

## Chapter-II

### 2. MATERIALS AND METHODS

#### 2.1. SELECTION OF ROUTES AND CAMPING

A thorough reconnaissance survey of the virgin Neora Valley was made with the volunteers of Siliguri based North Eastern Society for Preservation of Nature and Natural Resouces (NESPON), a non-Government Organisation and the personnel of Forest Department, Government of West Bengal. Map procured from the Forest Department was thoroughly studied and altitudes of the various places of the difficult valley were recorded. In the process, trekking routes or paths and the Camps-sites were identified. The vast areas of the valley were demarcated on the basis of available trekking path, availability of water source, ideal camping site to cover the areas from as low as 300m to as high as 3100m. With the past experience of Forest Department personnel as well as trained mountaineers, routes to reach dense and deep valley, hill furs and crests in all the four directions were identified and camping sites selected. Different camping sites were selected in various parts of the dense valley so as to penetrate the inaccessible and difficult terrain of Neora Valley. One ideal place was earmarked as Base Camp and from there many advanced Mobile Camps were selected depending upon the areas to be covered in each trip and duration of the field survey. However, the big problem faced in the process of selecting some of the Camps-sites and erecting camps in desired places of the Valley was the non-availability of the water sources on the ridges.

A plan of action was drawn for the purpose of field survey, collection of plant samples, etc. Tents and trekking equipments were hired from Himalayan Mountaineering Institute, Darjeeling, and Forest Personnel as well as volunteers of NESPON were deputed to assist in the field arrangement. Porters were employed to carry the head loads/luggage. A few cowboys were also approached for guiding the scientific team in the dense forest.

Base camp was established in a natural cave at Alubari (2280m). Abandoned mule track was followed as a path to cross some hill terrains. The choppers had to be used now and then to cut the way for a single file to sneak through. The activity of collection of specimens from the field was initiated in the year 1993 and continued till the year 1998. The areas of the Neora forest were visited repeatedly in different seasons so as to record all the species growing in the area. The plant samples were randomly collected from all the accessible parts of the Neora Forests during the field surveys. Initially, short field trip was undertaken in order to acclimatise the members of the team in the entirely different set of climatic conditions of the valley, and the subsequent field trips were arranged for longer durations (upto 20 days).

A Control Room was set up at Lava Range Office of the Forest Department with a view to give back-up support and security to the scientific team as well as to coordinate and meet up the various needs of the team in the field for the entire field activities. The scientific team used to communicate with the control room through wireless set (Walky-talky) provided by the Forest Department, and the control room used to coordinate the activities of the field team in the extremely remote and difficult hill terrains of the valley.

## 2.2. COLLECTION AND PROCESSING OF MATERIALS

With a precise and clear workplan, the team sneaked through all types of the habitats including virgin dense forests, partially denuded areas, seasonally cultivated forest lands, grasslands, river catchments, lakes, etc. Fields were visited in different seasons to facilitate the record of flowering and fruiting and also to encounter the seasonal short-living plants. Wherever it was possible, the specimens were collected in both the flowering and fruiting conditions. However, some plants were collected also in their vegetative condition. The specimens were properly tagged on the spot and field characters were recorded in the field notebook. The specimens were then temporarily preserved in large polythene bags with mouths being kept tied with rubber band in order to prevent the desiccation. Such collections were further processed at the camp in which each specimens were segregated, cleaned, trimmed and then, properly displayed in Blotting-paper sheets taking care of the exposure of different plant parts, and pressed under the Herbarium Press. Generally, some amount of formalin solution was sprayed over the specimens for better preservation, especially to check the fragmentation of plant parts. Next day, the specimens were replaced to fresh blotting papers, checked, repositioned and readjusted. This operation was continued everyday or every two to three days. Then, coming back to University Laboratory, the specimens were shifted to larger plant press. Sometimes, Hot Air oven was also used for proper and quick drying. These specimens were then poisoned with 4% solution of  $HgCl_2$  in rectified spirit in order to save those specimens from fungal and insect attacks.

Thereafter, the specimens were carefully mounted on standard herbarium sheets (i.e. 41.5 x 28 cm) using adhesives, needle and thread. The herbarium label of the size 15.5 x 10cm with important information of the specimen written on it was pasted on the right hand bottom side of each sheet. Some crucial information contained in the label included (a) Field Number, (b) Date of Collection, (c) Name of the plant species, (d) Family to which it belongs, (e) Local Names if any, (f) Habit, (g) Habitat, (h) The place of collection, (i) Altitude of the place of collection, (j) Flower colour, (k) Ecological status, (l) Ethnobotanical and medicinal uses, (m) Names of collector and determinator, etc.

Beside, other significant and larger plant parts like fruits, tubers, rhizomes etc. were also collected whenever felt necessary, and cut systematically into smaller parts and dried and preserved separately using cotton pads and blotting-papers. Hot-hair oven was also used from time to time in order to ensure easy and quicker drying of these specimens.

## 2.3. IDENTIFICATION AND STORAGE

Identifications of processed specimens were done stagewise one after other in the Taxonomy and Environmental Biology Laboratory of the Department of Botany, North Bengal University by matching in the NBU-Herbarium (NBUH) and using literature. The indeterminate specimens were taken to different Herbaria of Botanical Survey of India at Calcutta (CAL) and Gangtok (BHSC), Sikkim, Herbarium of the Forest Department, Government of Sikkim, Gangtok, and compared with the available preidentified herbarium sheets.

In the final state of checking the authentication of identification, these specimens were again properly matched and varified at the Central National Herbarium (CAL), Howrah, West Bengal. Different floras, monographs, prologues, revisions etc. have been referred

to in the identification process and the effort has been made to provide latest or updated i.e. the correct nomenclature.

Specimens for all the recorded taxa were processed into 3 sets to prepare 3 separate herbarium sheets. One set of these voucher specimens will be deposited in the Central National Herbarium, Howrah (CAL). The next set is preserved in the Herbarium of the Department of Botany, North Bengal University (NBU), Siliguri, and the last set will be submitted to the Department of Forest, Government of West Bengal where it is likely to be stored at the *Interpretation Centre* at Lava.

## 2.4. DESCRIPTION

Specimens were studied properly in the Taxonomy and Environmental Biology Laboratory of the Department of Botany, North Bengal University, and were described in usual technical terminology. Major characters are placed in the following definite sequence within the description: Habit ⇒ Stem ⇒ Leaf ⇒ Flower ⇒ Fruits and seeds. Leaves, inflorescence, flowers were also described sequentially into further details as follows:

Leaf: base ⇒ petiole ⇒ lamina (measurement ⇒ margin ⇒ tip ⇒ base)

Inflorescence: type ⇒ peduncle ⇒ pedicel ⇒ bract ⇒ bracteole

Flower: overall characters ⇒ calyx ⇒ sepal ⇒ corolla ⇒ petal ⇒ androecium ⇒ stamen ⇒ filament ⇒ anther ⇒ gynoecium ⇒ carpels ⇒ ovary ⇒ chamber ⇒ style ⇒ stigmas.

However, all the major characters were not essentially used in the description of all plants. Instead, only some important characters have been selected which are essential for the recognition of the species, and are arranged according to above sequence.

## 2.5. CITATION OF REFERENCES

For each taxon, references to the protologues have been provided after the author-citation. After this, major taxonomic references related to the taxon have been cited in this work. Following abbreviations have been used in the citation for the well-known books, journals, periodicals, etc. so as to make the presentation shorter.

### Important Books

- Beng. Pl. : *Bengal Plants* by D. Prain
- EFPN : *An Enumeration of the Flowering Plants of Nepal* by Hara *et al* (ed.).
- FBI : *Flora of British India* by J.D. Hooker (ed.)
- FEH : *Flora of Eastern Himalaya* by H. Hara and H. Ohashi (ed.)

- Fasc. Fl. Ind : *Fascicles of Flora of India* (Publication of Botanical Survey of India)
- Fl. Ind. : *Flora Indica* by W. Roxburgh  
 FI : *Flora of India* (Publication of Botanical Survey of India)
- FPK : *An Enumeration of the Flowering Plants of Kurseong* by K.M. Mathew
- Prodr. Fl. Nep. : *Prodrumus Florae Nepalensis* by D. Don
- Pl. As. Rar. : *Plantae Asiaticae Rariores* by N. Wallich
- Rho. Sik. Him. : *The Rhododendrons of Sikkim Himalaya* by J.D. Hooker
- Fl. Sik. : *Flora of Sikkim* by P.K. Hajra and D.M. Verma (Vol. 1)
- Fl. Asm. : *Flora of Assam* by U.N. Kanjilal and A. Das
- Fl. Meg. : *Forest Flora of Meghalaya* by K. Haridasan and R. R. Rao
- Orch. Sik. Him. : *The Orchids of Sikkim Himalaya* by G. King and R. Pantling
- FB : *Flora of Bhutan* by Grierson *et al* (ed.) and H.J. Noltie
- FWB : *Flora of West Bengal* (Publication of Botanical Survey of India)
- FWP : *Flora of West Pakistan* by E. Nasir and S.I. Ali (ed.).
- WI : *Wealth of India*. (Anonymous)
- Fl. Jow. : *Flora of Jowai* by N.P. Balakrishnan
- Trs. N. Beng. : *Trees of North Bengal* by A.M. Cowan and J.M. Cowan
- Trs. Sik. Hil. : *Trees of the Sikkim Hills* by L.K. Rai
- FIEM : *Flora Indicae Enumeratio Monocotyledonae* by S. Karthikeyan, S. Jain, M. Nayar and M. Sanjappa
- F. & Fl. Nep.Him.: *The Fauna and Flora of Nepal Himalaya* by H. Kihara (ed.)
- Fl. Non. Arun. Prad.: *A Contribution to the Flora of Nongpoh and Vicinity* by J. Joseph

HFD : *Herbaceous Flora of Dehra Dun.*

Nam. Chang. Flr. Pl.: *Name Changes in Flowering Plants* by S.S.R. Bennett

SFSH : *Spring Flora of Sikkim Himalaya* by H. Hara.

### **Important Journals, Papers and Periodicals**

AMBG : *Annals of the Missouri Botanical Garden.*

ARBGC : *Annals of the Royal Botanic Garden, Calcutta.*

BASB : *Bulletin of Asiatic Society of Bengal.*

BBMB : *Bulletin of British Museum (National History) Botany*

BBSB : *Bulletin of Botanical Society of Bengal.* Calcutta.

BBSI : *Bulletin of Botanical Survey of India.*

Gard. Bull. Singap. : *The Garden's Bulletin.* Singapore.

IF : *Indian Forester.* Dehra Dun.

IJF : *Indian Journal of Forestry.* Dehra Dun.

JAA : *Journal of Arnold Arboretum.* Massachusetts.

JASB : *Journal of Asiatic Society of Bengal.*

JBNHS : *Journal of Bombay Natural History Society.* Bombay

JJB : *Journal of Japanese Botany.* Tokyo.

Jour. Econ. Tax. Bot. : *Journal of Economic and Taxonomic Botany.*

Journ. Lin. Soc. : *Journal of Linnean Society.*

KB : *Kew Bulletin.* United Kingdom.

RBSI : *Records of Botanical Survey of India.*

TBRI : *Transactions of the Bose Research Institute.* Calcutta

NRBGE : *Notes from Royal Botanic Garden.* Edinburgh.

## 2.6. METHODS OF ENUMERATION

The flora of Neora Valley in this work has been presented following the sequence of arrangement of major taxa as in Bentham and Hooker's *Genera Plantarum* (1862-1883) which was also followed in *The Flora of British India* (Hooker, 1872-1897), and have been presented with the slight changes made in conformity with the recent literature including that of *Flora of Bhutan* by D.G. Long and A.G.C. Grierson (1993, 1984, 1991, 1994). In the presentation, the families have been delimited just by following Hutchinson (1973), Cronquist (1981), Dahlgren (1980) and Dahlgren *et al* (1985). The names of different families have been used as per the guidelines given in Article 18 of the *International Code of Botanical Nomenclature*, Tokyo (1994). All the genera and species have been presented in the alphabetical sequence under each family whereas in case of the varieties, type variety has been placed first followed by others.

The local names of different species of plants, wherever and whenever available, either in the literature or from the local people have been given before the taxonomic description of the species.

The valid names of the species are written in bold and italic, and the basionyms and synonyms are presented in italics only. The nomenclature of the taxa have been updated as per the provisions presented by S.S.R. Bennett in his work *Name Changes in Flowering Plants* (1987), and the recently available volumes of *Flora of Bhutan* (D.G. Long and A.G.C. Grierson), *Flora of Sikkim* (R.C. Srivastava), *Flora of West Bengal*, *Flora of India* (Publications of Botanical Survey of India) and other taxonomic literature dealing with the different taxa which have been referred to properly in the enumeration. However, only a few important basionyms and synonyms have been presented in the systematic enumeration for each taxon. Early operable identification keys to the genera and species have been developed and presented in the work. Besides, local and general distributions for each of the enumerated taxa have also been indicated along with their status.