Streptocaulon sylvestre Wight [Asclepiadaceae]

CHAPTER-1

INTRODUCTION

CHAPTER-1

INTRODUCTION

The environmental conditions of the earth before the advent of life or at about that time was very different than what it is today. The evolution of life on the earth has gone hand in hand with the evolution of environment (Ambasht & Ambasht,1996). Moreover, every aspect of life is influenced by the environment and the activities of organisms affect their environment. Environment consists of biotic and abiotic components, functioning together as a common system and a harmony is generally maintained between the two. This process between the biotic and abiotic states of the environment has been going on from the time the first living organism appeared on this planet, and in which plants became the basis for biotic components and without their capacity to capture the solar energy through the process of Photosynthesis there would have been no life on the earth. Therefore, the conservation of plants in natural ecosystem is vital to the continued existence of life.

In biology, ecology emphasize on the study of the behavioural aspects coupled with the interrelationships of life with their environment. Although ecology's roots extend to the origin of humanity, it is now clear that with the growing population and the rapid advancement of industrial technology, ecology has become a prime science for the survival of living organisms including man. Besides, in recent years there have been rapid development of ecological thoughts and ideas centering around pollution, conservation, rehabilitaion and other applied aspects. The latest stress area in the field of ecology is the **"conservation of biodiversity"**.

The biodiversity is intimately associated with habitat diversity. Therefore, with different kinds of hustlings on natural habitat the diversity is also getting reduced. The rate of extinction of many species which were quite common in the past is the fast increasing. In an ecosystem each species has some specific function to perform. When a species gets extinct or removed from the ecosystem, its specific function may be partly taken up by some others but full replacement is not possible and the balance in the ecosystem gets disturbed. It is lost for ever and to reconstruct the species as a whole is just impossible. Once a species becomes extinct, that combination of gene pool is permanently lost and man can no more recover the same for its future use. Therefore, conservation of biotic resources is all the more important.

The flora of Indian sub-continent is extremely rich in biological diversity due to

its widely varied topographic and climatic conditions. The process of evolution worked here for a long time under nearly complete isolation rendered mainly by the great Himalayas and vast ocean surrounding the sub-continent. During continental drift the Indian landmass certainly have carried some basic species and received many more species through different migratory channels after its merger with the Chinese land (Das, 1996 a). Since then, mixture of all these elements and through other natural phenomena, a large number of new elements have evolved here. It is estimated that there are 5-10 million species of plants and animals on this earth (Jain, 1992). According to a rough estimate, India has about 45,000 species of plants (Vascular plants Ca. 15,000, Pteridophytes 600, Bryophytes 2,700, Algae 5,000, Fungi 20,000 and Lichens 1,600) (Jain, 1992; Singh & Chowdhury, 2001).

McNeely *et al.*(1990) estimated that 70 % of the worlds flowering plants occur in 12 countries which he designated as the Mega biodiversity countries. India is one of those twelve countries (Ahuja, 1998) with only 2.47 % of the global land area it harbours about 11 % of the world's biota so far described (Singh & Chowdhury, 2001). According to J.D. Hooker (1904) "The Indian flora is more varied than that of any other country of the equal area in the eastern hemisphere, if not on the globe."

Chatterjee (1940) have estimated a very high level of endemism in India which is corroborated by Nayar & Shastry (1987-90) and Jain & Rao (1983). The estimates of endangered species of flowering plants in India today have sharply risen from a few hundred to a few thousand species, and it is feared that 15 to 20 percent of the total vascular flora i.e. over 2500 species may now fall in one or other category of threatened species. A total of about 5000 species of flowering plants are expected to be endemic in India (Jain, 1992). However, the present Director of Botanical Survey of India, Dr. N.P. Singh considered that "as many as Ca. 6000 species belonging to 140 general and 47 families are endemic to Indian region (Singh & Chowdhury, 2001).

The situation is quite worse in Eastern India. In Eastern India, the part of Eastern Himalaya and its foot region show a distinctive richness in floristic components. The region has been influenced by an wide spectra of climate, and, ecology represents a unique floristic diversity (Das, 1995), a full assessment of which cannot be made until external distributions of all taxa in the Eastern Himalayas are worked out and analysed on non selective basis (Grierson & Long, 1983). After the emergence of the Himalayas during the Tertiary period, an extremely rich flora developed there, almost in an undisturbed condition for millions of years and the very recent human settlements, during last few hundred years only, are destroying and / or modifying those vegetation

in a ruthless manner leading to the extinction of thousands of plant species. About 40 % of the Himalayan flora are endemic to the region, particularly to the eastern flank (Ahuja, 1998). According to Mgers (1989,1990) there are Ca 3500 endemic species of higher plants in Eastern Himalaya. Of the total 622 endangered plants listed so far in the Red Data Books, 137 occur in the Himalayan region. Of the 137 species, 71 species are from the Eastern Himalaya, 56 species from the Western Himalaya, and ten species are common to both these regions (Ahuja, 1998).

Six ecoregions in the Himalayas have been included in the list of Global 200 ecoregions which are now recognised as priority biodiversity conservation sites. Of these six ecoregions, rangelands or herblands make up four of the six (Olson & Dinerstein, 1997). These include the Tibetan Plateau Steppe ecoregion, the Eastern Himalayan Alpine Meadows, the Terai-Duars Savannas and Herblands and the Middle Asian Mountains Temperate Forest and Steppe.

Darjeeling constitute an important part of the Eastern Himalayas, falling in the state of West Bengal in Eastern India and a well known place of tourist interest for its colourful natural greenary and paramount glistening back ground of the snow peaks, the Mount Kanchenjunga (8,586 m) and its associates. From the administrative point of view, Darjeeling is being treated as a district falls naturally into two distinct tracts, the Sub-Himalayan Terai immediately beneath the hills, and the ridges and deep valleys of the lower Himalayas. The Terai portion is within the altitudinal range of 120-132 m above m.s.l., traversed by numerous rivers and streams rushing down from the hills and by the upland ridges which mark their courses. North of the Terai, the mountains tower abruptly from the plains, which stand out in a succession of bold spurs, the appearance of which has been compared with that of the weather-beaten front of a mountainous coast. The hill portion is a confused labyrinth of ridges and narrow valleys which achieving an altitude nearly 3800 m like Tonglu (3000 m), Kalapokhari (3300 m), Sandakphu (3500 m) and Phalut-Gosha (3600-3800 m).

The vegetation of the Sub-Himalayan foot hill or Terai region is important from various aspects such as cultural, scientific, and utilitarian. The region displays a wide range of habitat providing ample opportunity for ecological diversity. With the over increasing human and livestock population, much of the land has yielded to plough and settled to the cultivation of various crops and tea plantation. As a result, natural vegetation specially forest in most part has been completely annihilated, leaving here and there few trees or strips of forests, as evidence of the previously existing magnificent woods which have fallen victim of the hungry and greedy growing population.

Nonetheless, the region displays admirable range of economically important plants of both indigenous and exotic origin.

Moreover, due to aforesaid thrusts, the soil of the region, in many places has been subjected to insolation causing poor plant cover to encourage drastic soil erosion. After the loss of primary vegetation and due to the frequent changes of courses of numerous small to large rivers of this region secondary herbaceous vegetation has occupied large areas, at some places which is looking like savannas with tall long grasses. Before the occurrence of recent population explosion, most of these areas were unaffected except grazing by local wild herbivores. Most of these vegetation are now dominated by few tall grasses e.g. *Imperata cylindrica, Saccharum spontaneum, Sporobolus indicus, Chrysopogon aciculatus, Digitaria sp.* etc. Apart from these, a large number of other grasses and herbs and few small shrubs are growing there but are certainly covering a much less area. These herblands as well as grasslands are not only providing home for a large number of species of plants and animals but are also rendering an environment for evolution and nursing of many rare and endangered species including newly born taxa.

These herblands have largely been neglected in the past (and were mostly modified into tea gardens and other type of cultivated lands). Proper management of the still existing herblands is essential in order to conserve their biological diversity and to promote sustainable economic development of the region. The lack of concern for these grazing land ecosystems and misconceptions regarding their functioning and use have led to a general downward spiral in the productivity and loss of biodiversity.

Streptocaulon sylvestre Wight (Asclepiadaceae) is categorized in the group of endangered species which is a little known endemic plant of Eastern India (Das, 1996). It grows only in herbland habitat under grasses with no or extremely low grazing disturbance within the campus of the University of North Bengal situated in the Sub-Himalayan Terai region of Darjeeling. These herblands are dominated by *Cymbopogon pendulus, Borreria alata, Sporobolus indicus, Mitracarpus verticillatus, Imperata cylindrica, Saccharum spontaneum* etc. From its recorded distribution it is clear that the species has been originated in the Terai region but could not spread much. It is now extremely endangered and might be eleminated (i.e. to be extinct) on any day after any type of modification of its last known natural habitat. Realising this threat, it is now very much essential to provide all type of assistance to the species not only for its survival but also for its propagation and increase of its area of distribution.

1.1. DISTRIBUTION AND HISTORICAL BACKGROUND OF *Streptocaulon sylvestre* WIGHT.

Streptocaulon is a small genus of Asclepiadaceae distributed in a very restricted area starting from Mayanmer to Eastern India. Like its all other species, *Streptocaulon sylvestre* is also reported to grow in a very small area in Terai (foot hill) of North Bengal (i.e. the northern part of West Bengal) and Bihar (Hooker, 1883). So far, only four floras,
(i) *Flora of British India* (Hooker, 1883),
(ii) *Bengal Plants* (Prain, 1903),
(iii) *The Botany of Bihar and Orissa* (Haines, 1921-25) and
(iv) *Flora of Bhutan* (Grierson & Long, 1999), have recorded this species, based on nearly same set of specimens from CAL. Hara and his co-workers (Hara, 1966, 1971; Hara *et al.*1978, 1982; Hara & William, 1979) and Ohashi (1975) floristically explored the adjoining regions of its places of original distribution but have not recorded this plant. Recent expedition made for the *Flora of Bhutan* (which also coverd some parts of Darjeeling and Sikkim) also failed to trace it in nature.

The historical background of *S. sylvestre* is very small but interesting. Fr. Buchan -an-Hamilton collected this small, prostrate and suffrutescent plant from *Sanyasikata* (and not 'Sanaashygota' as in Wight, 1834) of the then Rangpur District on 7th April of 1809 (after 1869, Sanyasikata or Siliguri was annexed with Jalpaiguri District and later in 1880, again, was transferred to Darjeeling District, vide-Buchanan-Hamilton, 1809; Hunter, 1876; Dash, 1949.) and thought it to be a species of *Periploca* with doubt. Later on Wight in 1834 named it as *Streptocaulon sylvestre.* Wallich recorded the specimen in his catelogue of dried specimens in 1847 (Wall. Cat. No. 8251), with no duplicate. Apart from the Type (Ham. Herb. No. 763 in CAL.) only few more specimens were located at CAL.: C.B. Clark 11656 (2 sheets), Siliguree (=Siliguri), May 27, 1870; C.B. Clark 11707, Purnea, May 24, 1870; C.B. Clark 26455 (2 sheets), Siliguree, May 31, 1875; Ribu and Shommo 3790, Titalya (Terai plains), March 4, 1910. However, no other specimen was found in any other Indian Herbaria (Das, 1996). Even no detailed works are available in existing literatures, including Sarker *et al.* (1995); Kadir & Das (1998, 1999a, 1999b, 2000); Kadir *et al.* (1998).

So for the conservation of the species, it is now very much essential to understand the ecological conditions of these herbland habitats where the species is growing now as well as the habitats where from it has been eleminated during last about 200 years. In addition, it is also essential to determine the difficulties in its quick propagation and dispersal. As such, four selected herblands lying in the Terai or foot hill region of the Darjeeling Himalaya were taken under consideration.

1.2 DESCRIPTION OF STUDY AREA

1.2.1. LOCATION

The study was conducted at four natural herblands which were marked as site-I, site-II, site-III and site-IV. Of these, two herblands i.e. site-I and site-II are situated at the campus of North Bengal University where *Streptocaulon sylvestre* Wight is growing now (i.e. last known habitats for the species). Another two herblands i.e. site-III is located at Sanyasikata village (or Siliguri) and site-IV is at Kharibari (ex. Purnea) from where the species has been eleminated. All these sites are lying within the Siliguri sub-division of Darjeeling District. (Fig-1.1).

Site-I and Site-II : The campus of North Bengal University (i.e. site-I and site-II) is situated at 26°43' North latitude and 88°21' East longitude. It is located within the altitudinal range of 130-132 m m.s.l. and is about 10 km south from the base of the Eastern Himalaya in bird's way. Both the sites are situated side by side and separated by a 5 m wide motorable road. The area of site-I and site-II is about 11000 and 12000 m^2, respectively. The area of the University campus is also about 1.347 km^2.

Site-III : This area is situated at 26°44' North latitude and 88°30' East longitude with an altitude of about 130 m m.s.l. It is located about 15 km south from the base of the Eastern Himalaya in bird's way. Its area is about 12000 m^2.

Site-IV : This area is situated at 26°31' North latitude and 88°10' East longitude. It is located at an altitude of about 120 m m.s.l. and is about 20 km south from the base of Eastern Himalaya in bird's way. The area of site-IV is about 11000 m^2.

Moreover, site-IV is located about 20 km south of the site-I and site-II and is about 25 km southwest from the site-III, while site-III is situated about 13 km northeast of the site-I and site-II in bird's way.

The effect of grazing is a common practice in all the study sites. Residents of the University campus maintain a considerable number of cows and goats and a large number of cattles are taken inside the campus by local residents for grazing. Incidental artificial burning of vegetation is also one imprtant factor in the campus. The effect of grazing is also very high in site-III and IV. Both the sites are open field and, as such, grazing by domestic herbivores occurs regularly. However, mowing of grasses for fodder is a common practice in all the four sites.

1.2.2. RIVER AND DRAINAGE SYSTEM

Most of the rivers of Darjeeling district eventually drain southwards though, the Ghoom and Labha ridges cause a number of rivers rising on their northern face to flow

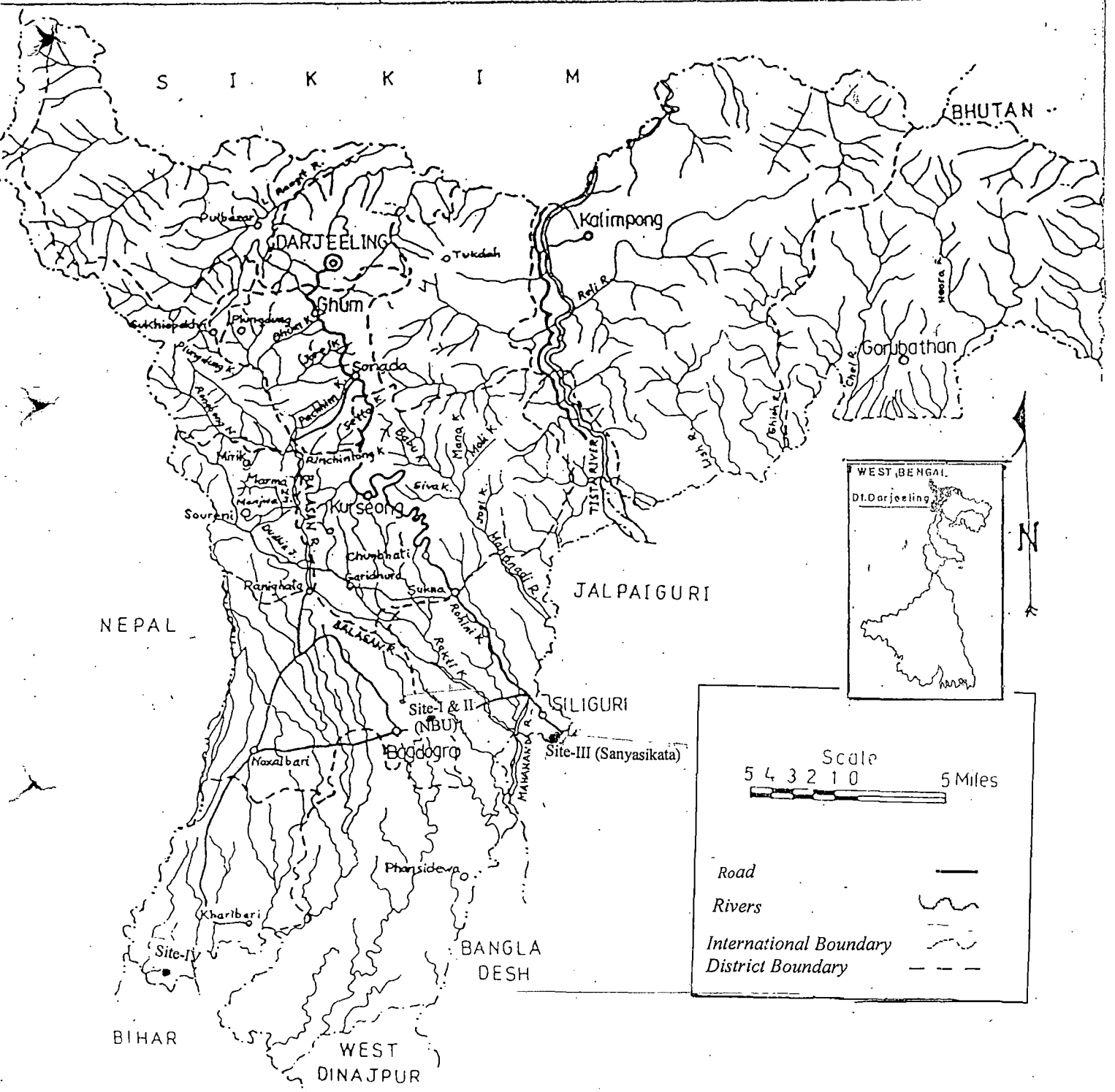

Fig-1.1 Map of Darjeeling District Showing Study Area

northwards. Therefore, a complicated system of drainage has evolved amidst the myriad of interlacing ridges and ramifying spurs.

The most important river of Darjeeling is the Tista originating from Zemu glacier of north Sikkim (5000 m). It is fed by numerous tributaries from within the limit of the district. In Darjeeling its principal tributaries are the Rangpo, the Rilli, the Great Rangit, the Rayeng and the Sivok. This river and its tributaries experiences their courses through the hills and cut the valleys at several places and forming very deep gorges before entering into the Darjeeling Terai at Sivok and ultimately joining the river Brahmaputra in Bangladesh.

Other important rivers of Darjeeling district include the Mahananda (rising at Mahaldiram), the Balason (rising at Lepchajagat), the Mechi (rising at Rengbong) and the Neorakhola (rising at Jorepukhri from Rechila peak 3040 m). All these rivers are flowing into the river Ganga through the Sub-Himalayan Terai.

In addtion, there are numerous small and considerable Jhoras or springs in Darjeeling hills. These springs are forming rivulet at the bottom of valley. The Sub-Himalayan Terai region of the district forms a very irregular belt, scantily clothed and intersected by innumerable rivulets from the hills, which unite and divide again on the flat and enter the plains, following devious courses, which glisten like silver threads.

The rivulet Magurmari flowing north-south through the North Bengal University campus and divides the campus into two halves. Both sides of Magurmari formed a flat river-valley, which gets flooded during heavy showers. Another small stream, Lachka, is also flowing through the western border of the campus, is also having a narrow flat valley. Magurmari river and a small unnamed tributary of it (produced from the 'Sal-grove' in the campus) and Lachka on the western border of the campus formed the main drainage system for sites-I & II. The rivulet Shahu flowing north-south besides the site-III and formed the main drainage system of the area. All these rivulets and their tributaries are rain-fed and remain almost dry in most of their portion when there is no rain in the area. But showers of rains in the Darjeeling Himalaya fills life to them.

1.2.3 GEOLOGY AND SOIL

1.2.3.1. GEOLOGY

The great Himalayan range was elevated during the Tertiary period, on the site of an ancient sea named Tethys, that had accumulated sediments of different geological ages. The geological formations of the Darjeeling district consist of unaltered sedimentary rocks, confined to the hills on the south, and different grades of metamorphic rocks over

the rest of the area. The present relief of high peaks and deep valleys has been carved by the erosional force of wind, water and snow, three principal agents of denudation. The products of disintegration of the mountains have been swept over the submontane tract as the rivers debouch into the plains. The Terai and the plains at the foot of the Himalayas were given their present form after the final unheaval of the range and consist of almost horizontal layers of unconsolidated sand, silt, pebbles and gravel (Dash, 1947).

1.2.3.2. SOIL

The soil of Terai region is a sort of neutral country, for a greater places of it being composed neither of the alluvium of the plains nor of the rocks of the hills, but of alternating beds of sand, gravel and boulders brought down from the mountains (O' Malley, 1907). Besides, this tract being composed some places of fertile alluvium soil which are light sandy loam or even wholly sandy or gravelly. In the forests, a thick mantle of humus soil is formed by death and decomposition of plants and animals, remains cover the ground surface. Red, yellow and gray soils have developed in the slopes of Himalayas. The greater portion of the area is lying under Darjeeling Gneiss which commonly decomposes to stiff reddish loam and stiff red clay and pure sand, a condition favourable for the cultivation of tea. Along the banks of Tista silty loam and silt is predominant.

The frequent changes of the courses of rivers and streams in this area formed a very loose soil which is acidic in nature.

1.2.4. CLIMATE

The climate of Darjeeling district varies greatly from one part of the district to another due to variation in altitude, exposure, distance from snow peaks and configuration of different mountains which deflect winds and affect rainfall and temperature locally to an appreciable extent. It exhibits a typical monsoon which is brought about by the vapour-laden monsoon wind flowing upward from the Bay of Bengal from June to October. Places in higher elevations of the district are cool, bracing and hygenic. On the other hand, the climate of lower hills, Terai and plains is almost similar to the adjacent districts of West Bengal and Bihar. All the study sites (i.e. site-I, II, III and IV) experience similar climatic regimes as situated in the same region of Terai and plains. On the basis of temperature and rainfall the whole year in the Sub-Himalayan Terai region can be divided into three main seasons, viz.

i. Summer : April to mid-June

ii. Monsoon : mid-June to October

iii. Winter : November to March

Being situated at the feet of the Himalayas, this region experiences a somewhat pleasant climate, with no extremes of temperature both in summer and winter. The climate of this region is conducive with heavy rainfall and high humidity for the growth and propagation of plants.

The mean daily temperature, relative humidity and rainfall of different months (average for the years 1998, 1999 and 2000) of Siliguri (at the Sub-Himalayan Terai) are presented in Table-1.1.

1.2.4.1. TEMPERATURE

Temperature in this region does not exceed beyond 37 °C. The daily temperature begins to rise from the end of March, and reaches its maximum during May. The night temperature, however, is also rises during May to September varies between 22.75 to 24.80 °C.

Table-1.1. Mean daily temperature, relative humidity and rainfall of different months (average for the years of 1998, 1999 and 2000) recorded in Siliguri (Champasari).

Months	Temperature (°C)		Relative humidity (%)		Monthly rainfall (mm)	Number of rainy days
	Maximum	Minimum	8.30 a.m.	17.30 p.m.		
January	23.07	9.66	86.0	68.5	0.00	0.00
February	23.30	13.10	77.5	61.0	4.00	0.33
March	27.75	17.20	62.5	47.5	16.85	1.33
April	31.05	19.50	73.0	66.0	102.23	5.33
May	33.55	23.25	79.0	73.0	344.66	14.00
June	32.40	23.75	84.5	76.5	692.86	17.66
July	31.95	24.80	87.5	79.5	843.31	22.66
August	30.90	22.75	87.0	81.0	829.90	22.33
September	30.75	22.80	87.5	81.0	468.25	17.00
October	29.15	20.65	82.0	75.5	153.41	7.00
November	26.30	19.15	81.0	74.5	35.10	2.00
December	25.05	11.20	80.5	70.5	3.65	0.66

Source : Flood Meteorology Station, Jalpaiguri

With the arrival of Monsoon about the middle of June the day temperature decreases by 1-2 °C. During Monsoon the mean day temperature varies between 29.15 to 32.40 °C. Winter starts from the beginning of November and continues up to the end

of March. January is the coldest month of the year with the mean daily maximum and minimum temperature of 23.07 to 9.66 °C respectively.

1.2.4.2. RAINFALL

Rainfall usually starts around the middle of April with the arrival of Nor' Westers or locally called 'Kalbaisakhi' and continues till the end of October. In summer, thunderstorms are quite frequent and occur generally in the afternoon, accompained often with heavy rain and hailstones in severe squalls, coming usually from the north-west. June, July and August are the months of heavy rainfall. Highest average rainfall was recorded in the month of July (843.31 mm). However, rainfall generally decreases after the month of September. In October, effects of depressions developed in the Bay of Bengal, generally, causes wide spread rain.

With the onset of winter, rainfall decreases abruptly from the month of November. While the minimum average rainfall was recorded in January (0.00 mm). Sometimes, a period of three to five months passes without a drop of rain. On an average there was 110.3 rainy days in a year. Formation of very dense fog during winter months is also a characteristic feature for this region which also contribute some amount of water specially for the shallow rooted plants.

1.2.4.3. RELATIVE HUMIDITY

Relative humidity remains quite high in the Sub-Himalayan Darjeeling region throughout the year. But during the end of winter (March) it is comparatively less, being around 63 % in the morning and 48 % in the afternoon. June to September is the period when, in general, a very high relative humidity is maintained in the atmosphere. With the approach of monsoon the sky regularly remains overcast with clouds, while the other seasons are moderately clouded in this region. If there is no fog, the clear sky can be vigible for a very long period, i.e. from December to March or April.

1.3. PREVIOUS WORKS

There has virtually been nothing published in the past about the ecology of these herbland communities under study and specially the foot hill regions of Darjeeling Himalaya. Das & Lahiri (1997) has worked on the phytosociological studies of the ground covering flora in Darjeeling, but in a very high altitude area (2350-2450 m). But numerous publications on the flora of this region has been made by many workers including Hooker (1872-1897), Prain (1903, not incorporated hill plants), Hara (1966,1971), Ohashi (1975),

Hara *et al.* (1978, 1982), Hara & Williams (1979), Das & Chanda (1982, 1986, 1987, 1988, 1990), Grierson & Long (1983-1987, 1991, 1999), Bhujel *et al.* (1984), Das *et al.* (1985, 2001), Das (1986, 1995, 1996, 2000), Mukherjee (1988), Das & Lama (1992), Bhujel (1996), Bhujel & Das (1996), Panda & Das (1997). Botanical Survey of India has initiated the publication of *Flora of India* (Sharma *et al.* 1993, 1993 a; Hajra *et al.* 1995) which is, no doubt, also covering Darjeeling and Terai region.

Herbland reseach in India has been mainly conducted in the form of study of grassland communities. Grasslands have been studied in small patches of land for phytosociology, reproductive capacity, production of biomass, etc. in relation to a variety of ecological factors especially grazing (Sant, 1962, 1965; Singh, 1967; Choudhury, 1968). Singh & Ambasht (1975, 1975 a) have worked out the interrelationships among community structure and productivity of grasslands. Misra & Misra (1981) have worked on the interspecific associations among the grassland species. Himalayan grasslands in the Western Uttar Pradesh have been investigated by Bharadwaj (1981). Misra (1983) has provided a detailed account of Indian Savannas. Singh (1973, 1976), Singh & Yadava (1974), Singh & Joshi (1979) and Singh *et al.* (1979)have contributed extensively to the knowledge of Indian grassland ecology. Other notable workers including Misra & Misra (1979, 1981 a), Sinha *et al.* (1988, 1991), Singh (1989), Katewa (1990), Katewa & Sharma (1998), Devi *et al.* (2000), Paulsamy (2000), also, have been worked on grassland in India.

There are very few works on *Streptocaulon sylvestre* Wight. Das (1996) has reported the occurrences of this almost forgotten endangered and little known endemic plant of Eastern India, which he found growing in grassland vegetation in the central of the North Bengal University. Sarkar *et al.* (1995), Kadir & Das (1998, 1999, 1999 a, 2000) and Kadir *et al.* (1998) also have been published concise accounts on its different ecological aspects. But no worker has tried to understand the details of its propagation and ecological behaviour from the conservation point of view.

1.4. OBJECTIVES OF PRESENT WORKS

Considering all these facts and needs in the background, the present piece of work has been planned and initiated with the following aims in mind :

i. To understand the community structure of herblands of the sub-Himalayan region in Darjeeling;

ii. to know the phenology of major floristic elements in herblands;

iii. to understand the different edaphic and climatic conditions of these herblands;

iv. understanding different basic ecological conditions of the habitat of *Streptocaulon sylvestre*;

v. to understand the social interactions of different members of herblands with *S. sylvestre*;
vi. understanding the differences of different ecological parameters in its past and present habitats;
vii. to understand the present method of propagation and dispersal of *S. sylvestre* and to improve its propagation efficiencies;
viii. to know the allelopathic effects of major floristic elements of herblands on *S. sylvestre*;
ix. finding out the possibilities of any type of utilisation of *S. sylvestre*;
x. formulation of strategies for the conservation of the species and the herbland habitats of the Sub-Himalayan region.

Therefore, under this dissertation, to fulfill the above objectives, following aspects have been covered :

1. Phytosociological studies in the herblands of the sub-Himalayan region specially in the regions of past and present areas of distribution of *Streptocaulon sylvestre.*
2. Phenological studies of major herbland flora and of *S. sylvestre*, starting from germination to maturity
3. Study of different edaphic and climatic conditions of these herblands
4. *In vivo* seed germination and seedling survivabllity of *S. sylvestre*
5. *In vitro* seed germination and micropropagation of *S. sylvestre*
6. Allelopathic effects of major associate plants on seed germination and seedling growth of *S. sylvestre*; etc.

All these works lead to the accumulation of considerable data for better understanding of the overall structure of herblands of the sub-Himalayan Darjeeling, their different edaphic and climatic conditions, phytosociological and phenological characters of different floristic elements, etc. All these findings may lead to understand the situation under which the presently endangered species *Streptocaulon sylvestre* Wight has been eleminated from the major parts of its distribution and is now being maintained (naturally) in a small area and, also lead to determine the difficulties in its quick propagation.

The present set of works will be useful for the naturalists, foresters, ecologists, economic planners, scholars and others to evaluate the herbaceous vegetation of this region and to formulate various developmental progammes to conserve, to enrich, to manage and even to exploit within the parameters of nature's balance. All these findings will also help us to formulate the strategies for preserving or conserving the beautiful and extremely endangered species, *Streptocaulon sylvestre* Wight which is now endemic to a small area in the sub-Himalayan Terai of Eastern India.