

PREFACE

Conservation of biodiversity is important for continued existence of life on earth. Convention of biological diversity is the most important and globally binding effort made towards this. Growing human population, multifarious anthropogenic activities and natural calamities push many of the taxa towards threatened categories. Maximum destruction is taking place in forest corporation areas of the region. Therefore, proper conservation of biodiversity is immediately required and every efforts towards exploration and documentation of Orchid flora is highly appreciable because there are maximum chances for species to get threatened and extinct before they are made known to the floristic world.

Darjeeling is situated almost at the central part of Eastern Himalaya. Darjeeling is a part of Himalayan hotspot. Sir J.D. Hooker appreciated the floristic richness of this region and introduced it to outside world. The occurrences of very large variation in physiographic, climatic and edaphic conditions often aided by biotic factors which are responsible for such richness and diversity.

The Darjeeling district is divided into four Sub-Divisions, three of which are now on hills namely Darjeeling, Kalimpong and Kurseong and the remaining Siliguri Sub-Division is situated in the plains adjacent to the hills. The region experiences the highest rainfall during the months between June to September. The areas located above 3000 m, specially from Tonglu to

Sandakphu to Phalut remain very cold for most of the time. It exhibits a typical monsoon climate, with wet summer and dry winter. The great variation in altitude and configuration of the neighboring mountain ranges greatly affect air movement, rainfall and temperature and leads to a greater range of variation in local climatic conditions.

Orchid species need special environmental conditions for their growth. Darjeeling Himalaya is positioned in such a way that the region is not only able to capture maximum rainfall and high humidity, which is favorable for lavish growth of vegetation including Orchid species.

I started my floristic work in the year 2007 when I was engaged for two years in a research project entitled “Medicinal and Aromatic Plants of Darjeeling District and Documentation of Status Habitat and Local Uses of the Plant Species” funded by the West Bengal State Department of Science and Technology, Kolkata. I have done synergistic field work both on project of medicinal plants and my Ph.D. research work covering the entire four Sub-Divisions of Darjeeling district. After completion of my project work, I was awarded Rajiv Gandhi National Fellowship for the achievement of a Ph.D. degree. My present work includes 321 species under 86 Genera from Darjeeling Himalaya. It has been recorded that 2 species with 2 genera are saprophytic, 100 species with 34 genera are terrestrial and the rest 219 species with 52 genera are epiphytic.

Field surveys were carried out between June 2007 to April 2015 and recorded the distribution and habitat status of different taxa. During my earlier field trips, random collection of 2-3 specimens of each Orchid species both flowering and non-flowering stages were gathered and planted near the residence of Dr. R. B. Bhujel, Hill Top, Kalimpong with tags and label. Proper management of those collected species was done by Mr. Aden Alfred

Lepcha who was the Project Assistant in the same project. After the completion of his tenure, Mr. Rakesh Tamang, assisted me on my several field trips to Siliguri, Sevoke low altitude to Sandakphu, Phalut high altitude of the studied region. Both of them are skilled for tree climbing for the collection of epiphytic Orchids from tree trunk and branches and I myself being habituated to climb the trees in absence of those two assistants. Some locally collected Orchid species were also planted at my own residence at Samalbong Busty, Kalimpong with proper care my sisters. While collecting specimen, we always assured that there is sufficient number of plants in the nature and without disturbing their population in the nature, specimens were collected.

This thesis provides details updated nomenclature, synonyms, flowering, fruiting, specimen cited, present availability status, local distribution within Darjeeling Himalaya, general distribution which is placed in enumeration chapter and details of above findings are given in discussion chapter. Besides this, photo plates and line drawings are also provided to facilitate the identification and observation of floral morphology and colour variated taxa of the region. A key based on noticeable field characters of each species is provided to help for identification of each taxa. The description has been based on characters of fresh specimens both in field and in laboratory. A total of 940 herbarium sheets were prepared during this course of study.

Description of species, drawing and dissection were done based on fresh specimens both in the field and the Laboratory. Consultation with Prof. A.P. Das, Professor of the Department of Botany, North Bengal University and Secretary of Taxo Club and Chief Editor of Plant Taxonomy Journal "Pleione", was also taken for publication of Himalayan Medicinal Orchids, colour variations of species of *Cymbidium lowianum*, *Chilochista parishii*, *Geodorum densiflorum*, *Eria lasiopelata*, *Malaxis acuminata*, *Phalaenopsis*

lobbii, *Pinalia amica* etc. were observed. On the suggestion of Mr. U.C. Pradhan, President, IUCN, Kalimpong, images were also taken while preparing the new variety of *Geodorum densiflorum* var. *kalimpongense* Rajendra Yonzon *et al.*

I have discovered a new variety of *Geodorum densiflorum* var. *kalimpongense* and named after Kalimpong Sub-Division from where the original specimens were collected and preserved and finally published in the Journal of McAllen International Orchid Society, USA. The Holotype was deposited at the Central National Herbarium and Isotypes are kept at NBU herbarium and the CWC herbarium. Many colour variations of *Geodorum*, species were observed and finally published in the Journal of Mc. Allen International Orchid Society, USA. In present study, it was possible to add 41 new records in the lists of the flora of Darjeeling Himalaya.

During this course of study, I have published 51 research articles related with Orchids in different national and international scientific journals, proceeding volumes, book chapters, and further published and presented 33 abstracts in different national and international seminars and conferences.

Survey work was done not only in forest and villages but also conducted in floral nurseries, research centres, botanical garden etc. Many *Dendrobium* and *Paphiopedilum*, species were found in nurseries viz., Nurserymen's Heaven, Holumba, International and Kaneybreed floral nurseries of Kalimpong in cultivated condition and those were brought from North Eastern states like Manipur, Arunachal Pradesh, Mizoram and Assam for business purposes and many of them were acclimatized in the climatic condition of Kalimpong. National Research Centres for Orchids, Indian Council of Agriculture Research, Darjeeling Campus, Darjeeling; Lloyd Botanic Garden, Darjeeling were also visited 4-5 times respectively during

the course of field survey work. Local field survey works were done with Mr. Khyanjeet Gogoi, Orchid Taxonomist, Life member of the Orchid Society of India (TOSI), and Dr. Samuel Rai, former Programme Coordinator of Darjeeling Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Kalimpong and now the Director, Cinchona and Other Medicinal Plants, Mungpoo, Darjeeling.

I also visited various herbaria, more importantly the Central National Herbarium, Botanical Survey of India, Howrah, BSI Dehradun, Gangtok and NBU, Siliguri.

Epiphytic Orchid species like *Bulbophyllum*, have the highest number of species diversity. Similarly in case of terrestrial species like *Peristylus* and *Platanthera*, possess equal and high number of species diversity in the Darjeeling Himalayan region. Some species of *Cymbidium* and *Liparis*, are found both in epiphytic and terrestrial habitat. After literature review, forty five (45) species were found to be utilized for many medicinal purposes.

Indiscriminate collection of Orchids for floral business, frequent landslides, extension of agricultural lands, developmental projects like National Hydral Power Corporation (NHPC), the extension of the National Highway 31 and harvesting of epiphytic old host trees for timber and fuel wood collection are major threats to the Orchid species in the studied region. Population of *Diplomeris hirsuta*, in the Coronation Bridge sides and Kalijhora road sides are drastically damaged because of habitat destruction by anthropogenic activities.

The present work is helpful for Orchid Taxonomists, Conservationists, Botanists, Floriculturists, Environmental scientists and

Government agencies for their future course of action and for a ready reference guide for study and assessment of the Himalayan Orchid Diversity Resources of India.

Taxonomic studies on the Orchid Flora of Darjeeling Himalaya needs more field trips rather than laboratory work. In this present work, several efforts have supported me to complete the work. Field work started from Sevoke and Sukuna of Siliguri Sub-Division of Darjeeling district (low altitude) to Sandakphu-Phalut (high altitude), and was conducted throughout the year. Epiphytic, terrestrial and saprophytic Orchids collections needed extra effort and were supported by many person without which, this work would have been incomplete. Therefore, I acknowledge their help and I express my sincere heartfelt gratitude to those people.

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