CHAPTER-9

ANALYSIS OF CLIMBING FLORA

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Darjeeling and Sikkim Himalayas are known to be one of the floristically very rich zones in the world. It occupies a considerable part of Eastern Himalaya which has been declared as a "**Hot-spot zone** for conservation" by IUCN. So the floristic richness of these zones have attracted plant explorers, botanists and other naturalists at least for the last centuries (Don 1821). This region has been floristically explored by many workers which led to the record of plants of all major groups in plant kingdom (Hooker 1849, 1872-1897; Gamble 1896; Cowan and Cowan 1929; Hara 1966, 1971; Hara *et al.* 1978, 1979, 1982; Grierson and Long 1983, 1984, 1987, 1991; Noltie 1993; Ohashi 1975; Matthew 1981; Das 1986, 1995; Bhujel 1996). Gamble (1896) for the first time prepared a list of trees and climber of Northern Bengal which has later on modified by Cowan and Cowan (1929). Northern Bengal in British India was a very large area covering a considerable part of present Bangladesh. Floristic study in the post independence Darjeeling was not much intensive before the surveys initiated by Das (1986). Das and Bhujel (1983) for the first time published a report on 85 species of climbers from temperate Darjeeling only. Later on Samanta and Das (1995,1996) published preliminary reports on the present status of angiospermic climbers in Darjeeling Himalaya.

9.1 THE CLIMBER FLORA:

The present survey in Darjeeling and Sikkim Himalaya recorded 284 (255 dicotyledons and 29 monocotyledons) species, under 140 (131 dicotyledons and 9 monocotyledons) genera and 56 (50 dicotyledons and 6 monocotyledons) families of angiosperms (Table 9.1)

Table 9.1: Numerical representation of genera and species of angiospermic climbers recorded from Darjeeling and Sikkim Himalayas

Taxa / Ranks	Total	Dicotyledonous		Monocotyledonous	
		Nos.	%	Nos.	%
Families	56	50	89.28	6	10.71
Genera	140	131	93.57	9	6.42
Species	284	255	89.78	29	10.21

Table 9.2 shows ten dominant families of angiospermic climbers of Darjeeling and Sikkim Himalayas where Papilionaceae occupied the top position with its 28 species representation. The climber family Cucurbitaceae closely followed the former with 27 species. These top ten families also include common climber dominating families like Vitaceae, Dioscoreaceae, Convolvulaceae and Menispermaceae. Among these Dioscoreaceae is the only representative of Monocotyledons.

Table 9.2: Top ten climber-dominating families in the flora of Darjeeling and Sikkim Himalayas

Sl. No.	Families	Number of Genera	Number of species
1.	Papilionaceae	16	28
2.	Cucurbitaceae	18	27
3.	Asclepiadaceae	10	15
4.	Vitaceae	4	15
5	Dioscoreaceae	1	13
6.	Convolvulaceae	5	12
7.	Rosaceae	2	12
8.	Menispermaceae	7	11
9.	Ranunculaceae	2	10
10.	Rubiaceae	5	10

The status of these ten climber-dominating families in the works of Gamble 1896; Cowan and Cowan 1929; Hara 1966, 1971; Ohashi 1975 and Matthew 1981 has been presented in table 9.3

Table 9.3 :The status of ten climbing dominating families of Darjeeling and Sikkim Himalayas-comparision with other floras covering this region

Sl. No	Families	Gamble' 1896		Cowan' 1929		Hara' 1966,1971 Ohashi'1975		Matthew' 1981		Present Survey' 1994-1996	
		Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.	Gen.	Spp.
1.	Papilionaceae	7	14	12	27	19	36	4	5	16	28
2.	Cucurbitaceae	-	-	-	-	16	22	6	7	18	27
3.	Asclepiadaceae	7	8	15	19	8	14	6	13	10	15
4.	Vitaceae	2	16	5	20	6	25	3	5	4	15
5.	Dioscoreaceae	-	-	-	-	-	-	1	3	1	14
6.	Convolvulaceae	5	10	6	13	5	18	4	8	5	12
7.	Rosaceae	1	8	1	20	2	11	1	6	2	12
8.	Menispermaceae	5	6	7	11	6	10	3	3	7	11
9.	Ranunculaceae	2	7	2	9	2	12	1	5	2	10
10	Rubiaceae	1	3	1	3	-	-	1	1	5	10

It is quite interesting to note that eight of the ten climber-dominating families of present survey are common with the top ten families of recorded climbers in the works of Gamble (1896), Cowan and Cowan (1929) and Hara (1966, 1971; Ohashi 1975). While all the ten families are common with Matthew (1981)[Table 9.4].

Table 9.4: Status of ten climbing-dominating families in different floras covering this region, compared with the present survey.

Families in present survey (1994-1996)	Gamble' 1896	Cowan' 1929	Hara' 1966, 1971; Ohashi' 1975	Matthew' 1981
Papilionaceae	2	1	1	5
Cucurbitaceae	-	-	3	3
Asclepiadaceae	4	4	5	1
Vitaceae	1	2	2	7
Dioscoreaceae	-	-	-	9
Convolvulaceae	3	5	4	2
Rosaceae	5	3	7	4
Menispermaceae	7	6	8	8
Ranunculaceae	6	7	6	6
Rubiaceae	8	8	-	10

Analysis at the generic level shows that *Dioscorea* is the best represented genus with 13 species in the climber flora of Darjeeling and Sikkim Himalayas. Though most of these species prefer a tropical climate but they were found to growing even at an altitude of 2200m in Darjeeling. *Clematis* with 9 species formed the second diverse climber genus in the area. The list included only one monocotyledonous genus *Smilax* which is ranked sixth with its six species representation in the flora. However, most of the climber-genera are represented in the flora with 1-3 species only. Genera represented with single climbing species may be due to various reasons. Some introduced plants (now naturalised/seminaturalised/escaped) like *Wisteria, Cobaea* and *Sechium* of which no second species was introduced. Also, there are other exotics of which only single species arrived the region like *Mikania* and *Lathyrus*. Another group of genera which are actually represented in the flora by more than one species of which only one is climber (*Croton, Hydrangea, Ficus, Jasminum, Zanthoxylum*, etc.). And, the last group is naturally isolated with their single species growing in this area (e.g. *Deeringia, Natsiatum, Adenia, Fallopia, Paramigyna, Plectocomia, Streptolirion*, etc.).

Again, at the comparatively higher level, there are families with single genus and single species and is a climber like Icacinaceae (*Natsiatum herpeticum*),

Asparagaceae (*Asparagus racemosus*), Lardizabalaceae (*Holboellia latifolia*), Cobaeaceae (*Cobaea scandens*) and Basellaceae (*Basella alba*). Some families are represented with a single genus but with quite a few species like Aristolochiaceae (8 spp. of *Aristolochia*), Piperaceae (9 spp. of *Piper*) and Dioscoreaceae (13 spp. of *Dioscorea*). However, there are many other families which are well represented in the flora but with one genus and one or more species of climbers like Acanthaceae (4 spp. of *Thunbergia*), Actinidiaceae (2 spp. of *Actinidia*), Amaranthaceae (1 spp. of *Deeringea* and 1 spp. of *Stilbanthus*), Campanulaceae (3 spp. of *Codonopsis*), Combretaceae (2 spp. of *Combretum*), Elaeagnaceae (2 spp. of *Elaeagnus*), Fumariaceae (2 spp. of *Dicentra*), Myrsinaceae (2 spp. of *Embelia*), Sabiaceae (3 spp. of *Sabia*), etc. This shows that the climber flora of Darjeeling and Sikkim Himalayas is quite rich and representing various types of families like primitive (Ranunculaceae) or advanced (Compositae), Dicotyledonous or Monocotyledonous, climber dominating or families with climbers as exceptional plants only, etc.

Table 9.5: Zonewise distribution of the major angiospermic climbers of Darjeeling and Sikkim Himalayas (upto 3200m)

Hills / Zones	Darjeeling	Sikkim
upto 800m	*Acacia torta, Coccinia grandis, Dioscorea pentaphylla, Diplocyclos palmatus, Hedyotis scandens, Natsiatum herpeticum, Ichnocarpus frutescens, Luffa acutangula, Mikania micrantha*, etc.	*Caesalpinia cucullata, Coccinia grandis, Quamoclit pinnata, Dioscorea bulbifera, Ipomoea angulata, I. pestigridis, Luffa acutangula, Pergularia pallida, Clematis gouriana*, etc.
800-1600m	*Cryptolepis buchanani, Edgaria darjeelingensis, Dioscorea bulbifera, D. prazeri, Chonemorpha fragrans*, etc.	*Edgaria darjeelingensis, Smilax lanceifolia, Holboellia latifolia, Senecio scandens, Persicaria perfoliata*, etc.
1600-2400m	*Tetrastigma serrulatum, Cissus javana, Cyclea bicristata, Codonopsis affinis, Gentiana speciosa, Clematis buchananiana*, etc.	*Tripterospermum volubile, Jasminum dispermum, Holboellia latifolia, Rhaphidophora hookerii*, etc.
2400-3200m	*Aconogonum molle, Lonicera acuminata, Leycesteria gracilis, L. formosa, Elaeagnus conferta, Schisandra grandiflora, Actinidia strigosa*, etc.	*Clematis nepalensis, Zanthoxylum oxyphyllum, Lonicera hispida, Rosa sericea, Rubus ellipticus, Galium asperifolium*, etc.

The habitat conditions both in Darjeeling and Sikkim Himalayas are overlapping.

Darjeeling is situated mainly on the outer spurs of lesser Himalayas. Sikkim is situated quite inside but certainly contiguous with the hills of Darjeeling (Fig.-1). A large part of Sikkim is covered with permanent snow. So, the hills of Sikim, specially in its northern part, are cooler than the hills of Darjeeling. Like Darjeeling in Sikkim also there are some low altitude places which remain quite hot, at least during day-time, for major part of the year. Places in the lower stretches of Rangeet and Teesta valleys like Jorethang, Melli, etc. show such environment.

Temperature is the main controlling factor for the distribution of plants in this region, because, the other major factor, water, is easily available due to the high and well distributed precipitation in the area. So, one can expect the plants of warm habitat in places of low altitude, in outer fringes and in Terai. Temperature and altitude are inversely proportional, so with the increase of altitude, plants adopted for cooler habitat have been selected.

To analyse such temperature controlled distribution, the climber growing area (roughly upto 3200m) have been divided into four altitudinal belts (I) upto 800m, (ii) 800-1600m, (iii) 1600-2400m and (iv) 1400-3200m.

The picture of such differential studies has emerged from the phytosociological studies (Chapter-4). Table 4.1 presented such altitude related distribution of climbers. It is very clear that the plants growing in the lowermost tier (upto 800m) are all tropical plants except few plants in the Sikkim part, e.g. *Clematis acuminata*. Plants growing in the second tier (800-1600m) are homogenous mixture of tropical and subtropical elements.

During the present survey, areas upto 3660m have been visited to record the occurrence of angiospermic climbers but the limit of their distribution has been recorded to be the 3200m. Plants adopted cold temperate regions and some other temperate climbers found to grow in the tier.

However, the distribution of these plants can not be circumscribed with the occurrence of such artificial belts. The range of distribution of various species (Table 4.1) varies greatly. While only one species (1.06%)[*Hemidesdmus indicus*] is known to grow throughout this altitudinal range, another 40.4% species are known to have very wide range of altitudinal distribution. But, majority (58.53%) of the species prefer to grow in much narrow altitudinal range. Altitudinal range of distribution of all the recorded angiospermic climbers have been provided along with their floristic enumeration in Chapter-3.

9.2 HABIT GROUPS:

Like other members of the flora, habits of angiospermic climbers are also much variable. While plants like *Vicia hirsuta* or *Lathyrus aphaca* are very short lived and small annuals, there are large woody lianas on the other hand. So, climbers can be herbaceous or shrubby or lianas. Among the herbaceous climbers, in turn, there are annuals and perennials. These perennials are mostly geophytic plants which wither their aerial part during unfavourable seasons and produce aerial branches with the onset of favourable season

Table 9.6: Habit groups of the angiospermic climbers of Darjeeling and Sikkim Himalayas

Habit groups	No. of species	% distribution	Examples
Annuals	52	18.30	*Deeringia amaranthoides, Dumasia villosa, Dicentra scandens, Ceropegia longifolia,* etc.
Geophytic	20	7.04	*Dioscorea bulbifera, Stephania elegans,* etc.
Shrubby	192	67.60	*Embelia floribunda, Celastrus stylosus, Lonicera acuminata,* etc.
Lianas	20	7.04	*Actinidia strigosa, Rosa banksiae, Bauhinia scandens, Mucuna macrocarpa,* etc.

9.2.1 HERBACEOUS:

Two types of plants are generally regarded as herbaceous. Annuals growing for few months to little over one year (biennials!) and geophytes which produce annual aerial parts from their under ground perennial perennating structure during favourable seasons only. In a habitat where an extremely difficult season alternate with favourable seasons this type of herbs tends to colonise there.

A. Annual climbers: 18.30% of the climbers recorded from this region are annuals. These are therophytic i.e. they perennate the winter and dry months as dormant seeds only. The common climbers include *Dicentra scandens, Dumasia villosa, Galium asperifolium, Gentiana speciosa, Persicaria perfoliata, Porana grandiflora, Rubia manjith, Streptolirion volubile, Tripterospermum volubile*, etc.

B. Geophytic climbers: 7.04% of the climbers are geophytic. Common geophytic climbers include *Asparagus racemosus, Dioscorea belophylla, D. bulbifera, Sechium edule, Stephania elegans, S. glandulifera, S. japonica*, etc.

9.2.2 SHRUBBY CLIMBERS:

67.60% of the recorded climbers are shrubby. They are found to grow throughout the altitudinal range of the present area of exploration. These plants produce an woody main stem which generally grow upto a considerable height. Most of these plants are winter deciduous and in many cases their smaller branches dies. These are all phanerophytic plants. Common shrubby climbers include: *Aconogonum molle* var. *rude, Actinidia callosa, A. strigosa. Amphicarpea ferruginea, Aristolochia griffithii, Croton caudatus, Dalbergia pinnata, Gymnema thomsonii, Hemidesmus indicus, Holboellia latifolia, Hydrangea anomala, Jasminum dispermum, Leycesteria gracilis, Lonicera glabrata, L. japonica, Rosa brunonii, Sabia campanulata, S. parviflora, Schisandra grandiflora, Thunbergia coccinea, Treutlera insignis*, etc.

9.2.3 LIANA:

Only 7.04% of the recorded climbers are liana. They are generally found to grow in dense and high forests. Very long thick and woody stems of these plants remain hanging in variuos directions is a common sight specially in the forest of lower two tiers. Most of these phanerophytic plants are also winter-deciduous. Some of the common liana include *Bauhinia scandens, B. vahlii, Combretum roxburghii, Entada rheedii, Milletia pulchra, Mucuna macrocarpa, Pueraria sikkimensis*, etc.

9.3 MODE OF CLIMBING:

The main trouble face the climbers is to grow upwards for to available essential sunlight. They need to climb over the support and this they adopt various methods of climbing and modify their various organs like root, main axis, lateral branches, stipules, variuos parts of leaves, inflorescence axis, etc. modified into different types of climbing organs.

According to the mode of climbing this special groups of plants can be classified as follows (Table 9.7).

Table 9.7: Classification of angiospermic climbers of Darjeeling and Sikkim Himalayas

Types		No. of species	Examples
Ramblers		13	*Deeringia amaranthoides, Aconogonum molle, Celastrus stylosus, Hedyotis scandens*, etc.
Scramblers		28	*Mimosa himalayana, Rubia manjith, Rubus paniculatus, Zanthoxylum oxyphyllum*, etc.
Twiners		151	*Bauhinia scandens, Gentiana speciosa*, etc.
Root-climbers		26	*Hedera nepalensis, Hydrangea anomala*, etc.
Adhesive climbers		02	*Ampelocissus sikkimensis, Trichosanthes* spp., etc.
Hook-climbers		04	*Combretum roxburghii, Acacia torta*, etc.
Tendril climbers		60	
Stipule tendril	09		*Heterosmilax indica, Smilax glaucophylla*, etc.
Leaf tendril	01		*Lathyrus aphaca*
Petiole/petiolule tendril	09		*Clematis acuminata, Naravelia zeylanica, Jasminum dispermum*, etc.
Leaflet tendril	04		*Vicia sativa, V. tetrastigma*, etc.
Lamina tendril	00		
Apical shoot tendril	11		*Gouania leptostachya Tetrastigma dubium. T. serrulatum, Cissus javana*, etc.
Axillary shoot tendril	26		*Bauhinia vahlii, Edgaria darjeelingensis, Passiflora foetida*, etc.

9.3.1 RAMBLERS: Ramblers constitute an important part of the vagetation of these hills. These are shrubby or lianous plants which do not have any specialised structure for climbing or their stem do not twine the support. Their stem first rests on the lower branches of supporting plant grow further, rests on upper branches of support,

produce a branch system within branches of host and finally reach the canopy. Out of the 16 species of recorded ramblers. *Aconogonum molle, Blumea riparia, Celastrus monospermus*, etc. are common in middle and high altitude region, but *Deeringia amaranthoides, Embelia floribunda, Hedyotis scandens*, are restricted to low and middle elevation vegetation. While many of these grow on bushes, some can even climb upto the tree-tops e.g. *Celastrus monospermus.*

9.3.2 SCRAMBLERS: These are the plants which grow over bushes and remain that position with the help of their special structures like thorns, spines or prickles. Out of recorded climbers only 9.85% fall under this category. Out of 28 species of recorded scramblers, *Rubus acuminatus R. paniculatus, Rosa sericea*, etc are very common in upper hills while *Calamus flagellum, Mimosa himalayana, Persicaria perfoliata,* etc. are common in lower hills and species like *Gallium asperifolium, Rubia chaerifolia, R. manjith*, etc. are common in midde hill region.

Paramigyna monophylla is a good example of thorny scrambler. But the armour of majority of the scramblers are prickles as in member of Rosaceae. *Toddalia asiatica*, *Persicaria perfoliata*, etc. A special condition is found in some members of *Rubus* where some straight and stiff hairs helps in climbing as in *Rubus ellipticus*. The condition in *Rubia* and *Galium* is different, where the tips of leaves (and of leafy stipules) are with the minute sharp hooks-which helps them to climb.

9.3.3 TWINERS: This is very simple mode of climbing. 53.16% climbers are twiner. They do not produce any special structure for climbing, instead, when their growing stem touch a support it tends to turn like a spring. So, the stem itself is responsible for climbing. Two types of twiner are recognised according to the direction of the turning of stem:

(a) ***Dextrorse or Right handed twiner***: When a climber coils /twines clockwise or to right, it is regarded as a dextrorse twiner, e.g. *Mikania micrantha, Dioscorea alata, Thunbergia fragrans, Chonemorpha fragrans, Ichnocarpus frutescence, Aristolochia griffithii, Ceropegia spp., Cryptolepis chinensis,* etc. Out of recorded twiner only 57 species of climbers found to twine dextrorsely.

(b) ***Sinistrorse or Left handed twiner***: When a climber coils /twines anticlockwise i.e. turns left it is known as a sinistrorse twiner. Common sinistrorse include *Gymnema thomsonii, Cynanchum corymbosum, Treutlera insignis, Combretum flagocarpum, Ericybe paniculata, Mucuna nigricans, M. prurita, Pueraria sikkimensis, Fallopia convolvulus*, etc. 63 species of climbers found to twine sinistrorsely.

Generally twiners are very common in all types of vegetation and in all habit groups

(*Cardiospermum halicacabum, Ceropegia pubescens, Dicentra scandens, Dumasia villosa, Tripterospermum volubile*, etc. are annuals; *Adenia cardiophylla, Aganosma gracilis, Aspidopterys nutans, Combretum flagocarpum*, etc. are shrubs and *Bauhinia scandens, Entada rheedii, Mucuna macrocarpa*, etc. are liana).

9.3.4 ROOT-CLIMBERS: These plants are fasten themselves with the support with the help of their adventitious roots developing from nodes and internodes. Out of recorded climbers, only 9.15% fall under this category. The most common root climbers are *Euonymus echinatus, Ficus hederacea, Hedera nepalensis, Hydrangea anomala, Michrechites ellipticus* and climbing members of Piperaceae and Araceae. They are generally distributed in the places of lower to middle altitudinal zones.

9.3.5 ADHESIVE CLIMBERS: In these plants, the tips of tendrils form a flat haptera /disc like adhesive structure which help them to climb. This recorded in some members of Vitaceae (e.g. *Ampelocissus sikkimensis*), Araliaceae (e.g. *Hedera nepalensis*) and Cucurbitaceae (Species of *Trichosanthes*). Both in Vitacean and Cucurbitation, plants produce very good tendrils. But due to the structure of the support, some tendril sometimes fail to coil round it. Then in many species, the tips of tendrils generally form a discoid pad which gets itself attach with surface of the support with the help of minute hair like papillae (Metcalfe and Chalk 1950).

9.3.6 HOOK CLIMBERS: This is a very important group of climbers, for their climbing stipule (e.g. *Uncaria sessilifructus*), stem (e.g. *Combretum roxburghii*) etc. modified into hook like structures which these plants used as thier climbing organ. This type of climbers are found to grow foot-hill region.

9.3.7 TENDRIL CLIMBERS: This type of climbers climb with the help of a specialised structure knnown as tendril. This group including liana (e.g. *Bauhinia vahlii, Parthenocissus semicordata*, etc.). Except lamina-tip tendril (as in *Gloriosa*) all types of tendril are common among angiopspermic climbers of Darjeeling and Sikkim Himalayas. Different types of tendril climbers are named after the organ which on modification produced the tendril.

(i) **Apical shoot-tendril**: When apical bud modified into tendril (e.g. *Cissus javana, Gouania leptostachya, Tetrastigma rumicispermum*, etc.

(ii) **Axillary shoot-tendril**: When axillary buds are modified into tendrils [*Biswarea tonglensis, Melothria heterophylla, Tricosanthes cordata, T. dioica* (wild), etc].

(iii) **Inflorescence axis tendril**: When inflorescence axis modified into tendril (e.g. *Cardiospermum halicacabum*).

(iv) **Stipule tendril**: When stipules are modified into tendrils (e.g. *Heterosmilax indica, Smilax lanceifolia*, etc.).

(v) **Leaf tendril**: When entire leaf is modified into a tendrils (e.g. *Lathyrus aphaca*).

(vi) Petiole/petiolule tendril: When petioles or petiolules are modified into tendrils (e.g. *Clematis acuminata, C. montana, Solanum jasminoides, Naravelia zeylanica*, etc.).

(vii) Leaflet tendril: When terminal leaflet modified into tendrils (e.g. *Cobaea scandens*, *Vicia sativa, V. tetrasperma*, etc).

In case of axillary shoot tendril plants from two families from the present record has been considered in this classification, Passifloraceae and Cucurbitaceae. A careful observation shows that the place of origin of tendrils in Cucurbitaceae is not exactly the axillary but slightly lateral. This has created confusion. Trinkgeld (cf. Metcalfe and Chalk 1950) considered that in some species it is the modification of leaves (e.g. *Cucumis spp*) and in other genera it is the modification of axillary leafy-shoot.

9.4 DEVELOPMENT OF TENDRIL

Among plants 'climbing' is a special habit for the weak stemmed ones. In the path of evolution, pteridophytes is the first group of plants where the climbing habit has been initiated. The genus *Lygodium* (fern) is representing such a group of plants. The climbing habit was also available among the extinct gymnosperms and among the extant gymnosperms genera like *Ephedra* and *Gnetum* have some climbing species. So, the climbing habit is not a nearly developed character in angiosperms.

Actual path for the origin of angiosperms is not clear. But, most of the recent authors like Hutchinson (1973), Cronquist (1981), Thorne (1976,1983), and Dalgren (1980, 1981) are of opinion that Magnoliaceae is the earliest evolved extant angiospermic family. Magnoliaceae is one of arboreal family with most of its members are trees and with few shrubs only. Taxa related to Magnoliaceae are also arboreal. According to Hutchinson (1973), Rendle (1904, 1925) and other workers who deviced some dicta expressing their ideas about the trend of evolution among the angiosperms, one of opinion that woody-arboreal habit is the most primitive form from which shrubs, climbers, perennial herbs and annuals have evolved gradually.

With this at the base the dendrogram for angiosperm evolution it may be thought that climbers habit evolved a fresh in this taxon. In that case simplest form of climbing habit could have been seen in the earlier evolved families and comparatively complex modes of climbing should be available in advanced families only. But this is not the fact. We get twiners in Schisandraceae, Menispermaceae; petiole or petiolule tendrils

in Ranunculaceae; leaf or leaflet tendrils in Papilionaceae, etc. It indicate that this character was already hidden in the genome which was expressed at different stages, sometimes with modifications.

Rambler is the simplest mode of climbing:

However, from the observations on different modes of climbing and the climbing organs in Angiosperms, rambling is probably the simplest mode of climbing. These plants do not have any specialised climbing organs and their moderately woody stem can grow upwards taking only little support from other strong and erect plants. Their binding with the upper part of the host plant is almost automatic and become effecting only with the development of lateral branches which intermingled with the branches of the host plant. Profuse branching of ramblers at or near the lighted canopy makes this binding quite strong.

Irregular partial coiling-first formed climbing organ:

An irregular half-coiled bending of stem, as it is formed in *Celsatrus stylosus*, is probably first-formed type of climbing device which provided a better grip to the ramblers.

Irregular but complete coiling:

Irregular but complete coiling round is exhibited by *Acacia torta*, where the stem grows straight but when touches a support it coils irregularly. This binding become very strong with the initiation and progress of secondary growth.

Shortening of the coiled stem:

In the plants like *Combretum roxburghii and C. wallichii* the coiled stem, which looks very similar to other branches of the plant (except being coiled) though developed from an extraaxillary branch), do not continue the growth as a normal shoot. In *Dalbergia volubilis* the coiling involved is a few branches of a lateral shoot.

Specialisation involved a larger part of the shoot:

In plants like *Gouania leptostachya* this specialisation involved a larger part of the shoot. Coiling part represent the single terminal internode, which is much specialised and looks much different from normal shoot. Hence this specialised shoot can be termed as tendril.

Excess suppression of specialised branches formed a hook:

After reduction of branches as formed in *Combretum wallichii* or *Dalbergia volubilis*

further reduction of stem took plcae in many plants which led to the elemination of complete coiling but the formation of highly specialised hooks. Excellent hook-fomation in many members of Annonaceae (e.g. *Artabotrys hexapetalus*).

Further specialisation in terminal (apical) shoot tendril:

Many members of Vitaceae, like *Tetrastigma leucostaphyllum*, produce tendrils with no partially modified stem attached to the base. In this family such apical tendrils are pushed aside by the vigorous growing shoot which is responsible for the continuation of the growth of leafy-shoot. In many other plants of this family tendrils become branched (*Vitis heynena, Tetrastigma obtectum)* and the anatomical studies has produced the axial nature all such branches (Chapter-5).

Specialisation shifted to a axillary shoot:

The first formed tendrillar structure attached to a specialised shoot (as in *Gouania leptostachya*) is slightly modified leading to the shifting of the specialised shoot to the axillary position (as in *Bauhinia vahlii*). This structure took its final shape of a regular tendril in many other taxa as in *Passiflora* spp.

In Cucurbitaceae the basic morphology of tendril is slightly doubtful where it develops from a position which is slightly lateral to the axile. However, the anatomical studies has definitely proved of its axial nature (Chapter-5).

Regularisation of simple bending produced twiners:

The type of irregular bending are incomplete bending as it has already been discussed for the plant *Celastrus stylosus*, it might have gradually regularised through a definite degree of bending or curving round the support-whenever the growing shoot comes in contact. Twiners probably have produced directly in this way.

Restriction of twining produced tendrils:

This might be additional or a supplementary branches leading to the production of tendrils. If in twiner, the twining habit become restricted to certain lateral branches, tendrils may be produced on subsequent shortening of these branches.

Petioles too can suppoprt climbing:

A slightly curved petiole or if bend downwards or if the lamina is bend down ward then a leaf or more particularly a petiole can provide some support to climb. In different species of *Clematis* and *Naravelia* petiole or petiolule can coil once or two and forms an effective binding. In *Solanum jasminoides* petioles coils upto one complete bending.

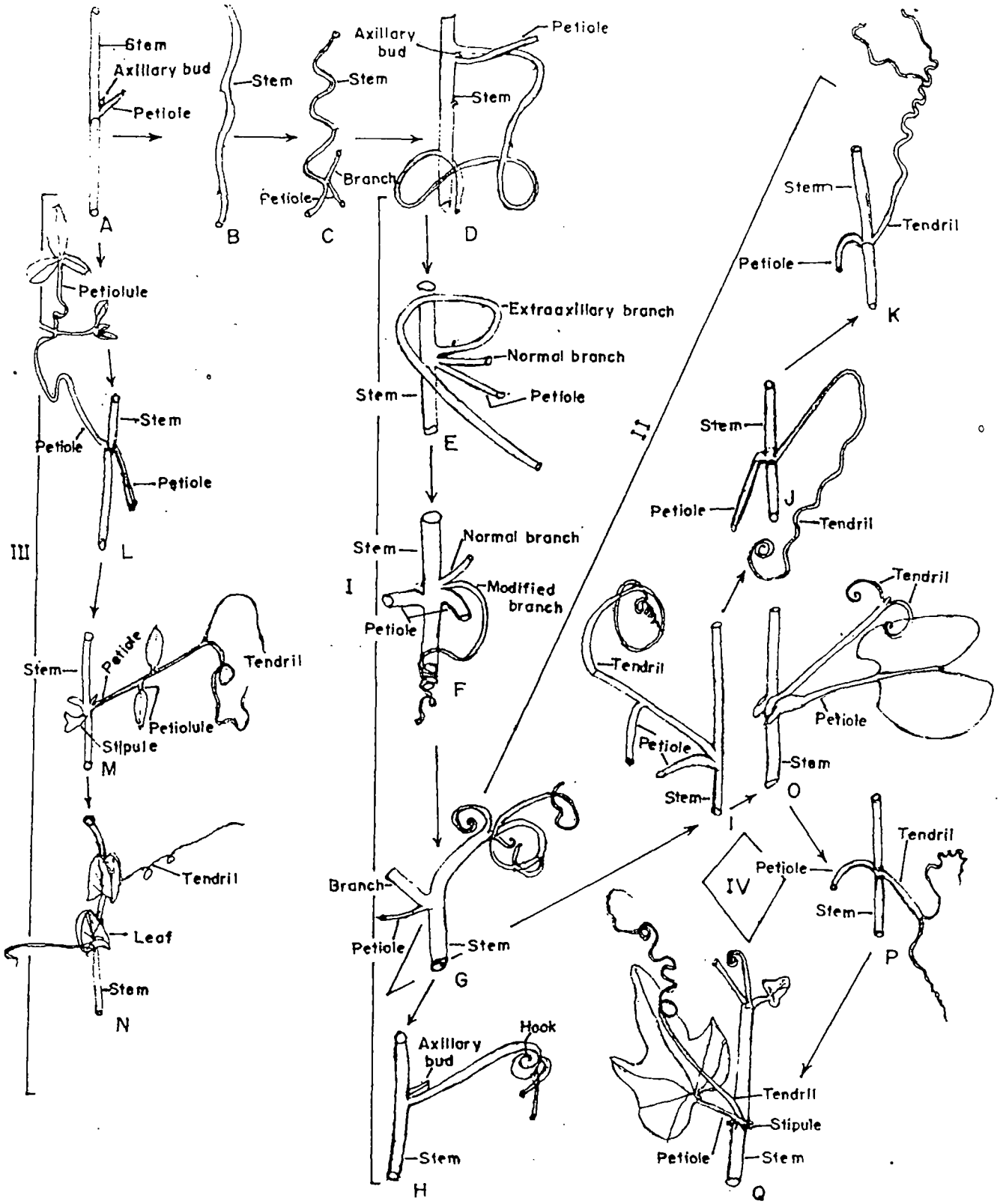

Fig-9.1: A diagrammatic scheme to show the development of tendril in angiospermic climbers: I. *Milletia cineria*(A); *Celastrus stylosus*(B); *Abrus pulchellus*(C); *Acacia torta*(D); *Combretum roxburghii*(E);*Combretumwallichii*(F); *Dalbergia volubilis*(G) and *Artabotrys hexapetalus*(H);II. *Dalbergia volubilis*(G); *Gouania leptostachya*(I); *Tetrastigma leucostaphyllum*(J); *Cayratia japonica*(K); .III. *Milletia cineria*(A); *Clematis gouriana*(L); *Vicia sativa*(M) and *Lathyrus aphaca*(N); IV. *Gouania leptostachya*(I); *Bauhinia vahlii*(O) *Luffa cylindrica*(P) and *Passiflora foetida*(Q).

Further specialisation modified part of the leaf into tendril:

In different species of *Vicia* (e.g. *V. hirsuta* and *V. sativa*) and *Lathyrus* (e.g. *L. sativa, L. odoratus*) terminal leaflets of their unipinnate leaves modified into tendril.

Extreme specialisation involved entire leaves:

This type of extreme specialisation is found only in a few plants. In some cultivars of garden pea (*Pisum sativum*) complete flattened laminar structures produced a bunch of branched tendrils. Further reduction took place in *Lathyrus aphaca* where due to complete suppression of leaflets am unbranched slender and long tendril is produced. In both of these plants the normal functions of leaves are transformed to their large leafy stipules.

The present scheme(Figure-9.1) to understand the stages of development of tendril is based on the observation on the available climbers in Darjeeling and Sikkim only. Observation on the larger number of species, from different parts of the world, accompanied in internal structure of modified organs will be helpful for drawing a better developmental sequence.

9.5 ENDEMIC VALUE OF THE ANGIOSPERMIC CLIMBERS OF DARJEELING AND SIKKIM HIMALAYAS

Darjeeling and Sikkim Himalayas are well known for its wide range of vegetation covering almost all major groups of plants including a high number of endemics (Biswas 1940; Chtterjee 1940; Das 1995; Das and Chanda 1987; Samanta and Das 1995). While numerous species of plants migrated to this flora, a large number of species also have originated in this region.

The analysis of the distribution of recorded angiospermic climbers of this region revealed that there is a good proportion of plants with very restricted distribution. Such endemic climbers can be categorised as follows:

A. Plants endemic to Eastern Himalaya

B. Plants emdemic to E. Himalaya to N.E. India

C. Plants endemic to Himalaya

D. Plants endemic to Indian Subcontinent

Table 9.8 shows the distribution of these endemic plants: 33 species for Eastern Himalaya, 26 species for the Eastern Himalayan plants extending to N.E. India, 6 species of only Himalaya, and 10 species of Indian subcontinent.

Table 9.8: Endemic climbers restricted to E. Himalaya to Indian Subcontinent

Restricted zones	Number of species	% of total climbers
A. Eastern Himalaya	33	11.61
B. Eastern Himalaya to N.E. India	26	9.15
C. Himalaya	6	2.11
D. Indian Subcontinent	10	3.52

A. Plants endemic to E. Himalaya : Phytogeographically Himalaya encompasses Darjeeling, Sikkim, Nepal-Bhutan and parts of Northern Assam (Chatterjee 1959). There are 11.61% of the total climbers found to be endemic to Eastern Himalaya. The endemic climbers includes:

Name of the plants	Families	Altitude in m
Aconogonum molle var.*rude*	Polygonaceae	Upto 2250
Actinidia strigosa	Actinidiaceae	2200-3000
Aganosma gracilis	Apocynaceae	Upto 1220
Argyreia roxburghii	Convolvulaceae	110-2000
Aristolochia griffithii	Aristolochiaceae	Upto 3000
A. nakaoi	Aristolochiaceae	840-3000
Biswarea tonglensis	Cucurbitaceae	2000-3000
Celastrus paniculatus	Celastraceae	1600-2150
Cissus assamica	Vitaceae	110-1200
Ceropegia longifolia var. *darjeelingensis*	Asclepiadaceae	1200-1800
C. longifolia var. *longifolia*	Asclepiadaceae	1200-1800
Codonopsis affinis	Campanulaceae	Upto 2650
C. inflata	Campanulaceae	1800-2700
Derris cuneifolia	Papilionaceae	500-1300
Dioscorea alata	Dioscoreaceae	132-1000
Dysolobium grande	Papilionaceae	Upto 300
Edgaria darjeelingensis	Cucurbitaceae	1500-3000
Gymnema thomsonii	Asclepiadaceae	Upto 2000
Holboellia latifolia var. *angustifolia*	Lardizabalaceae	Upto 3000
Passiflora geminiflora	Passifloraceae	1200-2000
Piper suipiqua	Piperaceae	800-2450
Plectocomia himalayana	Rutaceae	1200-2200
Porana grandiflora	Convolvulaceae	800-2200
Rhaphidophora calophylla	Araceae	300-2050
Rubia chaerifolia	Rubiaceae	Upto 1500
R. manjith	Rubiceae	1400-2500
Rubus senchalensis	Rosaceae	2350-2600

Scheffelera venulosa var. *macrophylla*	Araliaceae	Upto 2600
S. venulosa var. *roxburghii*	Araliaceae	1000-1900
Smilax glaucophylla	Smilacaceae	Upto 3050
Synotis sikkimensis	Asteraceae	Upto 1600
S. tetrantha	Asteraceae	1300-1560
Thunbergia lutea	Acanthaceae	900-2300

B. Eastern Himalayan plants extended to N.E. India: This group of plants are distributed over a slightly larger region. The plants extended their distribution in some states of North East India i.e. Assam, Maghalaya, Arunachal Pradesh, etc. and covering 9.50% of the total recorded climbers, they includes:

Name of the plants	Families	Altitude in m
Adenia cardiophylla	*Passifloraceae*	700-1000
Ampelocissus rugosa	*Vitaceae*	1500-2000
A. sikkimensis	*Vitaceae*	Upto 1000
Aristolochia cathcartii	*Aristolochiaceae*	1500-2300
A. platanifolia	*Aristolochiaceae*	1500-2000
A. saccata	*Aristolochiaceae*	350-2500
Calamus flagellum	Arecaceae	Upto 1220
Clematis nepalensis	Ranunculaceae	
Cyclea bicristata	Menispermaceae	110-1800
Elaeagnus pyreformis	Elaeagnaceae	Upto 1100
Heterosmilax japonica	Smilacaceae	1450-2650
Michrechites elliptica	Rutaceae	120-1800
Parthenocissus semicordata	Vitaceae	1800-2400
Piper sylvaticum	Piperaceae	100-2450
Rhaphidophora glauca	Araceae	1400-2200
Rubia wallichiana	Rubiaceae	
Rubus paniculatus	Rosaceae	1500-3100
Sabia leptandra	Sabiaceae	Upto 2300
Smilax aspericaulis	Smilacaceae	300-2200
S. ferox	Smilacaceae	1850-3200
Stephania. elegans	Menispermaceae	300-2200
S. glandulifera	Menispermaceae	132-1800
Tetracerac sarmentosa	Dilleniaceae	Upto 350
Tetrastigma bracteolatum	Vitaceae	132-1500
T. rumicispermum	Vitaceae	1500-2250
Treutlera insignis	Asclepiadaceae	1400-2500

C. Endemic to Himalaya: Only 2.11% of total climber endemic to Himalaya. Climber includes:

Name of the plants	Families	Altitude in m
Euonymus echinatus	Celastraceae	1900-3200
Galium hirtifolium	Rubiaceae	1600-2400
Hedera nepalensis	Moraceae	1500-2600
Holmskioldea sanguinea	Verbenaceae	Upto 1500
Piper mullesua	Piperaceae	400-2150
Schisandra grandiflora	Schisandraceae	220-3200

D. Endemic to Indian Subcontinent: Only 10 climbers are found to be endemic in Indian iSubcontinent i.e. in Nepal,I Bhutan, Bangladesh, SriLanka and Pakistan. 3.52% of the recorded climbers are endemic, they include:

Name of the plants	Families	Altitude in
Aristolochia indica	Aristolochiaceae	Upto 150
Artabotrys hexapetalus	Annonaceae	Upto 300
Bauhinia vahlii	Caesalpiniaceae	132-3000
Cynanchum corymbosum	Asclepiadaceae	800-1600
Dioscorea bulbifera	Dioscoreaceae	110-2150
Gentiana speciosa	Gentianaceae	1800-3000
Paramigyna monophylla	Rutaceae	300-1850
Rhynchodia wallichii	Asclepiadaceae	300-1200
Smilax ovalifolia	Smilacaceae	110-1000
Uncaria sessilifructus	Rubiaceae	Upto 1300

So, the endemic value of climber flora of this region is quite high and as much as 75 of the recorded 284 species are endemic to various smaller or larger region of India or Indian subcontinent.

9.6 RECORDS OF RARE AND/OR ENDANGERED CLIMBERS:

Most of the endemic plants are rare and extremely restricted in their vertical and lateral distribution. Due to the wide scale modification of natural vegatation in this part of Himalayas numerous species of climbers are now loosing their acustomed habitat. Other types of biotic influences, e.g. grazing, forest floor cleaning, etc are also affecting their population, finally these plants are vanishing from numerous localities. The total area of distribution of a species is also very important. However, the threat to the survival of a species is multiple, Table 9.9 show such plants of different categories.

9.6.1 CATEGORIES OF RARE PLANTS : To know the present status of the plants, following are the categories as suggested by IUCN (Table 9.9).

Table 9.9: Records of rare/and or endangered climbers of Darjeeling and Sikkim Himalaya

Categories	Number of species	% of total climber
Critically Endangered	56	19.71
Endangered	46	16.19
Vulnerable	16	5.63

9.6.1A. CRITICALLY ENDANGERED (CR):

A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future. It may be due to a sharp decline in its abundance, in area of occupancy, quality of habitat or an increase in the potential levels of exploitation; if it is known to exist in a single location or the number of mature individuals is extremely low (less than 250) and the estimated number is less than 50(Table-9.10).

Table 9.10 :Records of critically endangered climbers from Darjeeling and Sikkim Himalayas

Name of the plants	Altitude in m	No.of plants observed	No. of recorded locations
Adenia cardiophylla	700-1000	2	2
Aganosma gracilis	1200	1	1
Aristolochia cathcartii	1500-2300	4	3
A. griffithii	2400-3000	3	2
A. nakaoi	840-3000	2	2
A. platanifolia	1500-2000	3	2
A. saccata	300-2500	2	2
Aspidopterys wallichii	800-1500	3	2
Bauhinia scandens	150-1000	6	3
Biswarea tonglensis	2000-3000	4	2
Celastrus stylosus	840-3000	6	3
Ceropegia longifolia var. *darjeelingensis*	1200-1800	2	1
Ceropegia longifolia var. *longifolia*	1800-2000	2	1
Clematis connata	1600-2200	6	3
C. gouriana	800-2400	24	4
C. grewiifolia	1550-2350	2	1
C. smilacifolia	Upto 1565	2	1

Name of the plants	Altitude in m	No.of plants observed	No. of recorded locations
C. wightiana	1500-2100	2	1
Combretum flagocarpum	Upto 1300	2	1
Cyclea barbata	Upto 500	20	5
Cynanchum corymbosum	800-1800	4	2
Dicentra paucinervia	1600-2800	1	1
Dioscorea deltoidea	800-1500	4	2
D. tomentosa.	Upto 350	1	1
D. trinervia	Upto 350	4	1
Dysolobium grande	Upto 3000	1	1
Gomphogyne cissiformis	1400-2300	4	2
Gymnema sylvestre	100-800	1	1
Heterosmilax indica	Upto 3000	1	1
Holboellia latifolia var. *angustifolia*	1700-3000	25	5
Ipomoea hirta	Upto 350	4	2
Kadsura heteroclita	2300-3100	6	2
Lonicera acuminata	1800-3000	20	3
L. hispida	1400-1800	2	1
Melothria angulata	Upto 200	6	2
Michrechites ellipticus	1200-1800	5	3
Mucuna nigricans	300-1500	4	2
Paramigyna monophylla	300-1850	2	1
Parthenocissus semicordata	1800-2400	4	2
Persicaria strigosa	Upto 350	18	2
Pleactocomia himalayana	Upto2200	4	2
Puearaia phaseoloides var. *subspicata*	Upto 350	4	1
P. sikkimensis	110-800	2	2
Rhynchodia wallichii	Upto310	2	1
Rubus indotibetinus	Upto 2450	10	2
R.. senchalensis	2350-2650	22	1
Scheffelera venulosa var. *macrophylla*	Upto 2000	3	2
Schisandra neglecta	2000-3200	8	2
Synotis sikkimensis	1300-1650	2	2
Tetracera sarmentosa	Upto 350	2	2
Tiliacora acuminata	Upto 850	1	1
Tylophora exilis	Upto 1300	2	1
Trichosanthes cordata	120-900	6	2
T. dioica	Upto 350	10	2

9.6.1B. ENDANGERED (EN):

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future. It is estimated applying the same criteria used for CR but with a lesser extent of risk. If the total area of fragmented population is over 250 individuals and if the taxon grow only in a particular area its estimated population is more than 5 but less than 250 mature individuals(Table-9.11).

Table 9.11 : Records of endangered climbers from Darjeeling and Sikkim Himalayas

Name of the plants	Altitude in m	No.of plants observed	No. of recorded locations
Abrus pulchellus	Upto 850	36	3
Ampelocissus sikkimensis	110-2100	6	3
Aspidopteris nutans	Upto 500	2	2
Blumea riparia	1000-1900	1	1
Calamus flagellum	Upto 1200	1	1
Clematis acuminata	300-2400	30	3
C. napalensis	Upto 3000	12	3
Celastrus monospermus	1000-2400	4	2
Chonemorpha fragrans	400-1500	8	4
Cissus assamica	110-1200	4	2
Cryptolepis sinensis	200-2000	8	4
Derris ferruginea	Upto 1000	4	2
Dioscorea hispida	Upto 1100	2	2
D. prazeri	110-1900	6	3
Edgaria darjeelingensis	1450-3000	25	3
Elaeagnus conferta	2000-2700	30	2
Embelia floribunda	1700-2000	3	1
Entada rheedii	1500-1600	6	2
Fallopia convolvulus	1900-2200	8	1
Gymnema thomsonii	Upto 2000	8	2
Herpetospermum pedunculosum	1600-3000	6	3
Ipomoea pestigridis	Upto 350	6	1
I. purpurea	Upto 2100	12	4
Leycesteria gracilis	1900-2750	12	3
Lonicera glabrata	1500-2300	8	3
Mucuna prurita	Upto 550	6	1
Myriopteron paniculatum	1600-2200	2	1
Piper peepuloides	Upto 1500	12	2
Pericampylus glaucus	Upto 2000	4	2
Persicaria perfoliata	1400-1800	16	4

P. thunbergii	Upto 1900	8	1
Rosa brunonii	1900-2200	2	1
Rubus niveus	1300-2000	9	3
Schisandra propinqua	1300-3000	6	2
Senecio araneosus	1500-2400	2	1
Smilax glaucophylla	Upto 2500	4	1
Stilbanthus scandens	Upto 2500	3	2
Tetrastigma leucostaphyllum	Upto 1500	6	3
T. thomsonianum	Upto 1800	4	2
Thladiantha cordifolia	840-2000	30	3
Thunbergia lutea	Upto 2000	8	3
Treutlera insignis	Upto 3000	10	3
Trichosanthes wallichii	Upto 2400	8	4
Uncaria sesselifructus	Upto 1300	2	1

9.6.1C VULNERABLE (VU):

A taxon is Vulnerable when it is not Critically Endangered or Endangered but facing a high risk of extinction in the wild in the medium-term future. In the similar scale of measurement (as it is applied for previous categories), the risk is lesser to a broader area of present availability, comparatively more number of populations and the number of mature individuals is less than 1000(Table-9.12).

Table 9.12: Records of vulnerable climbers from Darjeeling and Sikkim Himalayas

Name of the plants	Altitude in m	No.of plants observed	No. of recorded locations
Actinidia callosa	Upto1400	3	1
Codonopsis inflata	1800-2700	8	3
Diplocyclos palmata	Upto 500	20	3
Elaeagnus pyreformis	Upto 1100	8	1
Milletia cineria	132-1200	6	2
Prabaena sagittata	Upto 1200	3	3
Passiflora geminiflora	1200-2000	8	4
Piper suipiqua	800-2450	4	2
P. sylvaticum	Upto 2450	12	4
Rhaphidophora hookerii	350-2000	6	3
Rubus chaerifolia	Upto 1500	6	2
Streptolirion volubile	1400-2800	6	3
Tetrastigma rumicispermum	1500-2250	12	4
Zanthoxylum oxyphyllum	1900-3000	9	3
Ventilago denticulata	Upto 1000	4	2

9.7 EXOTIC CLIMBERS FROM DARJEELING AND SIKKIM HIMALAYAS:

A place with a rich basic when gradully turns into a human settlement by the migrated

people, it is expected that many plants from external world would will also be introduced there. When the British rule in India established the sanitorium at Darjeeling, then, certainly, they introduced many plants from Europe which were propular to them due to varios reasons. Ornamentals, common fruit plants and vegetables are main types of plants introduced in that manner. There are many plants which were introduced accidentally along with packing materials, along with the introduced seeds of other plants, soil of potted plants, etc. Many species have recorded there also with the process of natural migration. However, all there together enriched the flora of this region.

By human transport system it is direct and quick process but natural means is also direct but slow process. The natural migratory process has effected the entry of numerous plants from Malaysian, Chinese, Australian and North African region (Champion and Seth 1968). Recent and past published floras of these regions also recorded numerous exotics (Biswas 1940; Hara 1966,1971; Ohashi 1975; Matthew 1981; Yonzone *et al.* 1970; Das 1984,1986; Bhujel and Yonzone *et al.* 1985; Bhujel and Das 1995; Samanta and Das 1995).

The present investigation recorded 15 angiospermic exotic climbers form this region having/bearing ethnobotanical values(Table-9.13).

Table 9.13 : The table represents the status, probable means of entry, purpose and the native of the introduced climbers from which they have introduced.

Name of plants	Status	Probable means of entry	Purpose of entry	Native of-
Aristolochia elegans	Escaped	I	Om	Tropical America
Ipomoea angulata	Naturalised	I	Om	Tropical America
Cobaea scandens	Esacaped/ Seminat-uralised	I	Om	Mexico
Cyclanthera pedata	Escaped	I	Ed. pl	Tropical America
Ipomoea purpurea	Naturalised	I	Om	Tropical and Subtropical America
I. quamoclit	Naturalised	I	Om	Tropical America
Lathyrus aphaca	Naturalised	I	Ed.pl./Fod	Europe America and Asia
Lonicera japonica	Escaped	I	Om	Japan and China
Mikania micrantha	Naturalised	M	-	Tropics and South America

Passiflora edulis	Escaped	I	Ed. pl.	Brazil
P. foetida	Naturalised	I	Orn	Tropical America
Sechium edule	Naturalised	I	Ed. pl.	Tropical Africa
Solanum jasminoides	Escaped	I	Orn	Brazil
Vicia sativa	Naturalised	M	Fod.	Afro-Asiatic
Wisteria chinensis	Escaped	I	Orn	China

Abbreviations used: Ed.= Edible; Fod.= Fodder; I= Introduced; M= Migrated; Orn= Ornamental; pl.= Plant.

9.8 STRATEGIES FOR CONSERVATION OF ANGIOSPERMIC CLIMBERS:

Darjeeling and Sikkim parts of Eastern Himalayas are floristically very rich covering all major groups of plants including a good number of climbers (Hooker 1849, 1872-1897; Hara 1966, 1971; Hara *et al.* 1978, 1979, 1982; Grierson and Long 1983, 1984. 1987. 1991; Noltie 1993; Ohashi 1975). Due to over exploitation and other biotic interference, natural vegetation of Darjeeling and Sikkim Himalayas are dwindling at a very fast rate which in turn threatends the existance of many of these climbing species. As, climbing species are very sensitive to the modification to their habitat structure and gets eliminated at first when disturbed. Following are the proposed strategies for their conservation:

(i) Conservation of habitat for rare and /or endangered climbers is the first requirement for their *in situ* conservation. Establishment of National Parks (Neora Valley N. Park), Singalila N.P (3000-3660m),Wild Life Sanctuaries [Senchal W.L. Sanctuary (c 2350m), Mahananda W.L. Sanctuary (132-1400m)] and the proposed Kanchenjungha Biosphere Reserve will be of much help in that respect. However, many of these plants grow in so small areas and for those, where only one or few plants have been reported to exist and the areas are not covered by the conservatories, the strategy for their conservation must be different.

(ii) Propagation by seeds and other propagules to establish a population in gardens

(iii) Population of such species can also be increased by micropopagation

(iv) Reintroduction of plants in their natural habitat from the *ex situ* conservatories

(v) Establishment of a greater Biosphere Reserve connecting all National Parks, Wild Life Sanctuaries and Reserve forests in North Bengal with extension to Sikkim (if possible, also to include places in Bhutan) with well protected corridors

(vi) Popularising the centre of rare plants among common people specially those. who are intented in gardening

(vii) After the establishment of a basic protected population usefulness of some species can be worked out, so that they need to cultivated for procuring raw materials

(viii) Plants never reported from conservatories may be introduced in some to find a new house for them, etc.

9.9 ELEMENTS OF THE FLORA:

Hooker (1906) made a comment that a typical flora of India does not exist. A vast country with a multitude of habitat conditions and with many endemic species (Chatterjee 1940, Nayar 1980) especially in the Himalayas, probably render Hooker's contention untenable. The rich flora of Darjeeling and Sikkim Himalayas is attributed to the migrated plants from widely distributed countries like Nepal, China, Malaysia, Europe, America, Africa, etc (Das 1995; Bhujel 1996). The basis of the flora has been created by the migrated plants mainly from South East Asia and Malaysian region which is enriched by the plants of the region and by numerous species of plants originated and evolved in this part of the Himalayas. The diversity of the flora in this region is also enriched by a large number exotic elements introduced by human agencies, which subsequently escaped and go plant naturalised in this part of the Himalayas and the process is aided by its varied goeographical and climatic conditions (Das 1995).

On analysis the flora of Darjeeling and Sikkim Himalayas, plants from the following phytogeographical regions have been recognised (Table 9.14).

Table 9.14: Presentation of phytogeographical distribution of the angiospermic climbers of Darjeeling and Sikkim Himalayas

Phytogeographical zones	Number of speces	% of total
I. Himalayan	6	2.11
II. Eastern Himalaya	33	11.61
III. South East Asian and Malayan	149	52.46
IV. Eastern Himalayan plants extended to North East India	26	9.15
V. Indian Sub-continent	10	3.52
VI. Sino-Himalayan	6	2.11
VII. Sino-Japanese	11	9.50
VIII. Central Asiatic	6	2.11
X. Afro-Asiatic	17	5.98
XI. Eurasian	3	1.05
XII. American	12	4.22
XIII. Pantropic	3	1.05
Doubtful	2	0.70

I. HIMALAYAN: Climbers which grow all along the Himalayan ranges and sometimes slightly extending further to east and / or west are constitute as Himalayan elements.Total contribution consists of only 5 species i.e. 1.76% of the total climber flora.These plants are:

Euonymus echinatus
Galium hirtifolium
Hedera nepalensis
Holmskioldea sanguinea
Piper mullesua
Schisandra grandiflora

II. EASTERN HIMALAYAN: The areas of Darjeeling and Sikkim, Nepal, Bhutan and parts of Assam and Meghalaya constitute the Eastern Himalaya. 33 species i.e. 11.61% of the recorded angiospermic climbers are endemic to this region.

Aconogonum molle var. *rude*
Actinidia strigosa
Aganosma gracilis
Argyreia roxburghii
Aristolochia griffithii
A. nakaoi
Biswrea tonglensis
Celastrus paniculatus
Ceropegia longifolia var. *darjeelingensis*
Ceropegia longifolia var.*longifolia*
Cissus assamica
Codonopsis affinis
C. inflata
Derris cuneifolia
Dioscorea alata
Dysolobium grande
Edgaria darjeelingensis
Gymnema thomsonii
Holboellia latifolia var. *angustifolia*
Passiflora geminiflora
Piper suipiqua
Plectocomia himalayana
Porana grandiflora
Rhaphidophora calophylla
Rubia chaerifolia
R. manjith
Rubus senchalensis
Scheffelera venulosa var. *macrophylla*
Scheffelera venulosa var. *roxburghii*
Smilax macrophylla
Synotis sikkimensis
S. tetrantha
Thunbergia lutea

Of these one (*Synotis sikkimensis*) is endemic to Sikkim, two are endemic (*Ceropegia longifolia* var. *darjeelingensis* and *Rubus senchalensis*) are endemic to Darjeeling and these (Das 1987; Bhujel 1996) are endemic to Darjeeling and Sikkim Himalayas.

III. SOUTH EAST ASIAN AND MALAYAN: Climbers common with China, Burma, Malayan and the adjoining region are treated under this group. Total contribution is 149 i.e 52.46% of the climber flora. Following is the list of such plants:

Abrus pulchellus
Acacia intsia.
A. torta
Aconogonum molle var. molle
A. molle var. frondosum
Ampelocissus barbata
Aristolochia tagala
Aspidopterys nutans
A. wallichii
Bauhinia scandens
Blumea riparia
Butea parviflora
Caesalpinia cucullata
Cajanas scarabaeoides
Cayratia japonica
Celastrus monospermus
C. stylosus
Ceropegia pubescence
Chonemorpha fragrans
Cissus javana
C. repens
Clematis acuminata
C. buchananiana
C. connata
C. gouriana
C. grewiiflora
C. montana
C. smilacifolia
C. wighitiana
Clitorea ternatea
Codonopsis javanica
Combretum flagocarpum
C. roxburghii
Croton caudatus
Cryptolepis sinensis
Cuscuta sinensis
Cyclea barbata
Dalbergia pinnata
D. rimosa
D. stipulacea
D. volubilis
Deeringia amaranthoides
Derris ferruginia
Dicentra paucinervia
D. scandens
Dioscorea belophylla
D. glabra
D. hamiltonii
D. hispida
D. kamoonensis
D. pubera
D. prazeri
D. tomentosa
Dumasia villosa
Elaeafnus conferta
Elaeafnus conferta
Embelia floribunda
E. ribes
Entada rheedii
Ericybe paniculata
Euonymus vagans
Ficus hederacea
Galium asperifolium
G. elegans
Gomphogyne cissiformis
Gouania leptostachya
Gymnopetalum chochinchinense
Hedyotis scandens
Hemidesmus indica
Herpetospermum pedunculosum
Hiptage bengalensis
Hodsonia macrocarpa
Holboellia latifolia var. *latifolia*
Hydrangea anomala
Ichnocarpus frutescens
Jasminum dispermum
Kadsura heteroclita
Leycesteria formosa
L. gracilis
Lonicera acuminata
L. glabrata
L. macrantha
Melothria heterophylla
M. mucronata
Merremia hirta
M. vitifolia
Milletia cineria
M. extensa
M.pulchra
Momordica chochichinensis
M. dioica
Mucuna nigricans

M. prurita
Myriopteron paniculatum
Naravelia zeylanica
Natsiatum herpeticum
Paederia foetida
P. scandens
Parabaena sagittata
Pergularia pallida
Pericampylus glaucus
Persicaria chinensis
P. strigosa
Piper attenuatum
P. chaba
P. longum
P. nigram
P. pedicillatum
P. peepuloides
Pothos cathcartii
P. scandens
Pueraria phaseoloides
P. p. var. *subspicata*
P. sikkimemsis
Rhaphidophora hookerii
Rosa brunonii
R. sericea
R. acuminatus
R. ellipticus
R. indotibetinus
R. lineatus
R. niveus
R. rugosus
R. wardii
Sabia campanulata
S. parviflora
Schisandra neglecta
S. propinqua
Senecio araneosus
S. wightianus
Schuteria involucrata
Smilax lanceifolia
Stephania glabrata
Tetrastigma dubium
T. leucostaphyllum
T. obtectum
T. serrulatum
Thladiantha cordifolia
Thunbergia fragrans
Tiliacora acuminata
Tinospora cordifolia
Toddalia-asiatica
Trichosanthes cordata
Tripterospermum volubile
Tylophora exilis
T. indica
Uvaria hamiltonii
Ventilago denticulata
Zanthoxylum oxyphyllum

IV. EASTREN HIMALAYAN PLANTS EXTENDED TO NORTH EAST INDIA: 26 species i.e. 9.15% of climbers of Eastern Himalaya are extending their distribution over the hilly tracts of North East India (mainly Assam, Meghalaya, Khasia and Mishmi Hills, Manipur). It is difficult to recognise the main centre of distribution for most of these plants with the contoguity of the hilly tract and the climate. Following is the list of such plants.

Adenia cardiophylla
Ampelocissus rugosa
A. sikkimensis
A. cathcartii
A. platanifolia
A. saccata
Calamus flagellum
Clematis nepalensis
Cyclea bicristata
Elaeagnus pyreformis
Heterosmilax japonica
Michrechites elliptica
Parthenocissus semicordata
Piper sylvaticum
Rhaphidophora glauca
Rubia wallichiana
Rubus paniculatus
Sabia leptandra
Smilax aspericaulis
S. ferox
Stephania elegans
S. glandulifera
Tetracera sarmentosa
Tetrastigma bracteolatum
T. rumicispermum
Treutlera insignis

V. INDIAN SUBCONTINENT: Indian subcontinent include 6 countries Bhutan, Nepal, Bangladesh, Sri Lanka, Pakistan and India. Out of recorded climbers only 10 species i.e.3.52% and are found growing restricted to this region. These plants are:

Aristolochia indica
Artabotrys hexapetalus
Bauhinia vahlii
Cynanchum corymbosum
Dioscorea bulbifera
Gentiana speciosa
Paramigyna monophylla
Rhynchodia wallichii
Smilax ovalifolia
Uncaria sessilifructus

VI. SINO-HIMALAYAN: 6 species (i.e.2.11%) of climbing plants distributed over China and Himalayas in cluding Tibetare also growing hence which are:

Actinidia callosa
Cryptolepis buchananii
Periploca calophylla
Schefflera venulosa
Thunbergia coccinea
T. grandiflora

VII. SINO-JAPANESE: Eleven species (i.e.9.5%) of angiospermic climbers have been recorded from this place which have their centre of distribution in Sino-Japanese region. Some of them were introduced in different times and have become partially or fully naturalised.

Name of the climbers	**Status**
Gynostemma pentaphylla	Naturally occuring
Ipomoea muricata	Naturally occuring
Lonicera japonica	Naturally occuring
Mucuna macrocarpa	Naturally occuring
Persicaria thunbergii	Naturally occuring
Rosa banksiae	Escaped
Streptolirion volubile	Naturally occuring

Trichosanthes bracteata	Naturally occuring
T. lepiniana	Naturally occuring
T. walllichiana	Naturally occuring
Wisteria chinensis	Escaped

VIII. CENTRAL ASIATIC: Some of the climbers are distributed over Afganistan, Pakistan, including parts of West India, Russia and China. Only 6 species (i.e.2.11%) have been recorded from this region. They are:

Cissampelos pareira	*Lonicera hispida*
Cuscuta reflexa	*Mimosa himalayana*
Dioscorea deltoidea	*Persicaria perfoliata*

IX. AFROA-ASIATIC: 17 species (i.e. 5.98%) of angiospermic climbers of African and Arabian region are common to Darjeeling and Sikkim Himalayas which are:

Asparagas racemosus	*Luffa acutangula*
Basella alba	*Momordica charantia*
Coccinea grandis	*Merremia umbellata*
Dioscorea trinervia	*Mukia maderaspatana*
D. trinervia	*Stephania japonica*
Diplocyclos palmata	*Stilbanthus scandens*
Dumasia villosa	*Vicia sativa*
Gymnema sylvestre	*Vigna vexillata*
Ipomoea pestigridis	

X. EURASIAN: 3 species (i.e.1.05%) of the recorded climbers mainly distributed in Europe parts of Central Asia and extending to Himalaya, which are:

Fallopia convolvulus
Vicia hirsuta
V. tetrasperma

XI. AMERICAN: 12 species (i.e. 4.22%) of climbers of Darjeelilng and Sikkim Himalayas are American (mostly South American). Ten of these plants were introduced into the country either as ornamentals or for their edible fruits.

Aristolochia elegans	*Passiflora edulis*
Cobaea scandens	*P. foetida*
Cyclanthera pedata	*Sechium edule*
Ipomoea angulata	*Solanum jasminoides*
I. purpurea	*Lathyrus aphaca**
I. quamoclit	*Mikania micrantha**

The last two species (*) are weedy and were entered probably with the seeds of other species of plants.

XII. PANTROPIC: Only 3 species (i.e. 1.06%) of recorded climbers are pantropic in distribution. In Darjeeling and Sikkim these are recorded from low altitude places only. The three plants are:

Caesalpinia bonduc, Cardiospermum halicacabum and *Luffa aegyptiaca*.

But, the natural distribution of two cucurbits, *Cucurbita maxima* and *Trichosanthes dioica*, are very doubtful mainly due to their wide range of cultivation in many countries since the time immemorial. In the present discussion these were not included in any one of the above categories.

However, the above classification of the recorded climbers from Darjeeling and Sikkim Himalayas when in one hand, the elements (summarised in Table 9.7) from widely distributed places were recognised, there are also a considerable proportion of endemics.

9.10 CULTIVATED CLIMBERS FROM DARJEELING AND SIKKIM HIMALAYAS

Quite a good number of cultivated angiospermic climbers are recorded from different parts of Darjeeling and Sikkim Himalayas, following are some such climbers (Table 9.15).

Table 9.15: List of cultivated climbers from Darjeeling and Sikkim Himalayas

Name of climbers	Families	Local name(s)	Types of use(s)
Adenocalymma alliaceum	Bignoniaceae	-	Or
Aganosma caryophyllata G. Don	Apocynaceae	Gando-malati	Or
Allamanda cathcartica L.	Apocynaceae	Beng: Harkakra	Or
Antigonon leptopus Endl.	Polygonaceae	Beng: Raillata	Or
Aristolochia elegans Mast	Aristolochiaceae	- Or	
A. indica L.	Aristolochiaceae	Ben&Hind: Isharmal	Or/Md
Artabotrys hexapetalus (L.f.) Bhandari	Annonaceae	Beng: Kantalichampa	Or
Basella alba L.	Basellaceae	Beng: Poi; Nep: Koi	Veg.
Beaumotia grandiflora Wall.	Apocynaceae	-	Or
Bennincasa cerifera Savi	Cucurbitaceae	Beng: Chalkamra; Hind: Gol kaddu	Veg.
Bouganvella spectabilis L.	Nyctaginaceae	Beng: Kagajphool	Or
Clematis mantana DC.	Ranunculaceae	-	Or
C. napaulensis DC.	Ranunculaceae	-	Or
Campsis grandiflora K. Schum	Vrbenaceae	-	Or
Clerodendrum splendens G .Don	Verbenaceae	-	Or
C. thomsonae	Verbenaceae	-	Or
Clitoria ternatea L.	Papilionaceae	Aparajita	Or
Cucumis melo L.	Cucurbitaceae	Beng: Kakri	Veg.

Cucumis sativus L.	Cucurbitaceae	Beng: Sasa, Khira	Veg.
Cucurbita maxima Duch.	Cucurbitaceae	Beng: Mitha kaddu	Veg.
C. moscata Duch.	Cucurbitaceae	Beng:Safra kumra	Veg.
Dioscorea bulbifera L.	Dioscoreaceae	-	Veg./Md
D. pentaphylla L.	Dioscoreaceae	-	Veg./Md
Doliclos lablab L.	Papilionaceae	Beng: Shim	Veg.
Gloriosa superba L.	Liliaceae	Beng: Ulat chandal	Or
Hiptage bengalensis (L.) Kurz.	Malpighiaceae	Beng: Basanti, Madhabilata; Nep: Charpate Lahara	Or
Holmskioldea sangunea Retz.	Verbenaceae	Nep: Katli Lahara	Or
Hoya carnosa Br.	Asclepiadaceae	-	Or
Ipomoea batatas Lam.	Convolvulaceae	Beng: Mitha alu	Veg.
I. purpurea Lam.	Convolvulaceae	-	Or
I. tricolor Cav.	Convolvulaceae	-	Or
Jasminum officinale L.	Oleaceae	-	Or
Lagenaria vulgaris Ser.	Cucurbitaceae	Beng: Kodu	Veg
Lonicera japonica L.	Caprifoliaceae	-	Or
Lathyrus odoratus L.	Papilionaceae	Eng: Sweet pea	Veg.
Luffa acutangula Roxb.	Cucurbitaceae	Beng; Jhinga	Veg.
L. aegyptica Mill.	Cucurbitaceae	Beng: Dhundul	Fod.
Momordica charantia L.	Cucurbitaceae	Beng: Karela	Veg.
M. dioica Roxb.	Cucurbitaceae	Santal Kancha-arak	Veg.
Pachyrhizus angulatus Rich.	Papilionaceae	Beng: Sankalu	Veg
Passiflora coccinea	Passifloraceae	-	Or
P. edulis Sims	Passifloraceae	-	Or
P. incarnata	Passifloraceae	-	Or
P. racemosa	Passifloraceae	-	Or
Petrea volubilis L.	Verbenaceae	-	Or
Piper chaba Hunter	Piperaceae	-	Veg.
P. longum L.	Piperaceae	Beng: golemarich	Spi.
Pisum sativum L.	Papilionaceae	Beng: Cabuli-matar	Veg.
Pyrostegia venusta (Ker-Garwl.) Miers	Bignoniaceae	-	Or
Quisqualis indica L.	Combretaceae	-	Or
Rosa banksiae Aiton	Rosaceae	-	Or
Sechium edule (Jacq.) Swart.	Cucurbitaceae	Quash	Veg.
Solanum jasminoides Pax.	Solanaceae	-	Or
Thunbergia coccinea Wall. ex D. Don	Acanthaceae	Nep:Kanesi Lahara	Or
Trichosanthes cucumerina L.	Cucurbitaceae	Beng: Banchchinga	Fod.
T. dioica Roxb.	Cucurbitaceae	Beng: Patal	Fod.
Vigna catjanj Endl.	Papilionaceae	Beng: Barbati	Veg.
Vitis vinifera L.	Vitaceae	Beng: Angur	Veg.
Wisteria chinensis DC.	Papilionaceae	-	Or

Abbreviations used: Fod.:Fodder; Md.: Medicinal; Or: Ornamental; Spi: Spice; Veg.:Vegetable
'-': not recorded

Majority of these plants are introducedand all areeconomically important. But, introduce plants sometimes get escaped from the cultural condition and gradually naturalised in the local vegatation.In this way, while in one hand, local flora gets enriched, on the other hand their population may exert some detrimental effects on local or native species of the region.

9.11 LIST OF PLANTS PREVIOUSLY RECORDED FROM THIS AREA BUT ARE NOT RECORDED IN THE PRESENT SURVEY:

History of floristic survey in this part of the Himalayas dates back to the later part of the 18 th centuary. Specimen are also stored in numerous herbaria in different corners of the world. When compared with the previously publilshed floras on this region. The presently prepared flora of angiospermic climbers is missing a large number of plants. Certainy, once these plants were growing in this region and now, they either became extinct (for the endemic ones) or they no longer find this habitat suitable for their growth or survival. Following is a list of such plants:

Name of the plants	Name of the plants
DICOTYLEDONOUS	*Raphistemma pulchellum* Wall.
ANNONACEAE:	*Toxocarpus-himalensis* Falc.
Desmos chinensis Lour.	**ASTERACEAE**
D. domosus	*Vernonia vagans* DC.
D. praecox	**BORAGINACEAE**
Uvaria lurida Hook. f. et Thoms.	*Tournefortia hookerii* Cl.
U. macrocarpa Hook. f. et Thoms	**CAESALPINIACEAE**
APOCYNACEAE	*Bauhinia championii* Benth.
Chonemorpha griffithii Hook. f.	*B. wallichii* MacBride
Ecdysanthera micrantha A.DC.	*Caesalpinia microphylla* Ham
Trachelospermum axillare Hook. f.	**CAPPARIDACEAE**
T. lucidum (D.Don) K. Schumann	*Capparis acutifolia* Sweet
Vallaris solanncea (Roth) O.Kuntz.	*C. cathcarti* Hemsl.
ARALIACEAE:	*C. multifolia* Hook. f.
Pentapanax racemosus Seemann	*C. pumila* Champ.
ASCLEPIADACEAE:	**CELASTRACEAE**
Cryptolepis elegans Wall.	*Celastrus hookerii* Prain
Genianthus laurifolius Hook. f.	*Euonymus macrocarpa* Gamble
Gymnema tingens Wt. & Arn.	**COMBRETACEAE**
Gogronema nepalense (Wall.) Deca.	*Combretum griffithii*
Heterostemma alatum	*C. punctatum* Bl.
H. annularis Roth.	*C. wallichii*
Hoya edenii King ex Hook. f.	**CONVOLVULACEAE**
H. fusca Wall.	*Argyreia argentia* Roxb.
H. globulosa Hook .f.	*A. attropupurea* (Wall.) Raiz.
Marsdenia calesiana Wt.	*A. hookerii* Cl.

M. tenacissima (Roxb.) Moon.
M. roylei Wt.
M. tinctoria R. Brown
A. wallichii Choisy var. *coriacea*
Ipomoea kingii Prain
Letsomia atropuprpurea Cl
L. sikkimensis Cl.
L. strigosa Roxb.
L. thomsonii Cl.
Merremia hederacea (Burn.f.) Hallier
Poprana racemosa Roxb.
P. stenolobi
Rivea roxburghii Prain
CUCURBITACEAE
Trichosanthes ovigera Bl.
T. truncata Cl.
Zehneria japonica (Thunb) Jeff.
Z. mysoriensis (Wt.&Arn.) Arn.
GENTIANACEAE
Tripterospermum nigrobaccatum Hara
LOGANIACEAE
Pseudu-gardneria angustifolia
MALVACEAE

Hibiscus fragrans Roxb.
H. scandens
H. surattensisi L.
MENISPERMACEAE
Aspidocarya uvifera Hook. et Thoms.
Tinospora malabarica Miers.
MIMOSACEAE
Acacia rugata (Lam.)Voigt
OLACACEAE
Erythropalum scandens Bl.
OLEACEAE
Jasminum amplexicaule Hmilton
J. caudatum Wall.
J. *glandulosum* Wall.
J. multifloras (Buem. f.). Andrew
J. nepalense Spreng.
J. nervosum
J. scandens
J. subtriplinerve Bl.
PAPILIONACEAE
Abrus precatorius L.
A. nasirii D. Austin
A. wallichii Choisy var. coriacea
Butea minor Ham.
D. polystachya Benth.
Dunbaria circinalis (Benth.) Baker
D. pulchra Baker
D. rotándifolia (Lour.) Merr.
Dolichos tenuicaulis (Baker) Craib
Macrotyloma uniflorum (Lour.) Verdcour
Mucuna monosperma
M. pachcarpa Benth.
Puermi lobata (Willd.) Ohwi
P. peduncularis (Benth.) Benth.
P. wallichii DC.
Rhynchosia harrae Ohashi & Tateishi
R. minima (L.) DC.
Schuteria hispida Baker
Vigna clarkei Prain
V. umbellata (Thunb.)Ohwi
PIPERACEAE
Piper hamiltonii C. DC.
RHAMNACEAE
Berchamia flavescens (Wall. ex Roxb.) Brongniart
B.floribunda (Wall. ex Roxb.) Brongniart
Gouania napalensis Wall.
Rhamnus naplensis (Wall.) Lawson
RUBIACEAE
Rubia sikkimensisi Kurz.
Uncaria macrophylla Wall.
STERCULACEAE
Buettneria aspera Colebr.
B. pilosa Roxb
B. grandifolia
VERBENACEAE
Premna bracteata Wall.
P. interrupta Wall.
P. scandens Roxb.
MONOCOTYLEDONOUS:
PALMAE
Calamus acanthopathus Griff.
C. guruba Buch.-Ham.
C. inermis T. Anders.
C. leptofolius Roxb.
C. leptopadix Griff

9.12 NEW DISTRIBUTIONAL RECORDS:

During the survey of angiospermic climbers of Darjeeling and Sikkim Himalayas only three climbing species have been recorded here for the first time.

1.***Aspidopterys wallichii*** Hook. f. (Malpighiaceae) recorded from two places in Sikkim, Rhenek (W. Sikkim, c 800m), Mangan (N. Sikkim, c 1500m). This species is earlier recorded from Punjab and Uttarpradesh in India. This is the first time reported from Sikkim.

General Distribution: West tropical Himalayas; India; W. Malaysia, China.

2. ***Cyclea barbata*** Miers (Menispermaceae) has been collected from a number of places in low hill forests and in the foot-hills. Bamanpokhri, Rambi, Dolka Forest in Darjeeling (upto 500m) are the places where it is commonly growing in semiopen bushes. It can be easily distinguished from the commonly occuring species, *C. barbata* with its hispid throughout, base of lamina broadly truncate or rounded, etc. The species is earliest recorded from Assam and from Silent Valley forests, Palghat District, Kerala (Manilal and Sabu, 1985) in India. The species is known to occur in Malaysia and adjoining islands, Java, Burma, Siama and Cochinchina. It is its first time recorded from Sikkim Himalaya.

3. ***Melothria angulata*** Chakravarty (Cucurbitaceae) is found growing naturally at two location inside the North Bengal University campus in Darjeeling district. Earlier, it was considered as endemic to South India and was recorded from Karnataka and Tamil Nadu (Chakravarty 1982). So, it is the first record of the species from Eastern India (Darjeeling).

9.13 RECORDS OF NEW CLIMBING TAXA:

From the present survey only one new taxa (***Synotis sikkimemsis*** A P.Das and A.K.Samanta of Asteraceae) have been recorded from Sikkim. It's distinguishing characters, detailed description and drawings have been provided in the enumeration (Chapter-3). The species is closely related to *Synotis tetrantha* (DC.) C. Jeffrey et Y.L. Chen and the new species can be distinguished from this as shown it in table 9.16.

Table: 9.16 Comparision between *S. sikkimensis* and *S. tetrantha*

S. sikkimensis	*S. tetrnatha*
1. Stem 2-rjdged, remains green.	1. Stem terete, turns whitish with maturing.
2. Base of lamina generally equal, deeply cordate with broadly apart rounded to slightly hastate lobes.	2. Base of lamina oblique, shallowly cordate and attenuate with the petiole
3. Margin of lamina regular or sometimes slightly wavy, obscurely creanate, mucro longer (0.01-0.05cm) in the sinus of crenatures.	3. Margin of lamina irregularly dentatoserrate, mucro on tips of teeth smaller (0.01-0.05 cm).
4. Panicles sparse, main rachis zig-zig, each capitulum distinctly stalked, bracts and bracteols prominent, longer	4. Panicles dense, thyrsoid, main rachis straight, capitula densely aggregated on branches bracts and bracteols minute.
5. Length/breath of capitula c 1.7 x 0.35 cm	5. Length/breath of capitula c 0.35 x 0.23 cm long.
6. Involucral bracts c 1.2 cm long.	6. Involucral bracts c 0.35 cm long
7. Bristles of pappus 0.6-0.9 cm long, white.	7. Bristles of pappus 0.25-0.4 cm long, reddish-brown.
8. Achenes cuspidate-obovate, glabrous.	8. Achenes cylindric, puberulous

9.14 PLANTS OF BOTANICAL INTEREST:

Records of climbers from an widely distributed taxa and wide variety of character-composition. During the process of evolution many plants have developed some interesting features or structures to which a student of Botany might be interested. Following are some such examples:

Aristolochia spp: Gamopetalous flowers of these plants are quite interesting. The tube and lobes having different unique shapes and sizes. There are some downwardly projecting hairs inside the tube which permits an interest to move in but defy its exist. The insect, while moving inside the tube perform pollination and get released only after the rejection of perianth.

Asparagas racemossus: Terminal branches generally produce a branch of slender leaf-like structures. Morphologically each cladode is representing one internode. The genus do not produce normal leaf and cladodes function as leaves.

Bauhinia scandens: The zigzag old stem of this species looks like a moving snake. Here the secondary growth is anomalous when much more vascular tissue is

produced towards two margins and the stem bends at subsequent nodes in opposite directions (Photo-52).

Calamus flagellum: Whip like prickly leaf-sheath is one interesting structure, helps in climbing and is unique for the genus.

Cardiopermum halicacabum: The species is a twiner but lowemost pair of pedicel become sterile and produce a loose tendril of one and half coils.

Ceropegia spp: The corolla along with its corona produce quite interesting structure in this genus. Tips of petal lobes remain united at tip which is mainly responsible for producing these peculiar shapes. While in *C. longifolia* it is a short conical structure, in *C. pubescens* it is a slender elongated beak like structure.

Clematis spp, Naravelia zeylanica: 9 species of *Clematis and N. zeylanica* recorded this region and representing the presence of climbing habit in Ranunculaceae which is accepted as a very primitive taxon. Taxonomists also believe that climbing is a derived habit in plants (Hutchinson 1973). These plants are also interesting for some other reasons.The persistent and enlarged feathery style attached to the achenes (in eterios) for fruit dispersal is one interesting structure for the students of Botany. The tendril like behaviuor of petiole and petiolule, suppression of petals in *Clematis*, etc. are characters of botanical interest.

Cissus javana: Its variegated leaves attractive and is of ornamental importance, besides modification of apical shoot into tendril which is pushed to the lateral position due to stretching of the lateral shoot, is also one botanically interesting structure.

Combretum roxburghii: In flowering shoot there are one-two types of bracts of which some are larger leafy but entirely white (i.e. petaloid). Their petaloid bracts help its minute flowers by attracting the pollinators.

Cuscuta sinensis and ***C. reflexa***: These are obligate stem parasite collect their food from host with the help of numerous haustoria. Plants are yellow to golden yelloew to orange in colour, produce sticky seeds.

Deeringia amaranthoides and ***Stilbanthus scandens***: These are representing two climbing genera from the main herbaceous family Amaranthaceae

Dioscorea spp: All of the recorded 14 spp of the genus produce bulbils by modifying their axillary buds and acts as very good propagule.

Entada rheedii: Giant pods in this species are referred as longest-fruits in natural condotions. Its seeds are also quite large (3.5-5.0cm in diam).

Holboellia latifolia : Belongs to a very primitive climber family, Lardizabalaceaea which is very close to Ranunculaceae and Berberidaceae. Here the flowers are monochlamydeous with few free carpels.

Holmskioldea sanguinea: Conical, hat like coloured calyx is quite interesting looking which work together the corolla to attract the pollinator.

Lathyrus aphaca: Here the entire leaf modified into an unbranched tendril a function of leaf is taken over by large foliaceous stipule.

Mucuna prurita: Calyx and fruits are covered with extermely irritating stringing hairs.

Passiflora spp : Numerous long and coloured extrastaminal corona. presence of gynophore gives pecularity to these plants. In *P. foetida* sepals are much branched net like structures and the terminal segments bearing sticky glands. Fruits remain covered with such persistent calyx.

Rubia spp and ***Galium spp***: 3 species of Rubia and 3 species of *Galium* recorded here, bear leaflike structure in whorls of which only two are leaves (bearing axillary buds) and the rest are modified leafy stipules.

Schisandra spp and ***Kadsura heteroclta*** : 3 species of *Schisandra* and one species of *Kadsura* recorded here belonging to the primitive Schisandraceae which was previously included under Magnoliaceae (s.l.). Though a very primitive family but its members are all climbers. Elongated etario of drupes developed from its apocarpus pistil is also interesting.

Sechium edule: Fruits of this plant are single seeded (in Cucurbitaceae!) and on maturity, sometimes its tip opens thereby seeds become visible from outside. Another interesting phenomena in the occurrence of vivipary.

Smilax spp: Stipules in most of the genus (*Smilax*) have been modified into tendrils. It is one specialised structure analogus to climbing organs.

Solanum jasminoides: A climbing species of Solanaceae where petiole coils round a support (like tendril) for moving upwards.

Tinospora cordifolia: Arerial roots developing from different parts of stem and very long slender thread like, sometimes upto 12m long.

Thunbergia spp : It is the only climbing genus in Acanthaceae.

Tripterospermum volubile: Fruits in this family generally are septicidal capsules. In *Tripterospermum* fruits are berry like.