thoms.	VU
	Polyalthia rufescens Hook.f. & Thom.	CR
	Polyalthia shendurunii Basha & Sasi.	EN
	Sageraea grandiflora Dunn	EN
	Sageraea laurifolia (Graham) Blatter	LR/ nt

APOCYNACEAE	*Tabernaemontana heyneana* Wall.	LR/nt
AQUIFOLIACEAE	*Ilex gardneriana* Wight	EX
ARALIACEAE	*Schefflera bourdillonii* Gamble	EN
BONNETIACEAE	*Poeciloneuron pauciflorum* Bedd.	CR
BORAGINACEAE	*Cordia octandra* DC.	CR
CAESALPINIACEAE	*Cynometra beddomei* Prain	EN
	Cynometra travancorica Bedd.	EN
	Dialium travancoricum Bourd.	CR
	Humboldtia bourdillonii Prain.	EN
	Humboldtia decurrens Bedd. Ex Oliver	LR/ nt
	Humboldtia trijuga (Joseph & Chandras.) Mohanan	CR
	Humboldtia unijuga Bedd.	EN
	Humboldtia vahliana Wight	LR/ nt
	Kingiodendron pinnatum (Roxb. ex DC.) Harms	EN
CAPPARACEAE	*Capparis rheedei* DC.	LR/nt
CELASTRACEAE	*Ellonymus paniculatus* Wight ex Lawson	EN
CHRYSOBALANACEAE	*Atuna indica* (Bedd.) Kosterm.	EN
	Atuna travancorica (Bedd.) Kosterm.	EN
CLUSIACEAE	*Garcinia imberti* Bourd.	EN
	Garcinia rubro-echinata Kosterm.	EN
	Garcin ia travancorica Bedd.	VU
	Garcinia wightii T. Anders.	VU
	Mesua ferrea L. var. coromandeliana (Wight) Singh	CR
DIPTEROCARPACEAE	*Dipterocarpus bourdillonii* Brandis	CR
	Dipterocarpus indicus Bedd.	LR/nt
	Hopea erosa (Bedd.) van Sloot.	CR
	Hopea glabra Wight & Arn.	EN
	Hopea jacobii Fischer	CR
	Hopea parviflora Bedd.	LR/ nt
	Hopea ponga (Dennst.) Mabber.	EN
	Hopea racophloea Dyer	EN
	Hopea utilis (Bedd.) Bole	EN
	Vateria indica L.	VU
	Vateria macrocarpa Gupta	CR
EBENACEAE	*Diospyros barberi* Ramas.	VU
	Diospyros humilis Bourd.	CR
ELAEOCARPACEAE	*Elaeocarpus munronii* (Wight) Mast.	LR/nt
	Elaeocarpus recurvatus Corner	VU
	Elaeocarpus venustlls Bedd.	EN

ERICACEAE	*Rhododendron arboreum* J. E. Smith ssp. *nilagiricum (Zenk.)* Tagg.	LR/ nt
EUPHORBIACEAE	*Aporusa bourdillonii* Stapf	EN
	Cleistanthus malabaricus Muell.-Arg.	VU
	Cleistanthus travancorensis Jablonszky	EN
	Dimorphocalyx beddomei (Benth.) Airy Shaw	EN
	Drypetes confertiflora (Hook.f.) Pax & Hoffm.	EN
	Orypetes malabarica (Bedd.) Airy Shaw	EN
	Orypetes wightii (Hook. f.) Pax & Hoffm.	VU
	Glochidion bourdillonii Gamble	VU
	Glochidion hohenackeri (Muell.-Arg.) Bedd. var. *johnstonei* (Hook. f.) Chakrab.& Gangop.	VU
	Glochidion zeylanicum (Gaertn.) A. Juss. var. *tomentosum* (Dalz.) Chakrab. & Gangop.	EN
FLACOURTIACEAE	*Casearia rubescens* Dalz. var. *gamblei* Mukh.	CR
	Casearia wynadensis Bedd.	VU
	Homalium jaillii Henry & Swaminathan	EN
	Homalium travancoricum Bedd.	VU
	Hydnocarpus macrocarpa (Bedd.) Warb.	VU
	Xylosma latifolium Hook.f. & Thoms.	EN
LAURACEAE	*Actinodaphne campanulata* Hook.f. var. *campanulata*	VU
	Actinodaphne campanulata Hook.f. *var. obtusa* Gamble	EN
	Actinodaphne lawsonii Gamble	VU
	Actinodaphne malabarica Balakr.	LR/nt
	Actinodaphne salicina Meisner	EN
	Beilschmiedia wightii (Nees) Benth. ex Hook. f.	EN
	Cinnamomum chemungianum Mohanan & Henry	EN
	Cinnamomum filipedicellatum Kosterm.	EN
	Cinnamomum perrottetii Meisner	VU
	Cinnamomum riparium Gamble	VU
	Cinnamomum travancoricum Gamble	CR
	Cryptocarya anamalayana Gamble	EN
	Cryptocarya beddomei Gamble	VU
	Litsra beddomei Hook. f.	EN

	Litsea travancorica Gamble	EN
	Neolitsea fischeri Gamble	VU
MALVACEAE	*Julostylis polyandra* Ravi et Anil Kumar	EN
MELASTOMA T ACEAE	*Memecylon sisparense* Gamble	CR
MELIACEAEMIMOSACEAE	*Aglaia barberi* Gamble	EN
	Aglaia bourdillonii Gamble	VU
	Aglaia lawii (Wight) Saldanha	LR/ nt
	Aglaia malabarica Sasi.	CR
	Aglaia simplicifolia (Bedd.) Harms	LR/nt
	Dysoxylum beddomei Hiern	EN
	Dysoxylum ficiforme (Wight) Gamble	VU
	Albizia lathamii Hole	CR
	Inga cynometroides (Bedd.) Bedd. ex Baker	CR
MYRISTICACEAE	*Myristica fatua* Houtt. var. *magnifica* (Bedd.) Sinclair	EN
	Myristica malabarica Lam.	VU
MYRSINACEAE	*Rapanea thwaitesii* Mez	LR/nt
MYRTACEAE	*Eugenia argentea* Bedd.	CR
	Eugenia calcadensis Bedd.	VU
	Eugenia discifera Gamble	EN
	Eugenia indica (Wight) Chithra	EN
	Eugenia rottleriana Wight & Arn.	VU
	Eugenia singampattiana Bedd.	CR
	Metcoromyrtus wynaadensis (Bedd.) Gamble	CR
	Syzygium benthamianum (Wight ex Duthie) Gamble	VU
	Syzygium bourdillonii (Gamble)	
	Rathkr. & Nair	EN
	Syzygium chavaran (Bourd.) Gamble	EN
	Syzygium courtallensis (Gamble) Alston	CR
	Syzygium densiflorum Wall. ex Wight & Arn.	VU
	Syzygium gambleanum Rathakr. & Chitra.	EX
	Syzygium myhendrae (Bedd. ex Brandis) Gamble	EN
	Syzygium occidentalis (Bourd.) Gandhi	VU
	Syzygium palghatense Gamble	CR
	Syzygium parmneswarnii Mohanan & Henry	EN
	Syzygium rama-varmae (Bourd.) Chithra	VU

	Syzygium stocksii (Duthie) Gamble	EN
	Syzygium travancoricum Gamble	EN
OLACACEAE	*Anacolosa densiflora* Bedd.	EN
	Chionanthus linocieroides (Wight) Bennet & Raizada	EN
PITIOSPORACEAE	*Pittosporum dasycaulon* Miq.	LR/nt
RHIZOPHORACEAE	*Blepharistemma serratum* (Dennst.) Suresh	VU
RUBIACEAE	*Byrsophyllum tetrandrum* (Bedd.) Hook. f. ex Bedd.	EN
	Canthium neilgherrense Wight	VU
	Canthium pergracile Bourd.	EN
	Ixora agasthyamayana Sivadasan & Mohanan	EN
	Ochreinauclea missionis (Wall. ex G. Don) Ridsd.	VU
	Octotropis travancorica Bedd.	LR/nt
	Psychotria beddomei Deb & Gang.	EN
	Psydrax ficiformis (Hook.f.) Bridson	EN
RUTACEAE	*Vepris bilocularis* (Wight & Arn.) Engl.	EN
SAPOTACEAE	*Isonandra stocksii* Clarke	EN
	Madhuca bourdillonii (Gamble) H.J. Lam	EN
	Palaquium bourdillonii Brandis	VU
	Palaquium ravii Sasi. & Vink	EN
STERCULIACEAE	*Eriolaena lushingtonii* Dunn	VU
	Pterospermum reticulatum Wight & Arn.	VU
SYMPLOCACEAE	*Symplocos anamallayana* Bedd.	EN
	Symplocos macrocarpa Wight ex Clarke ssp. *kanarana* (Talbot) Nooteb.	VU
	Symplocos macrocarpa Wight ex Clarke ssp. *macrocarpa*	EN
	Symplocos mncrophylla Wall ex A. DC. ssp. *rosea* (Bedd.) Nooteb.	VU
	Symplocos nairii Henry *et al.*	EN
	Symplocos oligandra Bedd.	EN
	Symplocos pendula Wight,	EN
TILIACEAE	*Grewia pandaica* Drumm. ex Dunn	CR

EX=Extinct; CR=Critically Endangered; EN=Endangered; LR/nt=Low Risk/near threatened; VU=Vulnerable

(63 species). Among the families, Myrtaceae has 20 Red Listed tree species followed by Lauraceae (16 species), Leguminosae and Dipterocarpaceae (11 species), Euphorbiaceae and Anacardiaceae (10 species), Annonaceae and Rubiaceae (8

species), Symplocaceae and Meliaceae (7 species), Flacourtiaceae (6 species), C1usiaceae (5 species) and Sapotaceae (4 species). Recent floristic studies have reported the rediscovery of many threatened taxa including a few that were presumed to be extinct (Ramachandran, 1982; Mohanan, 1996; *Mohanan et al.,* 1997, 1999 & 2000; Sasidharan, 1998). However, the effort to relocate species such as *Actinodaphne lawsonii, Atuna indica, Buchanania barberi, Cinnamomum perrottetii, Casearia rubescens* var. *gamblei, Cleistanthus malabaricus, Diospyros barberi, Diospyros sulcata, Drypetes travancorica, Eugenia argentea, Hopea jacobii, Hopea utilis, Humboldtia laurifolia, Litsea mysorensis, Litsea nigrescens, Madhuca diplostemon, Memecylon sisparense, Polyalthia rufescens, Psychotria beddomei, Rapanea thwaitesii, Syzygium courtallensis, Syzygium gambleanum* and *Syzygium stocksii were* not successful so far. An analysis of the habitats of Red Listed species reveals that shola forests support 23 species, one species in the dry deciduous forests and the rest in the evergreen/semi-evergreen forests. The only Red Listed tree species recorded from dry deciduous forests is *Albizia lathamii* (Sajeev and Sasidharan, 1998).

The State of Kerala has a relatively higher percentage of protected areas. About 24 per cent of the *forests* have been declared as protected areas by establishing 12 Wildlife Sanctuaries and 2 National Parks. The flora of most of the protected areas have been studied recently resulting in the discovery of several new as well as threatened species (Manilal, 1988; Mohanan, 1995; Sasidharan, 1997, 1998, 1999,2002). The Red Listed tree species recorded in the Protected Areas are provided in Table 2.

Though, several Red Listed trees were rediscovered recently, quite a few of them are reported to be surviving by a few individua1s and their regeneration is extremely low (Sasidharan, 1998b). This calls for immediate measures *to* enhance their population status either through assisted natural regeneration *or* through artificial means for conservation *of* RET tree species. Detailed studies are needed to understand the genetical variation in the disjunct small population *of* these tree species. The Red Listed trees are also to be raised in *ex situ* centres like arboreta and botanic gardens.

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DISCUSSION

Dr. J.K. Shanua: How much of the forest area do *you* think, in Kerala has been explored for the RET species?
N.S.: In Kerala there are 14 protected areas. Only 8 have been explored. Others are being explored, but reports are not available. Northern Kerala needs to be thoroughly explored.

Dr. J.K. Shanna: Areawise, how much area has been explored?
N.S: Districtwise studies are being taken up by the Botanical Survey of India (BSI) and 12 districts have been already completed. Wayanad and Ernakulam have not been completed. Aralam is another important area where there is scope for further explorations.

Dr. A. G. Pandurangan: What is the locality of *Hopea jacobii?* Does it occur in Silent Valley?
N.S.: I have seen the specimens, but there are no indications on the locality. In BSI there are specimens from Karnataka.

Dr. A.G. Pandurangan: I have collected *Buchnania barberi* from southern Kerala. Any comment?
N.S.: It could be only B. *angustifolia,* the type locality of which is Nadayara, Kollam.

Dr A. G. Panduranagan: But we have verified the identity of the specimens of B. *baraberi* from Mr. Santhosh Kumar.

Dr. M.P. N ayar: The concept of RET species on the basis of political boundaries (District) should be changed. As they occur in the forest areas, they should be studied on the natural geographical area basis. GIS data should be also generated. It should not be a taxonomist's job alone. KFD should initiate programmes to conserve them, otherwise they can become extinct. Trees require more attention.
N.S.: 1 agree with Or Nayar. As custodians, KFD should take the initiative. Handbooks, CDs, and videos can also be brought out, so that untrained people can also understand and identify the species.

Dr.V.M. Chandrashekara: We have established nearly 60 permanent plots for the study of biodiversity, distributed throughout Kerala. And we have located the rare tree, *Actinodaphne lawsonii,* in two of plots in the Nilambur area.

Mr. V.K. Sinha: Do KFRI have programmes for population ecological and reproductive biological studies other than just exploration and identification?
N.S.: Yes. Dr K. Balasubramaniam will review it during his presentation.

Dr. C. Kunhikannan: Some of the RET plants such *Ellipnnthes neglectus* have been located in sacred groves.
N.S.: Sacred groves are really interesting and rich in plant diversity. They should be protected.

Mr. Nagesh Prabhu: Are RET species assessed on the basis of IUCN criteria? Are the ecologically valuable RET species economically also valuable? Are you going to involve forest officials in conserving the RET species?
N.S.: Yes, the RET species are to be assessed based on the recently revised IUCN (1994) criteria. Their website gives the details. Just as the RET species are ecologically important, many of them are economically important too. In fact, some of them are keystone species. Perhaps Dr M.P. Nayar can further highlight this aspect. We would be very happy to involve the forest officials for conservation of the RET species.

Dr.M.P. Nayar: The RET species are dependant on other species for their survival- e.g. for pollinators. The relationship is actually mutual. Take the case-of Cullenia exarillata - the lion tailed macaques are dependant on it for food. Conservation biology is related to the web of life. Any break in the food chain or web will create loss of species. Keystone species are important. So a holistic ecosystem study approach is required. The recently revised IUCN criteria provide more guidelines for defining the different RET categories.

Dr J.K. Sharma: RET species should be studied in close association with other species as they have strong ecological niches. Dr Nair has indeed made some good comments on this. Since a holistic approach is required, institutions should come together to tackle the problems jointly.