

STATUS AND DISTRIBUTION OF RARE, ENDANGERED AND VULNERABLE PLANT SPECIES AND THEIR SIGNIFICANCE AS CLIMATE CHANGE INDICATOR IN ARUNACHAL PRADESH.

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Abstract

Climate change, a multi-activated phenomenon, is largely accelerated by anthropogenic activities like huge exhaustion of Greenhouse gases (GHG's) and rapid depletion of forest cover. For past three decades, global temperature is increasing alarmingly thus strengthening the popular aphorism "Global Warming as the end result of climate change". Himalayan region is found to be very sensitive to climate change and fast rate extinction of endemic flora and fauna of this mountain region is indicating the effects of climate change. The present work was carried out to document the Rare, Endangered, Threatened (RET) and vulnerable species of plants and their significance as climate change indicator in Arunachal Pradesh. Based on secondary database, a total 48 number of RET and vulnerable plant species belonging to 18 families and 40 genera have been documented with their altitudinal range of occurrence, locality, life forms, and status. Family Orchidaceae represented by 14 species was the most dominant family among all, followed by Aceraceae and Begoniaceae with 3 species each. Being marked as the dominant family Orchidaceae species including other RET species needs strong attention in regard to climate change perception, prioritization and conservation.

INTRODUCTION

The Himalayan range with its mountains chains, valleys and flood plains is astounding not only from an aesthetic point of view but also in terms of abundance of flora and fauna, sheltered within the huge folds of rugged mountain valleys. The Eastern Himalaya is the repository of rare and endangered flora and fauna, diverse and luxuriant vegetation and high degree of endemism. More than 7000 species of plants, 175 species of mammals and over 500 species of birds have been recorded in the Eastern Himalayas (Chettri *et al.* 2008).

Arunachal Pradesh, being a part of the Himalaya-East Himalaya Biogeographic zone (Rodgers *et al.* 2000) lies at the juncture of three biogeographic realms, the Afro-tropical, the Indo-Malayan & the Indo-Chinese (Takhtajan, 1969). It

presents a vast range of species and ecosystem diversity in the Eastern Himalayan, thus holding its place as one of the eighteen "Biodiversity Hotspots" of the world (Chatterjee *et al.* 2006). Arunachal Pradesh which spreads over an area of 83,743 sq.km with location 26.28° and 29.30° N latitudes and 91.30° and 97.30° E longitude estimated to have over 5000 species of flowering plant out of which 238 as endemic species to the state. The state houses over 580 species of orchids out of 1300 species found in India. Further about 7 primates out of 16 primates of world and 650 bird species are documented in the state.

Climate Change, a change in the state of climate that can be identified by changes in the mean and/or the variability of its properties, and that persists

for an extended period typically decades or longer (IPCC, 2007). Climate is changing rapidly with disruptive impacts and that change is progressing faster than any seen in the last 2000 yrs (www.ecy.wa.gov). The Fourth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) concluded that changes in the atmosphere, oceans, glaciers and ice caps demonstrate that the planet is warming. The Eastern Himalayas shows a warming trend at higher altitudes and the areas at altitudes above 4000 m seem to experience the greatest warming trend. Climate change and its impacts in mountain regions and vulnerability of mountain biodiversity has brought mountain regions into the spotlight in global context. Threats to biodiversity include the possible loss of genetic resources and species, possible loss of habitats and a decrease in ecosystem services. Fragmentation and loss of habitats threaten species' survival-high altitude species found in the transition zone between sub-alpine and alpine and high-altitude wetland species will be more vulnerable to climate change (Sharma, *et.al.*, 2009). Arunachal Pradesh, being a part Eastern Himalaya, harbours a unique composition of different plant communities being influenced by various climatic factors including rainfall, temperature, humidity and altitude (Biswas, 1966). The biodiversity of Arunachal Pradesh is in threat due to deforestation, jhum cultivation, tea plantations, forest fires, hunting, soil erosion, timber felling, urbanization and encroachment problem (Chatterjee, *et.al.*, 2006). Keeping in view the importance of RET species as climate change indicator, it is pertinent to document their status and distribution.

Material and Methods

An extensive literature survey of RET plant species has been conducted, emphasizing more on endemic & vulnerable species to climate change. Experts were consulted to access information on the vulnerable species to climate change. Categorization of plant species as Vulnerable, Endangered, Rare and Threatened has been done using International Union for Conservation of Nature and Natural Resources (IUCN) Red List Criteria and Red Data Book of Indian Plants (Nayar & Shastri, 1987, 1988, 1990).

Result and Discussion

Based on the available literature, 88 species of plants of Arunachal Pradesh are found to be in rare, endangered, threatened and vulnerable categories, out of which 48 species are documented with their detailed information such as altitudinal distribution, locality, life form and current status in red list.

It is revealed that the 48 plant species belongs to 18 families and 40 genera are spread in a number of districts of Arunachal Pradesh i.e, Anjaw, Changlang, Lower Dibang Valley, East Siang, Lohit, Lower Subansiri, Papum Pare, Tawang, Tirap, Upper Dibang Valley, Upper Siang, West Kameng, West Siang occurring from 100 to 5000 m alt. Among the plants species *Aphyllorchis alpina*, *Malaxis muscifera*, *Renanthera imschootiana* have been recorded under Critically Endangered category; *Dalbergia clarkei* under Rare Endangered category; *Albizia arunachalensis*, *Amentotaxus assamicus* under Rare Threatened; *Ixonanthes khasiana* under Rare Vulnerable; *Garcinia pedunculata* under Near Threatened Category; 16 plant species are categorised under Rare; 8 plant species under Endangered category; 14 plant species under Vulnerable category; 2 plant species under Intermediate category (Table.1).

Orchidaceae with its 11 genera and 14 species is found to be the most dominant family among all followed by Aceraceae and Begoniaceae with 3 species each and Elaeocarpaceae and Ranunculaceae 2 species each. Orchids Species like *Bulleyia yunnanensis*, *Cymbidium eburneum*, *Diplomeris pulchella*, *Paphiopedilum fairrieanum*, *Pholidota wattii* are endemic to Arunachal Pradesh. *Renanthera imschootiana* (Red Vanda) and *Vanda coerulea* (Blue Vanda) are highly extracted for commercial international trade of this species. Species like *Aconitum ferox*, *Coptis teeta* and *Panax pseudoginseng* are vulnerable for their medicinal uses and pharmaceutical values.

Orchid diversity is considered to be in biggest threat due to climate change. Global warming directly affects the structure & composition, growth, behaviour, phenology, pollination of orchids. Change in microclimate associated with orchids growing is also a major cause of depletion of orchids (Barman, *et. al.*, 2013).

Table 1: List of RET, Vulnerable and Endemic Plant Species of Arunachal Pradesh

S.N.	Species	Family	Category	Endemism	Life Form	Altitudinal distribution	Locality
1.	<i>Acer hookeri</i> Miquel var. <i>majus</i> Pax	Aceraceae	Endangered	-	Tree	600-2100 m	Lower Subansiri, West Kameng
2.	<i>Acer oblongum</i> Wall. ex D.C. var. <i>membranaceus</i>	Aceraceae	Endangered	Endemic	Tree	1400-2000 m	Changlang, West Kameng, Lohit, Lower Dibang Valley, Upper Dibang Valley
3.	<i>Acer sikkimensis</i> Miquel var. <i>serrulatum</i> Pax.	Aceraceae	Endangered	Endemic	Tree	1500-2500 m	Changlang, Lohit, Tirap
4.	<i>Aconitum ferox</i> Wall.	Ranunculaceae	Vulnerable	-	Herb	3000-5000 m	Tawang, Lohit, Upper Subansiri, Lower Dibang Valley, Upper Dibang Valley
5.	<i>Albizia arunachalensis</i> Sahni & Naithani	Mimosaceae	Rare & Threatened	Endemic	Tree	1577 m	West Kameng, Lower Subansiri
6.	<i>Alniphyllum fortunei</i> (Hemsley) Makino	Styracaceae	Rare	-	Herb	1600 m	Lower Subansiri
7.	<i>Amentotaxus assamica</i> Ferguson	Taxaceae	Rare & Threatened	-	Tree	1600-2000 m	Anjaw
8.	<i>Aphyllorchis alpina</i> King & Pantl.	Orchidaceae	Critically Endangered	-	Herb	1800- 2100 m	Lower Subansiri, Kameng
9.	<i>Aquilaria agallocha</i> Roxb.	Thymelaeaceae	Rare	-	Tree	700 m	Lower parts of Arunachal Pradesh
10.	<i>Begonia arborensis</i> Dunn	Begoniaceae	Rare	Endemic	Herb	800-1500 m	East Siang, West Siang
11.	<i>Begonia burkillii</i> Dunn	Begoniaceae	Rare	-	Herb	500-1200 m	East Siang, West Siang
12.	<i>Begonia scintillans</i> Dunn	Begoniaceae	Intermediate	Endemic	Herb	500-2000 m	Upper Dibang Valley, Lower Diabng Valley, Siang, Tirap
13.	<i>Bulleyia yunnanensis</i> Schltr.	Orchidaceae	Rare	Endemic	Herb	1600- 2000 m	West Kameng, Subansiri

1	2	3	4	5	6	7	8
14.	<i>Calanthe mannii</i> Hook.f.	Orchidaceae	Rare	-	Herb	1000-1500 m	Lower Subansiri , Kameng
15.	<i>Canarium strictum</i> Roxb.	Burseraceae	Rare	-	Tree	1000-1200 m	Siang, Tirap
16.	<i>Cinnamomum tamala</i> (Buch.-Ham) Nees & Eberm	Lauraceae	Vulnerable	-	Tree	700 m	Lower parts of Arunachal Pradesh
17.	<i>Coptis teeta</i> Wallich	Ranunculaceae	Vulnerable	Endemic	Herb	1800 m	Lohit, Anjaw, Upper Dibang Valley
18.	<i>Cymbidium eburneum</i> Lindl.	Orchidaceae	Vulnerable	Endemic	Herb	1000-1500 m	Tirap
19.	<i>Cymbidium hookerianum</i> Reichb. F.	Orchidaceae	Vulnerable	-	Herb	1500-2650 m	Kameng
20.	<i>Dalbergia clarkii</i> Thoth.	Papilionaceae	Rare & Endangered	-	Shrub	1400 m	West Kameng
21.	<i>Dendrobium nobile</i> Lindley	Orchidaceae	Vulnerable	-	Herb	1000-1500 m	West Kameng, Lohit, Siang, Subansiri, Tirap
22.	<i>Dioscorea deltoidea</i> Wall. Ex. Kunth	Dioscoreaceae	Vulnerable	-	Climber	1000-3500 m	All parts of A.P.
23.	<i>Diplomeris hirsuta</i> Lindl.	Orchidaceae	Vulnerable	-	Herb	500-1500 m	Tirap , Kameng, Siang, Lohit
24.	<i>Diplomeris pulchella</i> D. Don	Orchidaceae	Vulnerable	Endemic	Herb	100-1000 m	Kameng, Lohit, Siang, Subansiri, Tirap
25.	<i>Elaeocarpus prunifolius</i> (C.Mueller) Mast.	Elaeocarpaceae	Rare	-	Tree	1400-1800 m	Subansiri & Tirap
26.	<i>Elaeocarpus acuminatus</i> Wall. ex. Mast.	Elaeocarpaceae	Rare	-	Tree	500-700 m	Lower Subansiri
27.	<i>Euonymus assamicus</i> Blakelock	Celastraceae	Endangered	-	Tree	1700 m	Upper Dibang Valley, Lower Dibang Valley, Anjaw
28.	<i>Garcinia pedunculata</i> Roxb.ex. Buch-Ham.	Clusiaceae	Near Threatened	-	Tree	1000-1200 m	West and Upper Siang, Lower & Upper Dibang Valley, Anjaw, Changlang and Tirap
29.	<i>Homalomena aromatica</i> Schott	Araceae	Vulnerable	-	Herb	500 m	Lower parts of A.P

1	2	3	4	5	6	7	8
30.	<i>Huodendron biaristatum</i> (W.W. Sm.) Rehder	Styracaceae	Rare	-	Herb	1700m	Lower Subansiri
31.	<i>Ixonanthes khasiana</i> Hook.f.	Ixonanthaceae	Rare & Vulnerable	Endemic	Tree	1000-1500 m	Papum Pare
32.	<i>Malaxis muscifera</i> (Lindl.) Kuntze	Orchidaceae	Critically Endangered	-	Herb	1500-2500 m	West Kameng, Siang
33.	<i>Michelia punduana</i> Hook.f. & Thomson	Magnoliaceae	Rare	Endemic	Tree	1000-1500 m	West Kameng, Lohit, Siang, Subansiri, Tirap
34.	<i>Neonauclea gageana</i> (King) Merr.	Rubiaceae	Intermediate	Endemic	Shrub	500-700 m	East and West Siang
35.	<i>Oroxylum indicum</i> Vent.	Bignoniaceae	Vulnerable	-	Tree	800 m	Lower parts of A.P
36.	<i>Panax pseudoginseng</i> Wall.	Araliaceae	Vulnerable	-	Herb	1600-2800 m	Tawang & Lower Subansiri
37.	<i>Paphiopedilum fairieanum</i> (Lindl.) Stein	Orchidaceae	Endangered	Endemic	Herb	1400-2200 m	West Kameng
38.	<i>Paphiopedilum spicerianum</i> (Reichb.F.) Pfliz	Orchidaceae	Vulnerable	-	Herb	350-1000 m	West Kameng
39.	<i>Paulia belladonna</i> Deb & Dutta	Solanaceae	Rare	-	Herb	2000 m	Tirap
40.	<i>Pholidota wattii</i> King & Pantl.	Orchidaceae	Rare	Endemic	Herb	500-1000 m	Lower Subansiri
41.	<i>Picrohiza kurroa</i> Royle.ex. Benth	Scrophulariaceae	Vulnerable, Endangered	-	Herb	3000-5000 m	Tawang, Upper Subansiri
42.	<i>Psychotria aborensis</i> Dunn	Rubiaceae	Endangered	Endemic	Herb	300-1200 m	West Siang, East Siang
43.	<i>Pueraria bella</i> Prain	Fabaceae	Rare	Endemic	Herb	200-1000 m	East Siang, West Siang, Lohit, Dibang, Tirap
44.	<i>Renanthera imschootiana</i> Rolfe	Orchidaceae	Critically endangered	Endemic	Herb	500-2000 m	West Kameng, Lower Subansiri
45.	<i>Rhododendron subansiriense</i> Chamberlain & Cox	Ericaceae	Endangered	Endemic	Shrub	2600-2800 m	Lower Subansiri

1	2	3	4	5	6	7	8
46.	<i>Swerfia chirayita</i> (Roxb. ex. Flem) Karst.	Gentianaceae	Vulnerable	-	Herb	1800-3000 m	Tawang, West Kameng, Lower & Upper Subansiri, Dibang Valley, Lohit
47.	<i>Vanda coerulea</i> Griff. ex. Lindley	Orchiaceae	Rare	-	Herb	1000-2500 m	West Kameng, Tirap, Changlang
48.	<i>Wallichia triandra</i> (J. Joseph) S.K. Basu	Areaceae	Rare	Endemic	Tree	900-1000 m	Hyuliang, Wakroo near Glow village in Lohit district

Source: Red Data Book of Indian Plants Vol. 1-3, BSI, Culcutta (www.bsienviis.nic.in), IUCN (www.iucnredlist.org), State Forest Research Institute (SFRI) Arunachal Pradesh

N.B. The list has been submitted to MoEF, Govt. of India by Systematic Botany Division, SFRI, Department of Env. of Forests, Govt. of Arunachal Pradesh.

Conclusion:

Deforestation which is a major factor influences climate change and exploitation of plant species for their medicinal properties and uses are rendering the plant species rare, endangered, threatened and vulnerable. Ever-increasing demand and alarming depletion of this endemic flora and other plant species is making them more vulnerable under climate change.

Orchids are key species in a forest ecosystem. Orchid relationship with forest flora and fauna, dependence for pollination, fungal interference,

microclimate and dispersal of seeds make them extremely susceptible to the effects of climate change. Orchids as well as the endemic species are good indicators of climate change, though these indicators may not be reflected adequately at this stage. Efforts are continuing to document this climate status of vulnerability affected by climate change. It is strongly suggested that a strong data base of vulnerability categorization over time shall reflect impact of climate change on plant species

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