Summary

Orchids are the most advance among the angiosperms and cosmopolitan in distribution, it grows more luxuriously in tropical and sub-tropical forests having rainfall more than 2500mm. The North eastern region of India due to its ecological and varied climatic conditions has the maximum diversity of orchid flora. The study is carried out in the tropical rain forests of three districts of upper Assam. For the present study 8 sites were selected in three districts of upper Assam where we find tropical rainforest ecosystem. *Viz*., Abhoypur reserve forest, Sola RF, Dilli RF in Sivasagar district; Jeypore RF and Jokai RF in Dibrugarh district; Digboi RF, Doom Dooma RF and Deopani RF in Tinsukia district.

The region experiences a pleasant weather throughout the year. The temperature ranges from 8º in winter to 35º during summer and is characterized by highly humid atmosphere and abound rains. The area of study falls under tropical climate, which is characterized by high precipitation. The amount of rainfall towards the end of the rainy season is frequent but there is some amount of precipitation in every month. Maximum annual rainfall recorded is 3640 mm (2007).

Diversity and species rarity

In the present investigation a total of 89 species of orchids were collected, out of which 83 species are identified covering 42 genera whereas 6 species could not be identified due to non flowering and is growing in our net house condition. Out of the collected orchid species 19 % are terrestrial (15 species), one saprophytic and 81% are epiphytic (67 species). Maximum number of species were encountered in Jeypore reserve forest (79 species) followed by Digboi reserve forest (57 species) and Abhoypore (53 species). Hence most of the rare species together with the ground species are encountered in these two sites. The other sites are isolated forest fragments and are exposed to various disturbances such as encroachment, tree felling, oil survey works, etc. These factors have resulted in the depletion of species richness in these sites. Least number of species of orchids were encountered in Sola reserve forest (20 species) and Deopani reserve forest (24 species). The forests of Jeypore, Abhoypore and Digboi reserve forests are comparatively less disturbed than the other reserve forests and hence could provide the micro sites for the growth of most of the orchid species. Among the different species *Dendrobium* (15) account for highest number of

species followed by *Eria* (6 speices); 24 genera has single representative and 12 genera has two species each.

From the distributional point 32 species are common and are encountered in most of the sites for several times. Among the common species are *Agrostophyllum khasianum, Bulbophyllum careyanum, Bulbophyllum sikkimense, Cymbidium aloifolium, Dendrobium aphyllum, Dendrobium lituiflorum, Dendrobium moschatum, Eria pubescens, Oberonia iridifolia, Papilionanthe teres, Pholidota articulate, Pholidota imbricate, Rhynchostylis retusa, Micropera purpurea* shows luxuriant growth in both disturbed and undisturbed areas and hence they are out of threat. The species of *Aredies, Cymbidium* and *Dendrobium* are more commonly collected from the wild for their showy flowers and are grown in the households. Among these the people often collect some rare species like *Aredies roseum, A. odorata, Dendrobium chrysotoxum, Cymbidium bicolour* and many other which poses threat to their population in wild. 34% of the species were categorized as rare (28 species) that are observed in more than two sites but encountered once in each site. And very rare species accounts for 28% of the total species collected (23 species) that includes most of the ground orchids along with the other epiphytes ones. Only one saprophytic orchid species, *Epipogium,* was collected from Jeypore reserve forest. This speices was collected from bamboo forest which may have association with the rhizosphere of bamboo. The species *Bulbophyllym sikkimensis* and *Thelasis longifolia* are found to be restricted in distribution in the northeastern region only.

Commercially important orchids

Among the collected species a total of 41 species are selected which can be recommended for commercial cultivation. Orchid species of *Aerides, Cymbidium, Dendrobium* and *Rynchostylis retusa* are generally grown in most the households of the people of the region. During Bihu festival girls use *Rynchostylis retusa* to adorn their hairs which are mainly collected from home gardens. These are even sold in the local market during the bihu festival. Apart from this the other species used are *Aerides multiflora, A. roseum* and *A. odorata* that are maily collected from the wild. However *Papilionanthe teres* is seen growing naturally in several tree species in the homegardens. The speicies like *Aerides* spp., *Arundina graminifolia, Cymbidium* spp., *Dendrobium* spp., and *Rynchostylis retusa* can be of high demand for cut flower market; whereas, the other species can be grown as potted plant. The *Cymbidium* species and *Eria ferruginea* has hard flowers and hence last

for longer period. The species *Aneoctochillus brevilabris* has beautiful coloured leaf and can be used as potted plant.

Ecology and Host species Diversity

Due to differences in ecological factors the distribution of all species is not equal in all ecosystems. The phenomenon of specific mycorrhizal association make orchids diverse and rare. In case of epiphytic orchids, host specificity is also very established fact in orchid availability. Various studies show that host tree specificity is related to the host suitability of fungi involved in species- specific orchid mycorrhizal associations. In the present study a total of 108 host tree species were identified from five different study sites. Out of these 25 are most preferred host tree species, in which more than 5 species of orchids were encountered, were identified. Some of them are also the dominant tree species of the reserve forests. The most dominant families with highest number of species include *Euphorbiaceae, Lauraceae, Magnoliaceae* and *Meliaceae.* The orchid species are found to occur in most of the tree species except in individuals having smooth barks such as *Terminalia chebula, T. bellerica, Duabanga sonneratioides, Dysoxylum* spp., *Elaeocarpus* spp, etc., but still they struggle to grow in fork of the branches. However they do not grow in young tree individuals even of the preferred tree species. They generally prefer to grow in old trees where lichen and mosses are abundant together with different epiphytic pteridophytes where adequate humus is present for their growth. Among the species the most preferred host species are *Bischofia javanica, Lagerstromia flosregine, Sterospermum chelonoides* and *Ficus elastica*. They do not prefer to grow upon dead tree individuals, if growing they will shed as the bark of those tree individuals torn out in due course of time and the orchid species cannot make their hold. The only species that can grow in dead trees are *Cymbidium aloifolium* and *Dendrobium moschatum*. Soil is an important parameter in determining the distribution pattern of ground orchids. A total of 16 terrestrial orchids have been reported in the present study. Out of these only one saprophytic orchid *Epipogium* sp is encountered. These species grow on the rich humus soil of the forest floor with sufficient moisture content. Most of the ground orchids are encountered in Jeypore reserve forest (14) which has maximum litter depth. Hence litter depth appears to be a major component for the terrestrial orchids to grow, that retain soil moisture and fertility. In Deopani reserve forest only two species of orchids were encountered viz., *Arundina graminifolia* and *Goodyera procera*. This may be due to the Deopani river which accumulate huge amount of sand and silt in the area where the terrestrial orchid cannot thrive.

The study of the flowering phenology of orchids shows that about 31% of the species flowers during pre-monsoon, 46% during monsoon, 18% during post-monsoon and 5% during winter season. However some species flowers throughout the year.

Ethnobotany of orchids

Orchids are also used as medicine since long years back. The presence of photochemical such as alkaloids, flavonoids, and glycosides has made orchids medicinally more valuable. Almost all parts of orchids are used in medicine which makes them useful for the cultural and religious purpose for the different tribes and races from Northeast India.

Among the species collected during the study *Acampe papillosa* , *Aerides multiflora* , *Arundina graminifolia*, *Cymbidium aloifolium*, *Dendrobium fimbriatum*, *D. moschatum*, *Dendrobium nobile*, *Eria pannea*, *Luisia thrichorhiza*, *Pholidota imbricate* , *Pholidota articulate*, *Spiranthes sinensis* and *Rhynchostylis retusa* are widely used by the local tribes of Assam and Northeast for the treatment of various ailments. Parts of the orchids are also used as food and also as fodder for animals. For the purpose of their use the tribes grows orchids in their household gardens which helps in the conservation of this plant community.

In conclusion, the most suitable method of orchid conservation is to protect the natural habitat of the orchids in the region which still is conducive for orchid species except in certain forested areas. But prior to this data on the population status of all the rare species is to be ascertain together with their distributional pattern.

***In-Situ* conservation**

- The orchid conservation areas are to be identified on priority basis, few of the reserve forest can be upgraded to orchid sanctuary
- The population status and present distributional pattern is to be evaluated together with geo-spatial mapping
- Conservation of host tree species and avoiding monoculture plantation
- Developmental works like *pucca* road construction and survey works inside the forested areas should be avoided
- Strict vigilance of the forested area for illegal tree felling is to be made which is noticed in most of the reserve forest
- Regeneration of degraded forest areas, particularly the peripheral region is to be made by planting suitable host tree species

- In-depth research on pollination biology of orchids is to be made

***Ex-situ* Conservation**

- Artificial propagation of rare and endangered species and reintroduction in the natural habiatat should be done
- Establishment of a suitable germ plasm bank in the area nearness to natural habitat of the orchids
- Establishment of orchidarium and orchid research centre in the region would help in conservation of orchid speices.
- More centres for commercial cultivation of orchids is to be developed in the region for socio-economic upliftment and effective conservation.
- A good electronic database is to be created having detail population status and distributional pattern of orchid species
- Awareness programmes should be done to aware the public as well as school students in nearby forest areas

Executive summery

- **Total Species collected– 89**
- **Total Genera – 42**
- **Dominant Genera – *Dendrobium, Bulbophyllum, Eria***
- **Number of rare species – 35**
- **Terresterial orchid – 15 (19%)**
- **Newly recorded species from Assam– 2 (***Bulbophyllum sikkimensis, Coelogyne flavida*)

- **Publications –**

1. P.C. Nath, A. Borgohain and A.B. Gogoi 2010. Orchid diversity and host specificity in Deopani Reserve Forest, Sadiya, Assam, *NEBIO*, 1 (3): 16-20.
2. P.C. Nath and D.R. Das. 2011. *Bulbophyllum sikkimense* (King & Pantling) J.J. Smith (Orchidaceae) – a new record for the orchid flora of Assam, India. *Pleione*, 5 (2): 341 – 344.
3. P.C. Nath and D.R. Das. 2012. Distribution of Orchids in Sibsagar district of Assam, India, 2: 88-92.
4. P.C. Nath and D.R. Das. 2013. Distribution of *Dendrobium* Swartz (Orchidaceae) in Tropical Evergreen Forests of Upper Assam, India, *Pleione*
5. P.C. Nath and D.R. Das. 2013. *Coelogyne flavida* Wall *ex* Lindl. (Orchidaceae) – a new record for the orchid flora of Assam, India, *Pleione*