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PROTECTING ENDANGERED MEDICINAL SPECIES: A RACE AGAINST TIME

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ABSTRACT

The Earth is home to an incredible diversity of plant and animal species, many of which have provided invaluable contributions to human health and well-being for centuries. However, the rampant destruction of natural habitats, overexploitation, and climate change have pushed numerous species to the brink of extinction. Medicinal species, which possess unique chemical compounds that hold tremendous potential for the development of life-saving drugs, are at great risk. The advantages of good outcomes, few or no side effects, and accessibility to the general population have led to widespread acceptance and adoption of a broad variety of medicinal plants in India, which are predominantly used by locals for health care. Indigenous and traditional medical practices have demonstrated efficacy (direct or indirect as immune-boosters) against numerous dreaded illnesses, including the most recent worldwide COVID-19 pandemic. There is alarm across the globe as the bulk of these plants, which were harvested from natural stands, are also in danger of going extinct due to predictions of the sixth mass extinction. In this article, we will explore the importance of endangered medicinal species, the factors threatening their survival, and the urgent need for conservation efforts to protect these valuable resources.

KEYWORDS: Endangered, Species, Extension, Medicinal species, Herbs, Ayurveda.

INTRODUCTION

Medicinal plants have been the subjects of man's curiosity since time immemorial. Almost every civilization has a history of medicinal plant use. Approximately 80% of the people in the world's developing countries rely on traditional medicine for their primary health care, and about 85% of traditional medicine involves the use of plant extracts. India has 2.4% of world's area with 8% of global biodiversity and it is one of the 12th mega diversity hotspot countries of the world with a rich diversity of biotic resources. Out of 34 hotspots recognized, India has two major hotspots - the Eastern Himalayas and the Western Ghats. The bio-geographic position of India is so unique that all known types of ecosystems range from coldest place like the Nubra Valley with "57°C, dry cold deserts of Ladakh, temperate and Alpine and subtropical regions of the North-West and trans-Himalayas, rain forests with the world's highest rainfall in Cherrapunji in Meghalaya, wet evergreen humid tropics.

Western Ghats, arid and semiarid conditions of Peninsular India, dry desert conditions of Rajasthan and Gujarat to the tidal mangroves of the Sunderban which harbours about 47000 species of plants of which 17 000 are angiosperms.[1]

Organization (WHO) has estimated that the present demand for medicinal plants is approximately US $14 billion per year. The demand for medicinal plant- based raw materials is growing at the rate of 15 to 25% annually, and according to an estimate of WHO, the demand for medicinal plants is likely to increase more than US $5 trillion in 2050.[2]

Biodiversity conservation is a demanding task that includes scientific, social, and political challenges. Given the enormous diversity of species and limited resources available to undertake these conservation programs, prioritization of species for conservation, assessment of threat status and the most suitable strategy to be adopted become the basic pre-requisites. To serve this objective, the International Union for Conservation of Nature (IUCN) a membership union composed of both government and civil society organizations, was established. An IUCN Red List of Threatened Species' was developed, which provides extinction risk and species distribution. As per IUCN classification, species are assigned a ranked threat category, such as extinct (EX), extinct in wild (EW), critically endangered (CR),

endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC) and data deficient (DD).[3]

A total of 560 plant species of India have been included in the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened species, out of which 247 species are in the threatened category. On a global basis, the IUCN has estimated that about 12.5% of the world's vascular plants, totalling about 34000 species are under varying degrees of threat.[4]

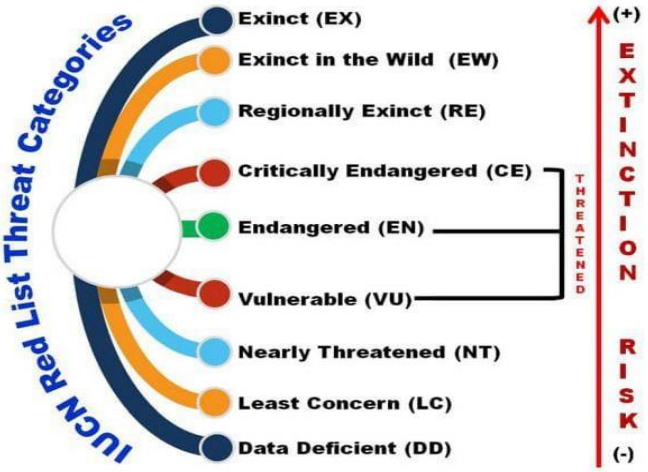

Fig. 1: IUCN Red List threat categories and their risk levels.[5]

Consolidated list of threatened medicinal plants represented by IUCN

Species	Threat Status	
	IUCN threat category	CAMP exercise threat category [State (threat category and year of CAMP exercise)]
Aconitum chasmanthum Stapf ex Holmes	CR	Jammu and Kashmir (CR 2003)
Aconitum heterophyllum Wall.	EN	Arunachal Pradesh (EN 2003), Himachal Pradesh (CR 2003, CR 2010), Jammu and Kashmir (CR 2003), Sikkim (EN 2003), Uttarakhand (CR 2003)
Aconitum violaceum Jacq. ex Stapf.	VU	Himachal Pradesh (VU 2003, VU 2010), Jammu and Kashmir (VU 2003), Uttarakhand (VU 2003)
Acorus calamus L.	LC	Andhra Pradesh (EN 2001), Chhattisgarh (EN 2003), Kerala (EN 1999), Madhya Pradesh (EN 2003), Tamil Nadu (VU 1998), Tripura (VU 2016)
Amorphophallus paeoniifolius (Dennst.) Nicolson	LC	Kerala (NT 1999), Madhya Pradesh (VU 2006), Tamil Nadu (VU 1998)
Angelica glauca Edgew.	EN	Himachal Pradesh (EN 2003, EN 2010), Jammu and Kashmir (EN 2003), Uttarakhand (EN 2003)
Aphanamixis polystachya (Wall.) R.Parker	LC	Karnataka (VU 1997), Kerala (VU 1997), Orissa (VU 2007)
Aquilaria malaccensis Lam. = *A. agalocha* Roxb.ex DC	CR	Arunachal Pradesh (CR 2003), Assam (EN 2003), Meghalaya (EN 2003), Tripura (DD 2016)
Artocarpus hirsutus Lam.	LC	Karnataka (VU 1999), Kerala (VU 1999), Tamil Nadu (VU 1998)
Bacopa monnieri (L.) Wettst.	LC	Madhya Pradesh (VU 2006)
Berberis aristata DC.	LC	Himachal Pradesh (EN 2010), Sikkim (DD 2014), West Bengal (VU 2007)
Betula utilis D. Don	LC	Himachal Pradesh (EN 2003, EN 2010), Jammu and Kashmir (CR 2003), Sikkim (NT 2014), Uttarakhand (NT 2003)
Boswellia ovalifoliolata Bal & Henry	VU	Andhra Pradesh (EN 2001)
Calophyllum apetalum Willd.	VU	Karnataka (VU 1999), Kerala (VU 1999), Tamil Nadu (VU 1998)
Cayratia pedata Juss. ex Gagnepain	VU	Kerala (EN 1999), Tamil Nadu (EN 1998)
Centella asiatica (L.) Urb. = *Hydrocotyle asiatica* L.	LC	Madhya Pradesh (VU 2006)
Chlorophytum borivilianum Santapau & R.R.Fern.	CR	Madhya Pradesh (EN 2006), Maharashtra (EN 2001), Rajasthan (CR 2007)
Chlorophytum tuberosum (Roxb.) Baker	LC	Chhattisgarh (VU 2003), Madhya Pradesh (VU 2003)
Cinnamomum macrocarpum Hook.	VU	Karnataka (VU 1999), Kerala (VU 1999), Tamil Nadu (VU 1998)
Cinnamomum sulphuratum Nees	VU	Karnataka (VU 1999), Kerala (VU 1999), Tamil Nadu (VU 1998)
Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm	LC	Arunachal Pradesh (VU 2003), Himachal Pradesh (VU 2003, VU 2010), Jammu and Kashmir (EN 2003), Meghalaya (VU 2003), Nagaland (VU 2015), Uttarakhand (VU 2003)
Cinnamomum wightii C.F.W.Meissn	EN	Karnataka (EN 1999), Kerala (EN 1999), Tamil Nadu (EN 1998)
Commiphora wightii (Arn.) Bhandari	CR	Madhya Pradesh (CR 2003), Rajasthan (CR 2007)
Coptis teeta Wall.	EN	Arunachal Pradesh (EN 2003)
Coscinium fenestratum (Goetgh.) Colebr.	DD	Karnataka (CR 1999), Kerala (CR 1999)
Curcuma pseudomontana Graham	VU	Karnataka (VU 1999), Kerala (EN1999), Tamil Nadu (EN 1998)
Cycas beddomei Dyer	EN	Andhra Pradesh (CR 2001)

Species	Threat Status	
	IUCN threat category	CAMP exercise threat category [State (threat category and year of CAMP exercise)]
Cycas circinalis L.	EN	Karnataka (CR 1999), Kerala (VU 1999), Orissa (VU 2007), Tamil Nadu (CR 1998)
Decalepis hamiltonii Wight & Arn.	EN	Andhra Pradesh (EN 2001), Karnataka (EN 1999), Kerala (EN 1999), Tamil Nadu (EN 1998)
Dendrobium devosianum J.J.Sm.	DD	Nagaland (EN 2015)
Dichrostachys cinerea Wight & Arn.	LC	Madhya Pradesh (VU 2006)
Diospyros candolleana Wight	VU	Karnataka (VU 1999), Kerala (VU 1999)
Diospyros paniculata Dalz.	VU	Karnataka (VU 1999), Kerala (VU 1999)
Drosera burmanni Vahl	LC	Madhya Pradesh (VU 2006), West Bengal (EN 2007)
Drosera indica L.	LC	Karnataka (EN 1999), Madhya Pradesh (EN 2006)
Drosera peltata Thunb.	LC	Arunachal Pradesh (NT 2003), Karnataka (EN 1999), Kerala (VU 1999), Meghalaya (VU 2003), Tamil Nadu (EN 1998)
Dysoxylum malabaricum Bedd.	EN	Karnataka (EN 1999), Kerala (EN 1999), Tamil Nadu (EN 1998)
Euryale ferox Salisb.	LC	Tripura (VU 2016)
Fraxinus floribunda Wall.	LC	Sikkim (EN 2014)
Garcinia indica (Thouars) Choisy	VU	Karnataka (VU 1999), Kerala (VU 1999), Maharashtra (NT 2001)
Gentiana kurroo Royle	CR	Himachal Pradesh (CR 2003, CR 2010), Jammu and Kashmir (CR 2003), Uttarakhand (CR 2003)
Gloriosa superb L.	LC	Andhra Pradesh (VU 2001), Chhattisgarh (VU 2003), Himachal Pradesh (VU 2003), Jammu and Kashmir (VU 2003), Karnataka (VU 1999), Kerala (VU 1999), Madhya Pradesh (VU 2003), Maharashtra (VU 2001), Orissa (EN 2007), Rajasthan (VU 2007), Uttarakhand (VU 2003), West Bengal (VU 2007)
Gmelina arborea Roxb.	LC	Madhya Pradesh (VU 2006)
Gnetum montanum Markgr.	LC	Tripura (DD 2016)
Gnetum ula Brongn. = *G. pyrifolium* Miq. Ex Parl.	LC	Orissa (VU 2007)
Grewia asiatica L.	LC	Madhya Pradesh (CR 2006)
Gymnema khandalense Santapau	EN	Kerala (EN 1999), Tamil Nadu (EN 1998)
Gymnocladus assamicus Kanjilal	CR	Arunachal Pradesh (CR 2003)
Humboldtia vahliana Wight	EN	Karnataka (EN 1999), Kerala (EN 1999), Tamil Nadu (EN 1998)
Illicium griffithii Hook. F. & Th.	EN	Arunachal Pradesh (NT 2003), Meghalaya (CR 2003)
Iphigenia stellata Blatter	EN	Maharashtra (EN 2001)
Juniperus communis L.	LC	Himachal Pradesh (VU 2010)
Lamprachaenium microcephalum Benth.	EN	Maharashtra (EN 2001)
Lasia spinosa (L.) Thwaites	LC	Andhra Pradesh (EN 2001)
Lilium polyphyllum Don	CR	Himachal Pradesh (CR 2003, CR 2010), Jammu and Kashmir (CR 2003), Uttarakhand (CR 2003)
Malaxis muscifera (Lindl.) Kuntze	VU	Arunachal Pradesh (CR 2003), Himachal Pradesh (CR 2003, CR 2010), Jammu and Kashmir (NT 2003), Sikkim (EN 2003, VU 2014), Uttarakhand (EN 2003)
Myristica dactyloides Gaertn.	VU	Karnataka (VU 1999), Kerala (VU 1999)
Nardostachys jatamansi DC.	CR	Sikkim (VU 2014)
Nepenthes khasiana Hook.f.	EN	Meghalaya (EN 2003)

Species	Threat Status	
	IUCN threat category	CAMP exercise threat category [State (threat category and year of CAMP exercise)]
Nilgirianthus ciliates (Nees) Bremek	VU	Karnataka (EN 1999), Kerala (EN 1999), Tamil Nadu (EN 1998)
Ochreinauclea missionis (Wall.ex G.Don) Ridsdale	VU	Karnataka (VU 1999), Kerala (VU 1999)
Osmunda regalis L.	LC	Madhya Pradesh (CR 2006)
Paphiopedilum druryi (Bedd.) Stein	CR	Karnataka (CR 1999), Kerala (CR 1999), Tamil Nadu (VU 1998)
Phyllanthus indofischeri Bennet	VU	Andhra Pradesh (VU 2001)
Pimpinella tirupatiensis Bal. & Sub.	EN	Andhra Pradesh (EN 2001)
Piper barberi Gamble	EN	Kerala (CR 1999), Tamil Nadu (CR 1998)
Piper pedicellatum C. DC.	VU	Arunachal Pradesh (VU 2003), Sikkim (VU 2003)
Pterocarpus marsupium Roxb.	NT	Chhattisgarh (VU 2003), Madhya Pradesh (VU 2003), Maharashtra (VU 2001), Orissa (EN 2007), Rajasthan (CR 2007), West Bengal (EN 2007)
Pterocarpus santalinus L.f.	NT	Andhra Pradesh (CR 2001), Tamil Nadu (CR 1998)
Salacia oblonga Wall.	VU	Karnataka (VU 1999), Kerala (VU 1999) Tamil Nadu (VU 1998)
Santalum album L.	VU	Andhra Pradesh (EN 2001), Karnataka (VU 1999), Kerala (EN 1999), Maharashtra (EN 2001), Tamil Nadu (VU 1998)
Saussurea costus (Falc.) Lipsch.	CR	Jammu and Kashmir (CR 2003)
Spatholobus parviflorus (L.) Engl.	LC	Tripura (DD 2016)
Syzygium alternifolium (Wt.) Wall.	EN	Andhra Pradesh (EN 2001)
Tacca leontopetaloides (L.) Kuntze	LC	Andhra Pradesh (NT 2001), Madhya Pradesh (NT 2006)
Taxus wallichiana Zucc.	EN	Arunachal Pradesh (EN 2003), Himachal Pradesh (EN 2003, EN 2010), Jammu and Kashmir (EN 2003), Meghalaya (CR 2003), Sikkim (EN 2003), Uttarakhand (EN 2003), West Bengal (CR 2007)
Terminalia pallida Brandis	VU	Andhra Pradesh (EN 2001)
Toona ciliate M. Roem = *Cedrela toona* Roxb. ex Rottler	LC	West Bengal (VU 2007)
Tribulus rajasthanensis Bhandari & Sharma	CR	Rajasthan (CR 2007)
Uraria picta (Jacq.) DC.	LC	Chhattisgarh (VU 2003), Himachal Pradesh (NE 2010), Madhya Pradesh (VU 2003), Orissa (EN 2007)
Utleria salicifolia Bedd.	CR	Kerala (CR 1999)
Valeriana leschenaultia DC.	CR	Karnataka (CR1997), Kerala (CR1997), Tamil Nadu (CR1997)
Zanthoxylum armatum DC.	LC	Himachal Pradesh (EN 2003, EN 2010), Jammu and Kashmir (VU 2003), Nagaland (VU 2015), Orissa (VU 2007), Uttarakhand (VU 2003)
Zeuxine strateumatica (L.) Schltr.	LC	Madhya Pradesh (VU 2006)

Table 1: Consolidated list of threatened medicinal plants represented by IUCN.[6]

Some other examples of species at risk[7]

- Slippery elm (*Ulmus rubra*): The gummy lining of the bark of the slippery elm has long been used in North America, especially Appalachia, as a soothing agent for coughs, gastrointestinal ailments, and skin irritations. This species has been identified at "at risk" by the U.S. Forest Service, the U.S. Park Service, and the National Center for the Preservation of Medicinal Herbs (NCPMH).
- Yew (Taxus species): Yew trees, including the Pacific yew (*Taxus brevifolia*) and Chinese yew (*Taxus chinensis*), are used to produce the popular, profitable, and effective cancer drug taxol. CITES has identified several yew species as in need of protection from over harvesting for international trade.
- American ginseng *(Panax quinquefolius*) Sales of wild and cultivated ginseng exceed $25 million each year in North America, with wild ginseng seen as the more desirable type. Wild ginseng is so much more profitable than cultivated ginseng that there is great concern about the decline and imperilment of the species in the wild.
- Black cohosh *(Cimicifuga racemosa*): This member of the buttercup family has traditionally been used to treat a variety of conditions including colds, pain, rheumatism, and menopause. Nearly 100 percent of black- cohosh supply comes from wild harvesting. The species has been identified by the U.S. Forest Service and other institutions as at risk from overharvesting and habitat degradation.
- Goldenseal (Hydrastis canadensis): This buttercup-family member has numerous traditional uses as a tonic and to treat ailments such as hemorrhoids. According to the NCPMH, more than 60 million goldenseal plants are being harvested annually without being replaced, and goldenseal is already considered rare, threatened, or endangered in many states

MAJOR CAUSES OF LOSS OF BIODIVERSITY-

Apparently the quick decline of the vegetation cover of a country is directly linked with the rapid population growth (102 crores in India) with ever increasing needs. The, major causes of the loss of biological diversity in India both in the hills and plains are anthropogenic. However, eight major causes for the loss of bio- diversity have been identified namely-(i) Habitat loss and

fragmentation, (ii) Introduced species (iii) Over exploitation of plant and animal species, (iv) Pollution of Soil, Water and atmosphere, (v) Global climate change, (vi) Expansion of Industry, agriculture and forestry, (vii) Want of pollinating vectors, (viii) Unisexual flowered species. Over-exploitation and indiscriminate use of wild resources in commercial demand now-a-days playa great role not only behind the quick decline of the species concerned, but also becomes a threat for the survival of other associated species, thus acting as the major factors disturbing the entire ecosystem.[8]

ON-GOING INITIATIVES [9]-

Protection and Conservation Strategies- Control of 'Wildlife Trade' is the most effective measure to protect the wild potential resources for their sustainable use. Using IUCN (1994) methods, Botanical Survey of India - the nodal organization responsible for monitoring and preparation of the list of plants to be included in the negative list of export- has so far listed 53 species for restriction in trade.

In Situ Conservation- Developing in situ conservation methods at different levels, ranging from species to ecosystem.

Habitat Conservation- India has a large network of 85 National Parks and 445 sanctuaries covering about 2.5% of total land surface as well as marine ecosystem. However the critical problem is not merely the conservation of a particular species or habitat, it is the continuation of the very process of evolution of all microorganisms, plants and animals in their totally as integral part of the natural ecosystem. To achieve the objective, the Government of India has designated 8 Biosphere Reserves out of 14 proposed. In West Bengal, Sunderban is one of the Biosphere Reserves. World Heritage Convention has designated 5 natural sites as world Heritage sites.

The GoI has also established NMPB in 2000 under Ministry of AYUSH, and provided funds for research on medicinal plants. In addition to NMPB and Department of Science and Technology (DST) have also supported researchers to undertake research on medicinal plants.In addition, several other government and non-government organizations, industries, ayurvedic practitioners are also involved in conservation and cultivation of these medicinal plants.

For ex situ conservation several institutes/organizations have been established by Gol, especially to undertake research on medicinal plants viz., Central Council for Research in Ayurvedic Sciences (CCRAS), Central Council for Research in Homoeopathy (CCRH), Central Council for Research in Siddha (CCRS) and Central Council for Research in Unani Medicine (CCRUM) under Ministry of Ayurveda, Yoga and Naturopathy.

SUGGESTED MEASURES AND ACTION PLAN.[10]

1. Preparation of a state level inventory of medicinal plant parts in trade in the major markets within the state. Species level scientific identification is extremely necessary in case of each item.
2. Rapid documentation of empiric knowledge base of tribal and ethnic communities and rural people of India about medicinal plants and their uses. Identification of threatened habitat and taxon.
3. Preparation of a reference sample collection of medicinal plant parts in trade for the country allowing public access to the collection.
4. State level initiatives to introduce and promote cultivation of medicinal plants occurring naturally within the state which are in high demand.
5. Promoting cultivation throughout the state giving priority to items which can be exnorted with cultivation certificate authentication only. Developing agro-technique for as many as possible plants. So far agro-technique could be developed for 42 medicinal plants only.
6. In situ conservation by establishment of natural reserves or biosphere resources. Ex situ conservation through medicinal plant gardens, artificial regeneration of botanical gardens and arboreta.
7. To popularize the potential avenue of medicinal plants among local farmers for their commercial cultivation.
8. To conduct regular training camps for the farmers for cultivation, harvesting and sustainable utilization.
9. Creation of medicinal plant gene bank. Proper assessment of population size mapping and biology of threatened plants
10. To popularize the potential avenue of medicinal plants among local farmers for their commercial cultivation
11. Dissemination of all related knowledge (conservation task) through print and electronic media.

CONCLUSION

The preservation of endangered medicinal species is not only a matter of ecological importance but also an ethical responsibility. As we recognize the immense value these organisms hold for human health and cultural heritage, urgent action is needed to protect them from the threats they face. By implementing effective conservation strategies, we can ensure the continued availability of medicinal resources and pave the way for future medical breakthroughs, all while safeguarding the delicate web of life on our planet.

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