

CHAPTER VII

ANALYSIS OF THE FLORA

"I know nothing of the kind that exceeds in beauty the flowering branch of *Rhododendron argenteum* with its wide spreading foliage and glorious mass of flowers ..."

- J.D. Hooker (1854)

The floristic richness is adjudged not only by the numerical value of different plant species in existence but also by the representation of different plant forms and their mode of living and the resultant habitat conditions. The Darjeeling region of Eastern Himalayas is floristically counted as one of the richest in India and has attracted the botanists and naturalists from throughout the world. The present survey on the **Dicotyledonous Flora of Darjeeling** confirms the floristic diversity and richness of the district. The survey has recorded 1877 species (including varieties) of dicotyledonous Angiosperms under 159 families and 772 genera (excluding the species restricted to cultural conditions, Table 7a).

Table 7a. Angiospermic dicotyledons of Darjeeling district

Dicotyledonous Plants	Numbers
Families	159
Genera	772
Species (and varieties)	1877

The vegetation of this district has been dominated by the dicotyledonous angiosperms, a fact observed in any part of the world. Previous studies on the flora (Hooker 1872-1896, Hara *et al.* 1966, 1971; Ohashi 1975, Yonzone 1976, Das 1987) and the present records reveal the monocot-dicot ratio of the flora to be approximately 1:2.5.

The comparative study of the dominant dicot families throughout the district shows that Leguminosae (subfamilies treated together) occupies the first position while Acanthaceae is the tenth among dominant dicot families (Table 7b).

Table 7b. Ten dominant families of the district

Sl.No.	Families	No. of species
1.	Leguminosae.	131
2.	Compositae	110
3.	Euphorbiaceae	77
4.	Rubiaceae	76
5.	Rosaceae	74
6.	Urticaceae	58
7.	Labiatae	56
8.	Scrophulariaceae	44
9.	Lauraceae	41
10.	Acanthaceae	39

Considering the wide range of altitudinal variation, it was essential to take up the flora from an altitude of 140m to 4000m, in the present study. It is observed that the rank of a family in the list of dominance differ from temperate to subtropical zones. The variation in the distribution and dominance of a family as per altitude and climatic conditions is clear from following observations (Table 7c and 7d). Covering both dicot and monocot families of the region J.D. Hooker (1907) made the following observation (Table 7.c):

Table 7c. List of Ten dominant families (dicot & monocot) as per J.D. Hooker (1907)

Sl.No.	Temperate zone	Sl.No.	Tropical zone
1.	Orchidaceae (1)	1.	Orchidaceae
2.	Compositae (8)	2.	Leguminosae
3.	Gramineae (3)	3.	Gramineae
4.	Rosaceae	4.	Urticaceae
5.	Cyperaceae (6)	5.	Euphorbiaceae
6.	Geraniaceae	6.	Cyperaceae
7.	Ericaceae	7.	Rubiaceae
8.	Liliaceae	8.	Compositae
9.	Labiatae	9.	Asclepiadaceae
10.	Umbelliferae	10.	Acanthaceae

(Figures in the bracket refer to their relevant position in tropical region)

In the present study of Angiospermic dicotyledons, a comparative study between temperate (including subalpine) zone and subtropical (including tropical and plains) zone (Table 7d) shows that Compositae is the most dominant family in the temperate zone, while Leguminosae dominates the counterzone. This position stands true to the study of J.D. Hooker (1907), but all the other families except Rosaceae which immediately follows compositae, show a change of position in the list of dominance in the present study. Family Labiatae ranks third above Ericaceae (4th) in the temperate zone, while Ranunculaceae, Urticaceae, Rubiaceae, Scrophulariaceae, Lauraceae and Leguminosae find their new entry to the zone. In the tropical zone, family Compositae occupying 8th position in Hookers table ranks second. This is followed by Euphorbiaceae, Rubiaceae, Urticaceae, Labiatae, Verbenaceae, Lauraceae, Acanthaceae and Rosaceae, all with their positions changed. The families Verbenaceae, Labiatae and Lauraceae are the new entries. The family Asclepiadaceae is outranked from the list of dominants. The families Geraniaceae and Umbelliferae do not enter this table and, this is especially so, because the families since then, have been broken to a number of smaller families.

Table 7d. Comparative study of Ten dominant families in the Temperate and Subtropical Zone

TEMPERATE ZONE

Sl.No.	Family	No. of spp. in the zone to zone only	No. of spp restricted both zones	No. of spp. common to counterzone	Their relevant position in
1.	Compositae	77	31	46	2nd
2.	Rosaceae	67	45	22	10th
3.	Labiatae	43	22	21	6th
4.	Ericaceae	33	31	2	--
5.	Ranunculaceae	33	30	3	--
6.	Urticaceae	33	13	20	5th
7.	Rubiaceae	31	11	20	4th

8.	Scrophulariaceae	25	16	9	--
9.	Lauraceae	20	9	11	9th
10.	Leguminosae	20	7	13	1st

SUBTROPICAL ZONE

1.	Leguminosae	111	98	13	10th
2.	Compositae	75	29	46	1st
3.	Euphorbiaceae	74	65	9	--
4.	Rubiaceae	62	42	20	7th
5.	Urticaceae	43	23	20	6th
6.	Labiatae	35	14	21	3rd
7.	Acanthaceae	34	27	7	--
8.	Verbenaceae	32	30	2	--
9.	Lauraceae	31	20	11	9th
10.	Rosaceae	25	3	22	2nd

It is noteworthy that the table of overall consideration displays a mixed picture of families phylogenetically. The families Lauraceae, Euphorbiaceae and Urticaceae form one group and the families Leguminosae and Rosaceae form the second group. Rubiaceae, Labiatae, Scrophulariaceae and Acanthaceae form a third group while Compositae stands alone in the line of phylogenetic considerations. In the temperate zone dominant families are phylogenetically in advanced ranks with compositae at its top. The subtropical zone again shows a representation 50% advanced families with compositae in second position after Leguminosae.

Taking habit groups into consideration, the flora of the district within 1877 dicots, is equally represented by herbs, shrubs, trees, and climbers, a condition favoured by the climate and geography. In terms of conspicuousness the trees are followed by shrubs but often the lianas such as *Entada rheedii* ssp. *sinohimalensis*, *Bauhinia vahlii*, *Mucuna* spp., *Cissus* spp., *Ampelocissus* spp., *Ichnocarpus frutescens*, and *Chonemorpha fragrans* outwit the shrubs and trees with their majestic overhangings, leaving the ground cleared for the herbs. Subalpine meadows and semi-savannah areas are dominated by herbs and grasses. The common weeds such as *Eupatorium adenophorum*, *Ageratum conyzoides*, *Lantana camara*, *Borreria repens* spread out rapidly in open areas often making difficult for other plant forms to settle.

Leguminosae is an equally represented family by herbs, shrubs, trees and climbers (annuals and perennials, including liana). The ecological amplitude of these plants are also very broad. There are many suffrutescent herbs and climbers, the aerial parts of which die down to perenniating bulbs or roots during winter and hot summer. Compositae is dominated by herbs with three climbers and four shrubby trees. Euphorbiaceae is represented dominantly by shrubs and trees. It is represented by 3 herbs, 32 shrubs and 42 trees. Rubiaceae is represented by 25 herbs, 28 shrubs, 1! climbers and 12 trees. The families Labiatae and Scrophulariaceae are totally dominated by herbs (except one tree in each); where as Lauraceae shows a dominance of trees to 100%. The primitive family Ranunculaceae exhibits 22 herbs and 10 climbers. (Table 7e):

Table 7e. Comparative Life form Observation on 11 dominant families

Sl.No.	Families	Trees	Shrubs	Climbers	Herbs
1.	Compositae	4	13	3	89

2.	Leguminosae	26	39	42	24
3.	Rubiaceae	12	28	11	25
4.	Rosaceae	20	21	16	17
5.	Acanthaceae	--	20	5	14
6.	Ericaceae	13	20	--	--
7.	Lauraceae	41	--	--	--
8.	Labiatae	1	1	--	54
9.	Scrophulariaceae	1	--	--	43
10.	Urticaceae	4	27	--	27
11.	Euphorbiaceae	42	32	--	3

The dominating species population of the flora are mostly represented by temperate or sub temperate families as exemplified by Compositae, Rosaceae, Ericaceae, Labiatae, Scrophulariaceae, Urticaceae, Rubiaceae, Ranunculaceae, Lauraceae, Primulaceae and Caryophyllaceae.

Out of 772 dicotyledonous genera of the district the dominant or better represented are shown in Table 7f. The most dominant genus is *Impatiens* with its poor representation in subtropical zone, while second in the rank *Ficus*, is contrastingly dominant in lower hills and plains. A number of genera such as *Desmodium*, *Rubus*, *Litsea*, *Elatostema*, *Begonia* show their uniform distribution throughout the hills. In this consideration *Rhododendron* is a complete temperate genus when *Glochidion* and *Boehmeria* are subtropical genera (Table 7f):

Table 7f. Dominant Dicotyledonous Genera in flora of Darjeeling district

Sl.No.	Genera	Families	No. of species
1.	<i>Impatiens</i>	Balsaminaceae	28
2.	<i>Ficus</i>	Moraceae	25
3.	<i>Rubus</i>	Rosaceae	21
4.	<i>Rhododendron</i>	Ericaceae	21
5.	<i>Persicaria</i>	Polygonaceae	16
6.	<i>Begonia</i>	Begoniaceae	16
7.	<i>Desmodium</i>	Leguminosae	15
8.	<i>Elatostema</i>	Urticaceae	15
9.	<i>Pilea</i>	"	12
10.	<i>Litsea</i>	Lauraceae	11
11.	<i>Glochidion</i>	Euphorbiaceae	11
12.	<i>Boehmeria</i>	Urticaceae	11

The floristic elements of Darjeeling display an interesting picture . The study records show that 607 dicot species are truly Himalayan. Among the major representations 518 species are Sino-Himalayan and 302 species are South East Asian and Malaysian. However, the dicot flora harbours the Indian (119 spp.), Central Asiatic (11), Eurasian (27), Afro-Asiatic (69), American (57), Australian (86) and Japanese (149) elements including the exotic species. There are 33 plants of cosmopolitan and 48 plants of pantropic distributions.

There are exotic plants from different countries such as N. America, China, Japan, Australia,

Africa, Mexico, W. Indies and S. America. 29 species are endemic to Darjeeling, 29 to Darjeeling-Sikkim and 144 to Eastern Himalayas alone. More than 700 wild dicots are found to be of economic value that are used as medicine, timber, household purposes or possess edible or ornamental plant parts. Among 156 plants found to be threatened 15 are endangered. The new distributional records have been made for 24 plants while 5 species nova, 71 variety nova and 2 forma nova have been added to the dicotyledonous flora of Darjeeling.

7.1. FORMS OF PLANTS

The forests and the flora of Darjeeling is not an exception to the increasing human interference. Human interference has adversely effected the natural habitat conditions of plants and animals in the Himalayas, while in many areas natural forest vegetation has been turned to monoculture plantation forests. Formation of colonies for human settlements and clear felling for forest villages, has also been exercised. Several places, suitable for plants and animals habitat has also been destroyed in the process and the whole corpus of knowledge and informations on ecology and natural history lost.

The floristic appearance does not remain the same as described by Hooker (1854). Yet, the richness of the flora is naturally preserved rather than degraded. The diversity in habitat, presence of a large number of species and display of all forms of habit in the flora stand for the positive remarks (Table 7.1).

Table 7.1. Different Plant Forms in the Dicotyledonous Flora of Darjeeling District

	Plant forms	Mode of living	No. of species	% of the total dicot species
HABIT-WISE	Herbs		732	38.99
		Annuals	377	20.08
		Perennial & Geophytes.	355	18.91
	Shrubs		351	18.70
	Climbers		310	16.51
		Twiners	120	6.39
		Tendril Climbers	57	3.03
		Root Climbers & Epiphytic Climbers	18	0.95
		Shrubby (Scandent)	115	6.12
	Trees		463	24.66
HABITAT-WISE		True Autophytes (Terrestrials)	1171	94.35
		Epiphytes	63	3.35
		Parasites	22	1.17
		Saprophytes	2	0.10
		Hydrophytes	19	1.01

The analysis in the Table 7.1 shows that herbaceous plants are present in higher proportion, almost double than the shrubs, trees and climbers. Representation of epiphytes is remarkable; parasite and hydrophytes have a low representation but show their distinction; while lowest representation is given by saprophytes (2 species).

HABITAT GROUPS

7.1.1 HERBS

With 38.99% of representation the herbs (including geophytes) show a much higher proportion than the other plant forms. Out of 732 herbs, 377 are annuals (20.08%) and 355 (18.91%) are perennials (including geophytes). In this respect the annual and perennial herbs almost have a coinciding degree of representation. The herbaceous flora form a ground cover throughout the district in open places and forests. Majority of the herb population prefer to grow as heliophytes. Shade loving plants (sciophytes) are common on forests and shady slopes facing north (to the Himalayas). But the heliophytes have been found to grow equally well in shades and north facing hills.

Some of the common herbs of the region are *Capsella bursa-pastoris*, *Viola diffusa*, *Stellaria media*, *Impatiens balsamina*, *Oxalis corniculata*, *Borreria repens*, *Ageratum conyzoides*, *Erigeron karvinskianus*, *Galinsoga parviflora*, *Spilanthes calva*, *Gentiana capitata*, *Solanum nigrum*, *Leucas cilita*, *Elsholtzia* spp., *Phyllanthus urinaria*, *Croton bonplandianus*, *Rumex nepalensis*, *Persicaria runcinata*, *Amaranthus viridis* (all annuals) and *Meconopsis napaulensis*, *Sida cordata*, *Desmodium* spp., *Begonia palmata*, *Heracleum nepalense*, *Galium elegans*, *Ophiorrhiza nutans*, *Eupatorium adenophorum*, *Ainslea aptera*, *Chirita macrophylla*, *Didymocarpus* spp., *Plantago erosa*, *Achyranthes aspera*, *Elatostema* spp. (perennials). Some of the common sciophytes are *Ranunculus diffusus*, *Corydalis chaerophylla*, *Viola biflora*, *Drymaria villosa*, *Impatiens* spp., *Boenninghausenia albiflora*, *Saxifraga strigosa*, *Drosera burmannii*, *Begonia dioica*, *Hydrocotyle nepalensis*, *Panax pseudoginseng* (all vars and forms), *Swertia chirayita*, *Loxostigma griffithii*, *Chirita urticifolia*, *Ajuga lobata*, *Notochaete hamosa*, *Pilea ternifolia*. The common hydrophytes are *Hydrobryum griffithii*, *Callitriche stagnalis*, *Utricularia aurea*, *Nymphoides hydrophyllum*, *Limnophila repens*.

The annuals among herbs exceed in number the other habit groups. The hilly terrains with poor water retention capacity has a bearing to this, but the humidity, monsoon rain and climatic conditions have favoured the perennials and geophytes to inhabit this region equally and profusely.

7.1.2 SHRUBS

The shrubs have dominated the landscape in subalpine region, fringe areas and damaged open forest lands. Shrubs prefer to grow as heliophytes. But their presence in the deep forests are not uncommon.

With 351 dicot species, the shrubs form the 18.70% of the dicot flora. Some of the common shrubs of open areas are *Berberis angulosa*, *Mahonia napaulensis*, *Leea guineensis*, *Rosa sericea*, *Desmodium* spp., *Butea buteiformis*, *Rubus ellipticus*, *Osbeckia stellata*, *Woodfordia fruticosa*, *Viburnum erubescens*, *Musaenda treutleri*, *Alstonia neriifolia*, *Eupatorium odoratum*, *Tithonia diversifolia*, *Maesa japonica*, *M. chisia*, *Cestrum aurantiacum*, *Daphne bholua*, *Ipomoea carnea*, *Antidesma acidum*, *Girardiana diversifolia*, *Boehmeria macrophylla*, *Lantana camara*, *Rhododendron cinnabarinum*, *R. wallichii*. The forest undergrowths have a good number of shrubs in them. The shrubs of the forests are *Hypericum hookerianum*, *Zanthoxylum acanthopodium*, *Skimmia laureola*, *Euonymus frigidus*, *Dobinea vulgaris*, *Neillia rubiflora*, *Astilbe rivularis*, *Hydrangea heteromalla*.

Oxyspora paniculata, *Aralia armata*, *Helwingia himalaica*, *Viburnum mullaha*, *Leycesteria formosa*, *Vaccinium retusum*, *Maesa rugosa*, *Phlogacanthus thyrsoiflorus*, *Edgeworthia gardneri*, *Ballospermum calycinum*, *Trema tomentosa*, *Flueggea virosa*.

The shrubs of the deep forests are generally protected and grow in a more natural environment. The shrubs already having a low height when growing in the open and fringe areas are prone to interference by men and domestic animals. Therefore, the open forests need a protection for the shrubs to establish and form shrubland. However, the herbaceous flora get a better protection under shrubs and formation of associations with them is a common picture.

7.1.3 CLIMBERS

The diversity in habit structure, habitat adaptation, mode of growing (climbing) and the degree of flexibility of stem have rendered the climbing plants constitute a distinct form of plant kingdom. The climbers rather need an elaborate and separate treatment on such studies in greater details. The present study has given a partial treatment in this line.

There are 310 angiospermic dicot climbers in the district forming 16.51% of total dicots. In the first place climbers can be classified to Herbs, Shrubby climbers and Liana. In this treatment there are 24 herbaceous climbers (including geophytes), 129 shrubby climbers and 155 lianes. According to the mode of climbing they are classified again as Twiner, Tendril climber, Root climber, Scandent climber and Epiphytic climber (Table 7.2).

Table 7.2. Climbing Dicotyledons of Darjeeling district

		Forms	No. of Species	% of Dicot flora	% of total Dicot climbers
CLASSIFICATION	Habit	a. Herbaceous	24	1.27	7.74
		b. Shrubby	131	6.97	42.25
		c. Liana	155	8.25	50.00
	Mode of Growth	a. Twiner	120	6.39	38.70
		b. Root climber	12	0.63	3.87
		c. Tendril climber	57	3.03	18.38
		d. Scandent	117	6.23	37.74
		e. Epiphytic	4	0.21	1.29

A. Herbaceous Climbers

7.74% of climbing plants and 1.27% of the dicots are herbaceous climbers. These forms are dominated by geophytes with perennial rootstock. However, representation of annual herb climbers are not uncommon. The common herbaceous climbers are *Dicentra scandens*, *Shuteria involucrata*, *S. hirsuta*, *Vigna umbellata*, *Vicia hirsuta*, *Persicaria perfoliata*, *Paederia foetida*, *Hedyotis scandens*, *Codonopsis affinis*, *Ceropegia pubescens* and *Tripterospermum volubile*.

B. Shrubby Climbers

The dicotyledonous shrubby climbers of the district amount to 131 which in turn is the 6.97%

of total dicots and 42.25% of the climbing dicots. Shrubby climbers have formed several dominant patches in the temperate region of the hills.

The common plants are *Schizandra grandiflora*, *Kadsura heteroclita*, *Actinidia callosa*, *Zanthoxylum oxyphyllum*, *Mimosa himalayana*, *Dalbergia pinnata*, *D. latifolia*, *Rubus acuminatus*, *R. paniculatus*, *R. splendidissimus*, *R. calycinooides*, *Combretum decandrum*, *Schefflera bengalensis*, *Aconogonum molle*, *Hydrangea anomala*, *Senecio scandens*, *Homskioldea sanguinea*, *Elaeagnus pyriformis*, *Croton caudatus*, *Desmodium heterophyllum*, *Lonicera lanceolata*, *Leycesteria formosa*, *Rosa roxburghii*, *R. macrophylla*.

C. Lianes

The common among the forms of climbers in the district are the Lianes, which constitute 50% of the total dicot climbers and 8.25% of the dicots. From deep forests, margin and fringe areas to river banks, their occurrence is common throughout the district. The common examples are *Clematis napaulensis*, *C. buchananiana*, *Ampelocissus barbata*, *Parthenocissus semicordata*, *Tetrastigma bracteolatum*, *Cissus javana*, *C. repanda*, *Tinospora cordifolia*, *Stephania glabra*, *Cissampelos pareira*, *Holboelia latifolia*, *Trichosanthes cordata*, *T. truncata*, *Zehneria indica*, *Edgaria darjeelingensis*, *Argyrea atropurpurea*, *A. roxburghii*, *Porana grandiflora*, *Milletia extensa*, *Mucuna macrocarpa*, *M. pruriens*, *Bauhinia vahlii*, *Entada rheedii* ssp. *sinohimalensis*, *Rubia manjith*, *Thunbergia fragrans*, *T. coccinea*, *Mikania micrantha*, *Ichnocarpus frutescens*, *Chonemorpha fragrans*.

More interesting field on the study of climbing plants is the mode of their climbing. In a broad consideration, the following types are recognised:

a. Twiners

The twining plants simply take on the host by their stem wiring around upwards, in dextrose or sinistrose mode. They do not possess special organs for climbing. In the present floristic analysis there are 120 dicot twining plants in the district constituting 6.39% of dicots and 38.70% of dicot climbers.

Some of the twiners are *Dicentra scandens*, *Pueraria peduncularis*, *Vigna umbellata*, *Uvaria hamiltonii*, *Celastrus monospermus*, *Pericampylos glaucus*, *Cissampelos pareira*, *Holboelia latifolia*, *Paederia foetida*, *Hedyotis scandens*, *Ceropegia pubescens*, *Rubia manjith*, *Argyrea* spp., *Porana grandiflora*, *Mucuna* spp., *Thunbergia* spp., *Mikania micrantha*, *Codonopsis* spp., *Aristolochia* spp.

b. Root Climbers

The root climbers are represented by 12 plants only, constituting 0.63% and 3.87% of dicots and dicot climbers respectively. The special organ for climbers of this category are the roots which spread over the host, providing the plant an easy dependence. The root climbers are *Hedera nepalensis*, *Piper chuyva*, *P. suipigua*, *P. attenuatum*, *P. khasianum*, *P. longum*, *P. pedicellatum*, *Ficus pubigera* var. *maliformis*, *F. hederacea*, *Broussonetia kurzii*, *Hoya fusca* and *H. globulosa*.

c. Tendril Climbers

Modification of more than one plant part into a special climbing organ (tendril) are important part of life of these climbers. This modification again invites for an elaborate study on its own, for its variation and complexity showing way to further classifications. However, on a broad treatment there

are 57 dicot tendrill climbers (3.03% of dicots and 18.38% of dicot climbers). The families Leguminosae, Cucurbitaceae, Vitaceae, Ranunculaceae and Passifloraceae are the only 5 families which have contributed to this category of climbing plants. The following are the examples; *Passiflora geminiflora*, *Ampelocissus barbata*, *A. sikkimensis*, *Parthenocissus semicordata*, *Tetrastigma serrulatum*, *T. rumicispermum*, *Cissus repanda*, *C. assamica*, *Mukia maderaspatana*, *Hodgsonia macrocarpa*, *Herpetospermum pedunculatum*, *Coccinea grandis*, *Edgaria darjeelingensis*, *Clematis montana*, *C. smilacifolia*, *C. b Buchananiana*, *C. connata*, *Shuteria hirsuta*, *Vigna umbellata*, *Dunbaria circinalis*.

d. Scandent Climbers

Most of the shrubby climbers fall in this category. 117 species constituting 6.23% of dicots and 37.74% of dicot climbers have been recorded here. The common examples are *Schizandra grandiflora*, *Capparis olacifolia*, *Celastrus paniculatus*, *Hibiscus fragrans*, *Actinidia strigosa*, *Caesalpinia cucullata*, *Acacia pennata*, *Rubus calycinoides*, *R. efferatus*, *Combretum decandrum*, *Hydrangea anomala*, *Embelia ribes*, *Jasminum nepalense*, *Senecio scandens*, *Elaeagnus conferta*, *Leycesteria formosa*, *Homskioledea sanguinea*.

e. Epiphytic Climbers

Since a number of epiphytic plants establish themselves as independent, in later life their exact classification is difficult. However, in this flora some epiphytic climbers which are shrubby and scandent in habit have been recorded. These climbers are *Schefflera impressa*, *S. elata*, *Hoya fusca*, *H. globulosa*, the last two species being root climbers.

The climbers, in this region have often reached a degree to form dominant canopy over small trees and bushes, especially in uninterferred forests. Of the climbers, the lianes are the dominant forms with higher percentage of representation in one hand and conspicuousness of appearance in the forests, in the other. Shrubby climbers follow the lianes immediately in number of representing species but their frequency is observed in thinner forests and open slopes. Considering the mode of climbing the twiners outcast the other forms, while scandent forms follow the twiners immediately. The presence of root and epiphytic climbers, although in a small proportion, have represented the climbing flora of the region significantly.

7.1.4 TREES

A total of 463 tree dicot species have been recorded in the district which happens to be 24.66% of the dicot flora. Since there are only a few trees in the Molecotyledons and Gymnosperms flora, the overall number of trees in the district would not exceed 500. Except in the subalpine meadow, savannah/grasslands, agricultural and inhabited villages, the trees form the **climax** vegetation in the areas under forests. The tree flora form the distinct canopy in the mountaineous land scape. Therefore, to a common man, as what it appears to be, the forest means the trees, no matter what the ecological status inside it, speaks of Some of the common tree species of the district are *Dillenia pentagyna*, *Michelia champaca*, *Magnolia campbellii*, *Alcimandra cathcartii*, *Schima wallichii*, *Saurauja napaulensis*, *Shorea robusta*, *Bombax ceiba*, *Sterculia villosa*, *Elaeocarpus lanceifolius*, *Ailanthus integrifolia*, *Garuga floribunda*, *Toona ciliata*, *Chukrasia tabularis*, *Ilex godajam*, *Acer hookeri*, *A. campbellii*, *Meliosma pinnata*, *Exbucklandia populnea*, *Syzygium spp.*, *Terminalia bellirica*, *T. chebula*, *Rhus succedanea*, *Choerospondias axillaris*, *Acrocarpus fraxinifolius*, *Bauhinia purpurea*, *Albizia spp.*, *Erythrina stricta*, *Prunus cerasoides*, *P. napaulensis*, *Sorbus spp.*, *Cotoneaster frigidis*, *Eriobotrya*

petiolata, *Duabanga grandiflora*, *Gynocardia odorata*, *Tetrameles nudiflora*, *Brassaiopsis* spp., *Alangium chinense*, *Anthocephalus chinensis*, *Wendlandia exserta*, *Rhododendron arboreum*, *Lyonia ovalifolia*, *Aesandra butyracea*, *Symplocos* spp., *Phoebe lanceolata*, *Beilschmiedia roxburghiana*, *Cinnamomum glaucescens*, *C.glanduliferum*, *Persea fructifera*, *P.glaucescens*, *Lindera heterophylla*, *Litsea* spp., *Bridelia verrucosa*, *B.retusa*, *Oroxylum indicum*, *Stereospermum chelonoides*, *Glochidion acuminatum*, *G. hirsutum*, *Ostodes paniculatus*, *Mallotus philippensis*, *M.tetracoccus*, *Macaranga indica*, *M.pustulata*, *Premna bracteata*, *P.bengalensis*, *Callicarpa vestita*, *Gmelina arborea*, *Cellis tetrandra*, *Ficus* spp., *Artocarpus lacucha*, *Morus macroura*, *Engelhardtia spicata*, *Betula alnoides*, *B.utilis*, *Alnus nepalensis*, *Quercus glauca*, *Q.lamellosa*, *Lithocarpus elegans*, *Castanopsis indica*, *C. tribuloides*, *C. hystrix*, *Populus gamblei*, *Salix tetrasperma*. (Note: The species in bold prints denote their dominant status. These species form associations at different altitudinal ranges, with other trees. The Coniferous-Rhododendron association is found only in higher temperate and subalpine belts).

A number of trees have been found to be threatened by biotic and abiotic factors in the region while some are already growing rare. The species like *Mesua ferrea* (Jaldhaka), *M.floribunda* (Rongong-Endangered), *Magnolia globosa* (Tonglu), *M. pterocarpa* (Nazoke), *Elaeocarpus sphaericus* (Kalimping), *Canarium strictum* (Panbu), *Sapindus mukorosi* (Guling), *Sorbus microphyllus* (Phalut), *Benthamidia capitata* (Meghma), *Rhododendron decipiens* (Kalapokhari), *R.campylocarpum* (Rachela), *R.thomonii* (Sandakphu), *R.maddenii* (Rachela), *R.triflorum* (Gosha), *R.anthopogon* (Gosha), *R.vaccinioides* (Shrub-Pankhasari), *Symplocos pyrifolia* (Pankhasari), *Callicarpa rubella* (Guling), *Premna interrupta* (Domsang), *Cinnamomum tenuipilis* (Singringtam), *Lindera hamiltonii* (Takdah), *Olea dioica* (Gorubathan), *Macaranga gamblei* (Bamunpokhari), *Ficus racemosa* (Kumai), *Boehmeria rugulosa* (Yangmakum), *Juglans regia* (Sukia Pokhari), *Quercus acutissima* (Peshok), *Cotoneaster sandakphuensis* (Sandakphu), have been found to be under threat, in this region.

Some of the forest areas have been clearfelled and developed to monoculture forest. The planted trees have, of course, become economically important. But as far as the hilly terrains are concerned, some tree species like, *Cryptomeria japonica*, *Tectona grandis*, *Shorea robusta* in particular and others in general have ecologically become harmful to the soil and for that matter, to the natural undergrowth. Planted forests are always characterised by the absence of herbs, shrubs or climbers. This is especially so because in contrast to the natural forests the planted forest trees leave enough gap at their height letting the monsoon rain droplets directly hit the ground soil and wash away the soil parts disturbed thereby. As a result, a hard soil surface develops and in the process, prohibits any future seeds to germinate. In case of *Cryptomeria japonica* and *Pinus* spp. secretion of allelopathic acid (Basu 1986) from their roots which are harmful to soil and ground vegetation, have been reported. In this manner the planted forest have their own ecological desert under them. This kind of forest, I feel, should not be encouraged in the mountainous regions, but may rather be restricted to cultivated lands under farm forestry programmes.

7.2 HABITAT GROUPS

It will be appropriate to say that the district of Darjeeling has a suitable home for epiphytes, parasites and saprophytes to thrive. However, 94.35% of the dicot flora comprise of terrestrial true autophytes (numbering 1771 species). 106 dicot species have adapted themselves to the other special habitats (Table 7.1).

7.2.1 Epiphytes

In the dicotyledonous flora there are 63 epiphytic species, forming 3.35% of the total dicots. In an advantage provided by the climatic and edaphic conditions the epiphytes again show a diverse range of habit and habitat. Different forms of epiphytes such as herbs, shrubs, climbers and trees have been recorded in the flora. Epiphytes may again be true or false. The true epiphytes always need a host on which they begin and complete their life cycle and do not destroy or overcast the host. But the false epiphytes grow on the selective hosts as epiphytes in the beginning (young plants) and establish themselves as independent form, later sending their roots directly to the ground through host plants. In the process they also overtop the crown of the host or even destroy them. More often, false epiphytes grow on the soil itself directly without showing any epiphytic character throughout their cycle (Table 7.2.1).

Table 7.2.1 Dicotyledonous Epiphytic flora of Darjeeling District

	Forms	No. of species	% of Epiphytes	% of total dicots
HABIT	Herbs	7	11.11	0.37
	Shrubs and Climbing	42	66.66	2.23
	Trees	14	22.22	0.74
NATURE	True Epiphytes	31	49.20	1.65
	False Epiphytes	32	50.79	1.70

The herbaceous epiphytes are *Peperomia heyneana*, *P.tetraphylla*, *Pilea approximata*, *P.ternifolia*, *Begonia gemmipara*, *Reinwardtia cicanoba* and *R.indica*. These herbs are true epiphytes yet owing to their greater distributional criteria they can also grow on humus soil.

The shrubby epiphytes have a higher proportion (66.66%) among epiphytes. The examples are *Hymenopogon parasiticus*, *Himenodictyon excelsum*, *Piper peepUloides*, *Lysionotus atropurpureus*, *Vaccinium vacciniaceum*, *Agapetes serpens*, *A. sikkimensis*, *Rhododendron edgeworthii*, *R.vaccinioides*, *Hoya* spp., *Aeschynanthus* spp.(all spp. of the district). The climbing epiphytes are *schefflera bengalensis*, *Ficus hederacea*, *Hoya fusca*, *H.globulosa*.

The epiphytic trees are mostly false epiphytes. The common examples are *Wightia speciosissima*, *Ficus rumphii*, *F.drupacea*, *Aralia armata*, *Heteropanax fragrans*, *pentapanax fragrans*, *P.racemosus*, *Schefflera impressa*, *Macropanax dispersmus*, *M. undulatus*.

Besides, the other false epiphytes are *Hymenodictyon excelsum*, *Vaccinium* spp., *Agapetes saligna*, *Rhododendron dalhousiae*, *R.edgeworthii*. The true epiphytes which form 49.2% of the total epiphytes (as against 50.79% of false epiphytes) are represented by *Aeschynanthus sikkimensis* (and all spp.), *Lysionotus atropurpureus*, *Euonymus echinatus*, *E. vagans*, *Piper mullesua*, *Hoya edeni* (and all spp.), *Pilea ternifolia*, *P.approximata*, *Begonia gemmipara*.

7.2.2: PARASITES

There are 22 parasitic species distributed to various altitudes of the district. But the most conspicuous parasites are the members of family Loranthaceae, distributed in the subtropical to temperate zones. Parasites may again be classified to following categories according to their habit and mode of

living (Table 7.2.2)

Table 7.2.2 Parasitic Dicot Flora of Darjeeling District

	Form	No. of Species	% of total parasites	% of dicots
HABIT	Herbs	9	40.90	0.47
	Shrubs	12	54.54	0.63
	Climber	1	04.54	0.05
MODE OF LIVING	Root parasite	5	22.72	0.47
	Stem parasite	17	77.27	0.90

Out of 1877 dicot species the parasites constitute 1.17% of the flora. Out of 22 parasites the herbs constitute 40.90%, shrubs 54.54% the lone climber forms 04.54% of the total. There are 5 root parasites (22.72%) and 17 stem parasites (77.27%). A complete list of the parasites has been stated below:

Herbs	Mode of parasitic living	Shrubs	Mode of parasitic living
1. <i>Aeginetia indica</i>	Root	1. <i>Loranthus odoratus</i>	Stem
2. <i>Boschniakia himalaica</i>	Root	2. <i>Helixanthera parasitica</i>	Stem
3. <i>Balanophora polyandra</i>	Root	3. <i>Scurrula parasitica</i>	Stem
4. <i>B. involucreta</i>	Root	4. <i>S. elata</i>	Stem
5. <i>Centranthera grandiflora</i>	Stem	5. <i>Taxillus umbellifer</i>	Stem
6. <i>C. nepalensis</i>	Stem	6. <i>Dendrophthoe falcata</i>	Stem
7. <i>C. tranquebarica</i>	Stem	7. <i>Macrosolen cochinchinensis</i>	Stem
8. <i>Striga euphrasioides</i>	Root	8. <i>Viscum monoium</i>	Stem
9. <i>Salmonia oblongifolia</i>	Stem	9. <i>V. album</i>	Stem
		10. <i>V. liquidambaricolum</i>	Stem
		11. <i>Duffrenoya granulata</i>	Stem
		12. <i>D. platyphylla</i>	Stem

Climber:

1. *Cuscuta reflexa* var. *brachystigma* Stem

7.2.3 Hydrophytes

The hilly district of Darjeeling does not favour the growth of aquatic plants. There are very few places having stagnant water for the purpose. The plains of the district however, has a number of such places. Yet 19 hydrophytic dicots have been recorded in the present work, constituting 1.01% of the dicot flora. According to the habitat adaptation they may be either *amphibian* or *free-floating*. The categorywise list showing the total number of hydrophytes is given below:

Amphibian	Range of Distribution	Free Floating	Range of Distribution
1. <i>Ipomoea aquatica</i>	200-300m	1. <i>Nymphoides hydrophyllum</i>	100-500m
2. <i>I. carnea</i>	200-400m	2. <i>Hydrobryum griffithii</i>	1000-1800m
3. <i>Achyranthes aquatica</i>	200-1200m	3. <i>Limnophila repens</i>	150-300m
4. <i>Persicaria hydropiper</i>	200-2200m	4. <i>L. indica</i>	150-500m
5. <i>Aschynomene indica</i>	200-1200m	5. <i>Utricularia aurea</i>	100-1000m
6. <i>Nasturtium officinale</i>	1200-2500m		
7. <i>Hygrophila polysperma</i>	150-300m		
8. <i>H. salicifolia</i>	150-400m		
9. <i>H. difformis</i>	150-1200m		
10. <i>Rotala indica</i>	200-1000m		
11. <i>R. rotundifolia</i>	200-1800m		
12. <i>R. mexicana</i>	150-200m		
13. <i>Callitriche stagnalis</i>	2000-3000m		
14. <i>Enhydra fluctuans</i>	100-300m		

The amphibians which represent the higher proportion form 73.68% of the total hydrophytes, while free floating species constitute 26.37% of the same. The aquatic dicots in the higher hills are very sparse. Only 3 species are truly restricted to the higher ranges. They are *Callitriche stagnalis*; *Nausturtium officinale* and *Hydrobryum griffithii*. The species like *Rotala rotundifolia*, *R. indica*, *Achyranthes aquatica*, *Utricularia aurea* and *Hygrophila difformis* extend rarely upto 1200m from the plains. This apart, all the hydrophytic elements are restricted to the altitudes below 300m.

7.2.4 SAPROPHYTES

Saprophytic dicots are rare in the Darjeeling flora. But leaving aside the Fungi, Saprophytes are not common features of any flora in the world. The wet and humid climate of deep dense forests have encouraged the thriving of 2 saprophytic dicots in the district which comes to 0.10% of the total dicot flora. The 2 Saprophytes are:

1. *Monotropa uniflora* (Neora Valley 2000-2500m).
2. *Monotropastrum humile* (Meghma Gairibas 2400-3000m).

Both of the Saprophytes are of rare occurrence and it is difficult to locate them in the fields. Yet, as far as their habitat is left undisturbed their propagation in nature itself, seems to continue as it is. The improvement of propagation (than of the present) in natural way in the present environment does not appear very hopeful.

7.3 PHYTOGEOGRAPHY OF THE DICOTYLEDONOUS FLORA OF DARJEELING DISTRICT

The Indian subcontinent, as a whole, with its great Himalayan barrier on the north and the vast stretch of ocean guarding the peninsular portion, is theoretically an ideal location that permits time and space for the development of its own flora. But the immigrant flora has a remarkable contribution, in the subcontinent. The great floristic diversity in the country, together with climatic and geographica-

al factors, is largely brought about by the immigrant species. J.D. Hooker (1906) stated that a typical Indian flora does not exist and the composition of the flora is attributed "to the immigration of plants from widely different border countries notably of Chinese and Malayan on the east and south, of Oriental, European and African on the west and Tibetan and Siberian on the north". However, the later phytogeographical studies render Hooker's contention untenable in the light of a vast country with multitude habitat conditions and many endemic species (Chatterjee 1940, Nair 1980) specially in the Himalayas.

Darjeeling district being situated in the central part of the Eastern Himalayas shares its common land mass stretch to Nepal, to Myanmar through N.E. India and the vast plains of India. The **great diversity in the flora** of this region, in fact, is attributed to the presence of a large number of endemic species, Himalayan elements, exotic elements and immigrant plants naturalised in the region, aided by geographical and climatic conditions (Das, 1995). Phytogeographical investigations reveal that the district of Darjeeling is represented by significant number of genera and species which share their distribution to other parts of the world, such as S.E. Asia and Malaysia, China, Japan, Australia, Europe, America, Africa and Siberia, in addition to Indian and Himalayan elements. Darjeeling, as a part of the Great Himalayan range of India, can therefore, be called the meeting ground of the flora of these countries. The widely varying climate and ecological conditions of the district have become instrumental in settling in of a large number of immigrant flora.

The immigration process or the route and agency has not been studied fully in the Eastern Himalayas. For this reason, a complete assessment of the immigration or indigenous status of the flora, remains unfulfilled. According to Grierson and Long (1983), "These elements are purely descriptive and do not imply any migration between these regions and the E.Himalayas. A full assessment of floristic elements cannot be made until the external distributions of all taxa in E.Himalayas are worked out and analysed on a non selective basis". J.S. Gamble (1875) observed the middle Hill forests of the district of having remarkable European character at the generic level, the specific level being different. Such genera are *Acer*, *Alnus*, *Betula*, *Castanopsis*, *Prunus* and *Quercus*. Hiroo Kanai (1966) has made a thorough survey and listed 295 Himalayan plants having their affinity and occurrence in Japan. Man has a great role in introducing new elements of any Taxonomic level. A large number exotic elements thus, entered and naturalised in the region. As an example, the Lloyd Botanical Garden of Darjeeling represents temperate flora of 13 different countries amounting to 50% of the plantation, the remaining 50% being the indigenous elements (Biswas 1940).

A correct assessment of the character of Himalayan flora, perhaps, points to the finding out of ancestral stock of either groups (Himalayan and with multinational distribution /immigrants?) and thereby establishing the relationships, if there is any, between these distant flora, and determine the routes of migration in terms of space and time. The geological evidences, in terms of fossils flora, of the past and changes in climate and vegetation over long periods of earth's history might be helpful in providing the correct interpretation of the phytogeographical relationships. On the other hand, the flora of a region, after all, is determined by the individual species that make up the flora, the higher taxonomic ranks such as families and genera being based on the specific epithet. Das (1995) has analysed the temperate (1500-2400m) flora of Darjeeling hills and assessed the floristic elements therein. The following statements shows the dicot species of Darjeeling district, as a whole, having their geographical distribution in the Himalayan regions and connected to various other countries (Table 7.3).

Table 7.3 Presentation of Phytogeographical Distribution of the Dicotyledonous Flora of Darjeeling District.

Sl.No.	Elements	No. of Species	% of total dicots
1.	Himalayan	607	32.33
2.	Sino-Himalayan & Japanese	518	27.59
3.	S.E. Asian & Malaysian	302	16.08
4.	Indian subcontinental	111	96.33
5.	Australian	86	4.58
6.	Afroasiatic	69	3.67
7.	American	57	3.03
8.	Eurasian	27	1.43
9.	Central Asiatic	11	0.58
10.	Pantropic	48	2.55
11	Cosmopolitan	33	1.75

It is observed in the present survey work (Table 7.3) that the distinction of the Darjeeling flora is brought about by the plants of Himalayan distribution in the main, which comprise of 32.33% of the dicot flora, and Sino Himalayan (including Japanese) elements in the second rank, forming 27.59%. In the third rank 16.08% of the dicot flora, especially distributed to lower hills, represent south-east Asia and Malaysian elements.

Representation from Indian and other contributing countries and the species of Pantropic and Cosmopolitan distribution account to below 7%. The present account also includes the distribution record of recent migrations.

The following is the outline of selective examples of phytogeographical elements of the district, which form only a small part of the presentation made in Table 7.3, but reflect the most obvious existing pattern of the flora.

Himalayan Elements:

A total of 607 dicot species have been treated as Himalayan. Included in this category are also the species showing their distribution to N.E. India and Tibetan frontiers, because, so many taxa in the region have an overlapping distribution that a further grouping appear to have negligible meaning. Within the Himalayan range itself there are eastern and western elements (Stainton 1972, Grierson & Long 1983) again. It has been observed that a large number of species (about 209 dicot species) are restricted to the Eastern Himalayas alone. The taxa listed below are the examples of dicots restricted to the Himalayan range:

<i>Actinodaphne angustifolia</i>	<i>Lindera pulcherrima</i>
<i>Ardisia involucrata</i>	<i>Litsea hookeri</i>
<i>Aster sikkimensis</i>	<i>Lysimachia evalvis</i>
<i>Asarum himalaicum</i>	<i>Mahonia napaulensis</i>
<i>Begonia nepalensis</i>	<i>Maytenus sikkimensis</i>
<i>B.sikkimensis</i>	<i>Maesa macrophylla</i>
<i>Beumontia grandiflora</i>	<i>Mesua floribunda</i>
<i>Boehmeria glomerulifera</i>	<i>Mussaenda treuleri</i>

<i>B.ternifolia</i>	<i>Neanotis gracilis</i>
<i>Ceropegia longifolia</i>	<i>Ophiorrhiza nutans</i>
<i>Chonemorpha griffithii</i>	<i>O. succirubra</i>
<i>Clematis acuminata</i>	<i>Persea clarkeana</i>
<i>C. nepalensis</i>	<i>Phoebe attenuata</i>
<i>Codonopsis affinis</i>	<i>Primula denticulata</i>
<i>C.subsimplex</i>	<i>P.listeri</i>
<i>Corydalis juncea</i>	<i>Rhododendron barbatum</i>
<i>C. chaerophylla</i>	<i>R. cinnabarinum</i>
<i>Didymocarpus andersoni</i>	<i>Rubus paniculatus</i>
<i>Edgaria darjeelingensis</i>	<i>R. splendidissimus</i>
<i>Elatostema sikkimense</i>	<i>Sorbus hedlundii</i>
<i>Elaeagnus caudata</i>	<i>S. foliolosa</i>
<i>Enkianthus deflexus</i>	<i>Syzygium balsameum</i>
<i>Euphorbia sikkimensis</i>	<i>S. wallichii</i>
<i>Geranium donianum</i>	<i>Terastigma bracteolatum</i>
<i>Gentiana bryoides</i>	<i>T.campylocarpum</i>
<i>G. kumaonensis</i>	<i>Trichosanthes truncata</i>
<i>Hoya lanceolata</i>	<i>Vaccinium nummularia</i>
<i>Hydrocotyle himalaicum</i>	<i>V.retusum</i>
<i>Hypericum himalaica</i>	<i>Viola wallichiana</i>
<i>Impatiens racemosa</i>	<i>Zanthoxylum oxyphyllum</i>
<i>I.spirifer</i>	
<i>Juglans regia</i>	

The stronger concentration are displayed by the genera like *Agapetes* (7 species), *Begonia* (14 spp.), *Didymocarpus* (6 spp.), *Elatostema* (8 spp.), *Impatiens* (26 spp.), *Primula* (7 spp.), *Rhododendron* (19 spp.), *Rubus* (9 spp.), *Sorbus* (8 spp.). The other genera represented by 4 or more species of Himalayan distribution are *Argyreia*, *Aristolochia*, *Bauhinia*, *Beilschmiedia*, *Berberis*, *Clematis*, *Corydalis*, *Gaultheria*, *Glochidion*, *Hypericum*, *Lindera*, *Litsea*, *Osbeckia*, *Persea*, *Pilea*, *Premna*, *Strobilanthus*, *Syzygium*, *Vaccinium* and *Viola*. It is observed that *Impatiens* and *Rhododendron* have most of their species members distributed within Himalayan range, and thus, establishing themselves as Himalayan Genera.

B. Sino-Himalayan and Japanese Elements

Both the Chinese and Himalayan regions are rich in having endemic as well as taxa extending over to two or more regions. "Geologically the Himalaya is younger than the Chinese mountains eastward whence much of its montane and alpine flora must have come" (Stearn 1976). The proportion of Chinese elements in the Eastern Himalayas steadily increase towards the east and decrease towards west. The western boundaries of these species is often well marked (Grierson & Long 1983). Since the distribution of Himalayan taxa in Japan normally passes through China and Tibet or S.E.Asian route, the Chinese and Japanese distribution has been treated together in accounting the total number of plants. A total of 518 dicots forming 27.59% of the total, has been recorded in this group. However, the examples below are cited separately to show the extent of distribution upto China, then upto Japan.

Ba. Taxa distributed from Darjeeling (Eastern Himalaya) to China

<i>Aconitum bisma</i>	<i>Meconopsis napaulensis</i>
<i>Aeschynanthus bracteatus</i>	<i>Merrillioanax alpinus</i>
<i>A. hookeri</i>	<i>Michelia doltsopa</i>
<i>Albizia lucidiior</i>	<i>M. velutina</i>
<i>Betula alnoides</i>	<i>Milletia cinearea</i>
<i>Bistorta emodi</i>	<i>M. extensa</i>
<i>Callicarpa rubella</i>	<i>Neillia rubiflora</i>
<i>Ceropegia pubescens</i>	<i>Notochaete hamosa</i>
<i>Cinnamomum impressinervium</i>	<i>Oxyspora paniculata</i>
<i>Clematis buchananiana</i>	<i>Panax pseudoginseng</i>
<i>Colquhounia coccinea</i>	<i>Pilea scripta</i>
<i>Dalbergia mimosoides</i>	<i>Plantago erosa</i>
<i>Dicentra scandens</i>	<i>Primula sikkimensis</i>
<i>Entada rheedii</i> ssp. <i>sinohimalensis</i>	<i>Rhododendron edgeworthii</i>
<i>Euonymus frigidus</i>	<i>R. lepidotum</i>
<i>Gentiana stylophora</i>	<i>R. maddenii</i>
<i>Hackelia uncinata</i>	<i>Rubus calycinus</i>
<i>Helwingia himalaica</i>	<i>R. fragarioides</i>
<i>Holboelia latifolia</i>	<i>R. fockeanus</i>
<i>Hydrangea heteromalla</i>	<i>R. indotibetanus</i>
<i>Ilex dipyrena</i>	<i>Salix sikkimensis</i>
<i>I. intricata</i>	<i>Sedum triactina</i>
<i>Leycesteria formosa</i>	<i>Schizandra propinqua</i>
<i>Litsea cubeba</i>	<i>Shuteria hirsuta</i>
<i>L. kingii</i>	<i>Symplocos racemosa</i>
<i>Lonicera glabrata</i>	<i>Tetradium fraxinifolium</i>
<i>Loxostigma griffithii</i>	<i>Thunbergia fragrans</i>
<i>Lysimachia prolifera</i>	<i>Urtica ardens</i>
<i>Magnolia campbellii</i>	<i>Viscum liquidambaricolum</i>
<i>M. globosa</i>	<i>Zanthoxylum acanthopodium</i>
<i>Macropanax dispermus</i>	

Bb. Taxa sharing their distribution in Darjeeling (Eastern Himalayas) and Japan.

In the present flora 149 dicot species of Darjeeling district have been recorded to occur in Japan through China or S.E. Asian region as connecting link. These species reflect the obvious pattern already showed by Hiroo Kanai (1966). Hara (1966) remarks that the Himalayan plants are adopted to more wild climate both in winter and summer than that of Japan. It is interesting to note that the corresponding Japanese taxa of the Himalayas such as *Edgeworthia gardneri*, *Euonymus hamiltonianus*, *Lyonia ovalifolia*, *Viburnum erubescens* which do not shed their leaves are strictly deciduous in Japan. *Prunus cerasoides* that flowers in autumn here does so in Spring in Japan. The occurrence of *Asarum himalaicum* and *A. cordifolium* in the eastern Himalayas establish a connecting link between Himalayas and Japan (Hara 1966). Examples of Japano-Himalayan distribution has been cited below:

<i>Amaranthus lividus</i>	<i>Persicaria pubescens</i>
<i>A. spinosus</i>	<i>P. thunbergii</i>
<i>Anaphalis margaritacea</i>	<i>Phytolacca acinosa</i>
<i>Artemisia dubia</i>	<i>Pouzolizia hirta</i>
<i>Bidens bipinnata</i>	<i>P. zeylanica</i>
<i>Cardamine impatiens</i>	<i>Quercus glauca</i>
<i>Centella asiatica</i>	<i>Rhus javanica</i>
<i>Chenopodium ambrossoides</i>	<i>R. succedanea</i>
<i>Choerospondias axillaris</i>	<i>Rorippa dubia</i>
<i>Cynoglossum zeylanicum</i>	<i>Rotala indica</i>
<i>Desmodium heterocarpon</i>	<i>Rubia wallichiana</i>
<i>Duchesnea indica</i>	<i>Rumex nepalensis</i>
<i>Ellisiophyllum pinnatum</i>	<i>Sajina japonica</i>
<i>Emilia sonchifolia</i>	<i>Sapindus mukororssi</i>
<i>Euonymus hamiltonianus</i>	<i>Senecio scandens</i>
<i>Geranium nepalense</i>	<i>Sida acuta</i>
<i>Gnaphalium affine</i>	<i>Siegesbeckia orientalis</i>
<i>Hedyotis diffusa</i>	<i>Stellaria media</i> var. <i>procera</i>
<i>Houttuynia cordata</i>	<i>Swertia bimaculata</i>
<i>Hydrocotyle nepalensis</i>	<i>Urena lobata</i>
<i>Limnophila indica</i>	<i>Vernonia cinearia</i>
<i>Ludwigia octavalvis</i>	<i>Viola biflora</i>
<i>Lyonia ovalifolia</i>	<i>V. diffusa</i>
<i>Melochia corchorifolia</i>	
<i>Monotropa uniflora</i>	
<i>Mosla dianthera</i>	

C. S.E. Asian and Malaysian Elements

A total of 302 dicot species figuring 16.08% of the total dicots occur in the district of Darjeeling with their wide distribution in S.E. Asian regions including S. Myanmar, Thailand, Indochina, Malaysia, Indoensia and also extending to China and Japan. These elements generally dominate the subtropical and warm subtemperate parts and are mostly characterised by the trees, shrubs and climbers. "These elements are more manifest in the east Himalaya and gradually decline westwards" (Stainton 1972). The typical examples are stated below:

<i>Acacia rugata</i>	<i>Lithocarpus elegans</i>
<i>Aconogonum molle</i>	<i>Litsea monopetala</i>
<i>Acrocarpus fraxinifolius</i>	<i>Macrosolen cochinchinensis</i>
<i>Aeginetia indica</i>	<i>Maesa montana</i>
<i>Alcimandra cathcartii</i>	<i>Mallotus philippensis</i>
<i>Ampelocissus barbata</i>	<i>Meliosma pinnata</i>
<i>Baccaurea ramiflora</i>	<i>M. simplicifolia</i>
<i>Bauhinia purpurea</i>	<i>Michelia champaca</i>
<i>Bridelia retusa</i>	<i>Mucuna nigricans</i>

Butea monosperma
Callicarpa arborea
Calotropis gigantea
Carallia brachiata
Clematis smilacifolia
Cissus simplex
Combretum punctatum
Debregeasia longifolia
Dendrocnide sinuata
Desmos dumosa
Duabanga grandiflora
Dysoxylum indicum
Embelia ribes
Engelhardia spicata
Erythrina variegata
Eurya acuminata
Exbucklandia populnea
Firmiana colorata
Garuga pinnata
Girardiana diversifolia
Glycosmis pentaplylla
Helicia nilagiria
Hodgsonia macrocarpa
Hydrobryum griffithii
Ichnocarpus frutescens
Lannaea coromandelica

M.pruriens
Oroxylum indicum
Paederia foetida
Piper attenuatum
Pratia montana
Rauwolfia serpentina
Rubus lineatus
Scurrula parasitica
Shuteria involucrata
Spilanthes calva
Spondias pinnata
Stephania glabra
Talauma hodgsonii
Terminalia bellirica
T.chebula
Tetrameles nudiflora
Toona ciliata
T.sureni
Triumfetta annua
Utricularia aurea
Viscum monoicum
Vitex negundo

D. Indian and Indian Subcontinental

A good number of dicots are distributed within the Indian subcontinental regions covering Srilanka, Bangladesh, Nepal, Pakistan and India while the species distributed within Indian nation alone form another group. For the convenience of treatment these groups have been considered together in which 119 dicots forming 6.33% of the total dicots have been recorded. The following statement gives the example of Indian subcontinental species occurring in Darjeeling district:

Azadirachta indica
Breynia retusa
Centranthera tranquebarica
Clausena dentata
Clerodendrum indicum
Coffea bengalensis
Drypetes assamica
Eugenia bracteata
Euphorbia antiquorum
Ficus semicordata

Lantana indica
Mallotus tetracoccus
Mesua ferrea
Mitrasacme indica
Nyctanthes arbortristis
Pavetta indica
Piper pedicellatum
Premna bengalensis
Protium serratum
Rinorea bengalensis

Fragaria nilgerrensis
Hilicicia nilagirica
Glochidion assamicum
Heliotropium strigosum
Hemidesmus indicus
Hibiscus radiatus
H. surattensis
Hygrophila difformis

Sida mysorensis
Stixis suaveolens
Striga angustifolia
Tinospora cordifolia
Torenia thouarsii
Triumfetta tomentosa
Uvaria hamiltonii
Vernonia squarrosa
Xeromphis uliginosa
Zehneria indica
Zizyphus rugosa

E. Australian Distribution

As many as 86 dicot species (4.58% of total dicots) have been found in Darjeeling district with their wide distribution upto Australia. Many of this category of plants are distributed through S.E. Asia and Japan. The following examples will give a picture of plants of this distribution (pantropic and cosmopolitan elements are excluded):

<i>Abutilon indicum</i>	<i>L. crustacea</i>
<i>Alysicarpus rugosus</i>	<i>Ludwigia perennis</i>
<i>Callitriche stagnalis</i>	<i>Knoxia corymbosa</i>
<i>Celastrus paniculatus</i>	<i>Melastoma malabathricum</i>
<i>Crateva religiosa</i>	<i>Mitrasacme indica</i>
<i>Centella asiatica</i>	<i>Mukia maderaspatana</i>
<i>Dentella repens</i>	<i>Murraya paniculata</i>
<i>Dendrophthoe falcata</i>	<i>Polygonum plebejum</i>
<i>Desmodium pulchellum</i>	<i>Rotala mexicana</i>
<i>D. gangeticum</i>	<i>Siegesbeckia orientalis</i>
<i>Erigeron karvinskianus</i>	<i>Stellaria uliginosa</i>
<i>Ficus hispida</i>	<i>Syzygium cumini</i>
<i>F. microcarpa</i>	<i>Toona ciliata</i>
<i>Flueggea virosa</i>	<i>Vicia sativa</i>
<i>Lagerstroemia reginae</i>	<i>Zornia gibbosa</i>
<i>Lindernia anagalis</i>	

F. American Elements

57 dicot species (3.03%) of this district are American elements and many of them having a pan-tropic distribution. Most of these species are categorised under exotic elements while the dicots like *Argemone mexicana*, *Borreria alata*, *Caltha palustris* (rare), *Chenopodium ambrossoides*, *Drymaria villosa*, *Eupatorium adenophorum*, *Euphorbia pulcherrima*, *Hedyotis corymbosa*, *Mikania micrantha*, *Nicandra physaloides*, *Physalis peruviana*, *Tithonia diversifolia* have abundantly naturalised, as to form an integral part of the flora. It is assumed that the American elements entered this region through transport and human agencies, more than by natural migration. Several American elements therefore,

have spreaded as ornamental plants in the first place and as weeds in the second. In this category the elements from Mexico, Canada and Southern American states have been cited as American. The following are selected examples:

<i>Achimenes longiflora</i>	<i>Gomphrena celosioides</i>
<i>Asclepias curassavica</i>	<i>Hyptis suaveolens</i>
<i>Calceolaria gracilis</i>	<i>Jatropha curcas</i>
<i>Catharanthus roseus</i>	<i>Lantana camara</i>
<i>Ceiba pentandra</i>	<i>Martynia annua</i>
<i>Cestrum aurantiacum</i>	<i>Mirabilis jalapa</i>
<i>C. elegans</i>	<i>Oxalis corymbosa</i>
<i>Crotalaria pallida</i>	<i>O. tetraphylla</i>
<i>Croton bonplandianus</i>	<i>O. latifolia</i>
<i>Datura metel</i>	<i>Plumeria rubra</i>
<i>D. suaveolens</i>	<i>Potentilla supina</i>
<i>Erigeron canadensis</i>	<i>Scoparia dulcis</i>
<i>Eupatorium ligustrinum</i>	<i>Solanum jasminoides</i>
<i>Galinsoga parviflora</i>	<i>S. mauritianum</i>
<i>Tropeolum majus</i>	

G. Afro-asiatic and Mediterranean Elements

69 species coming to 3.67% of the dicots are growing in this district, which show a common distribution with Africa and Mediterranean regions. Many of these dicots are cosmopolitan/pantropic. The examples are:

<i>Abutilon persicum</i>	<i>Lepisanthes senegalensis</i>
<i>Acacia pennata</i>	<i>Melia dubia</i>
<i>Achyranthes bidentata</i>	<i>Parochetus communis</i>
<i>Borreria repens</i>	<i>Passiflora foetida</i>
<i>Coccinea grandis</i>	<i>Phyllanthus reticulatus</i>
<i>Conyza stricta</i>	<i>Plumbago zeylanica</i>
<i>Desmodium velutinum</i>	<i>Physalis minima</i>
<i>Emilia sonchifolia</i>	<i>Ricinus communis</i>
<i>Enhydra fluctuans</i>	<i>Sanicula elata</i>
<i>Grewia serrulata</i>	<i>Thespesia lampas</i>
<i>Heliotropium indicum</i>	<i>Trema orientalis</i>
<i>Ipomoea purpurea</i>	<i>Trifolium repens</i>
<i>Laggera alata</i>	<i>Uraria picta</i>
<i>Lepidium sativum</i>	<i>Vigna umbellata</i>
<i>Lindernia paviflora</i>	<i>Zizyphus mauritiana</i>

In addition, the dicotyledonous flora of Darjeeling district displays a common distribution to Eurasian (27 species, 1.43%), and Central Asiatic (11 species 0.58%) regions while Pantropic (40 species 2.13%) and Cosmopolitan (33 species 1.75%) plants also have a noteworthy distribution in this district. The category-wise examples have been cited below:

H. Eurasian and Siberian

Distribution

Achillea millefolia
Anagallis arvensis
Cimicifuga foetida
Cardamine hirsuta
C. impatiens
Elsholtzia ciliata
Linaria cymbalaria
Mentha arvensis
Persicaria hydropiper
Potentilla abruscula
Rumex acetosella
Thlaspi arvense
Trifolium dubium
Veronica serpyllifolia
Vicia hirsuta

I. Central Asiatic

Distribution

Cannabis sativa
Cleome viscosa
Dicliptera bupleuroides
Euphorbia thymifolia
Hygrophila polysperma
Kydia calycina
Malva verticillata
Melia azedarach
Nymphoides hydrophyllum
Ranunculus pulchellus
Tabernaemontana divaricata

J. Pantropic Elements

Achyranthes aspera
Alternanthera sessilis
Amaranthus spinosus
A. viridis
Bidens pilosa
Blainvillea acmella
Boerhavia repens
Canscora diffusa
Caesalpinnia bunduc
C. crista
Cardiospermum helicacabum
Cassia fistula
C. floribunda
C. mimosoides
C. occidentalis
C. sophera
C. tora
Celosia argentea
Cissampelos pareira
Conyza sumatrensis
Corchorus aestuans
Crassocephalum crepidioides
Eclipta prostrata
Euphorbia hirta

Gnaphalium polycaulon
Ipomoea aquatica
I. carnea
I. quamoclit
Melochia corchorifolia
Merremia hederacea
Mimosa pudica
Mitreola petiolata
Nelsonia canescens
Phyllanthus urinaria
Portulacca oleracea
Sida acuta
S. cordata
S. cordifolia
S. spinosa
Solanum erianthum
Synedrella nudiflora
Tribulus terrestris
Tridax procumbens
Urena lobata
U. lobata spp. *sinuata*

E. hypersifolia
Evolvulus alsinoides
Glinus lotoides

K. Cosmopolitan Elements

<i>Adenostemma lavenia</i>	<i>Crotalaria spectabilis</i>
<i>Aeschynomene indica</i>	<i>Eupatorium adenophorum</i>
<i>Ageratum conyzoides</i>	<i>Galinsoga parviflora</i>
<i>Alysicarpus vaginalis</i>	<i>G. quadriradiata</i>
<i>Amaranthus lividus</i>	<i>Oxalis corniculata</i>
<i>Bidens bipinnata</i>	<i>Sagina procumbens</i>
<i>Blumea lacera</i>	<i>Solanum nigrum</i>
<i>Capsella bursapastoris</i>	<i>Sonchus asper</i>
<i>Centella asiatica</i>	<i>S. oleraceus</i>
<i>Cerastium glomeratum</i>	<i>Spergula arvensis</i>
<i>Chenopodium album</i>	<i>Stellaria media</i>
<i>Cleome rutidosperma</i>	<i>S. uliginosa</i>

7.4 CLIMATE, ALTITUDINAL VARIATION AND THE FLORA

The climate of the Eastern Himalayas has been regulated by two basic factors:

1. Flow of moisture laden wind from south (the Bay of Bengal) hitting the lofty upper mountains (up to Mt. Kanchanjunga)
2. Wide variation in altitudes and sharp differences in the configuration of hills.

The variation in altitudes and the amount of rainfall received effect its own local climate in Darjeeling district. The general climatic similarity however, can be observed from Eastern Nepal to Arunachal Pradesh (The Eastern Himalayas proper) in which Darjeeling lies about the centre. The typical monsoon climate of the district with wet summer and a dry winter, is characterised by the rainfall variation from 225-500, temperature variation from 0.8°C-35°C, relative humidity variation from 20%- 95% in average, at different altitudes (Figs. 7.4.1 a,b,c). The monsoon with heavy rainfall, clouds, fog and mists favours the local flora, more than any other season.

7.4.1 Presentation of Climatic Condition of Darjeeling district

The altitude which varies from 140m (plains) to 3660m (subalpine) is an important factor that determines the kind of climate and the flora in the region. The altitude has exposed the geographical surfaces of the district to different temperature and precipitation zones, thereby effecting variation and diversity of vegetational types and as many as 15 Tree associations. The district begins its boundary with the plains and dense tropical forest and goes upto a subalpine meadow. The endangered endemic species like *Streptocaulon sylvestre* (which does not thrive above an altitude of 200m) and *Rheum acuminatum* (which does not descend below 3500m altitude) both of which show a sharply contrasting ecological habitat fall within the parameters of the district and which in a way, mark the two diverse ends of the district and district flora. The presence of plains, Terai, Bhabar and Steep mountaineous (major portion) regions in the district also effect the typical local vegetation types.

Figure 7.4.1.a Presentation of climatic condition of Darjeeling district: rainfall variation

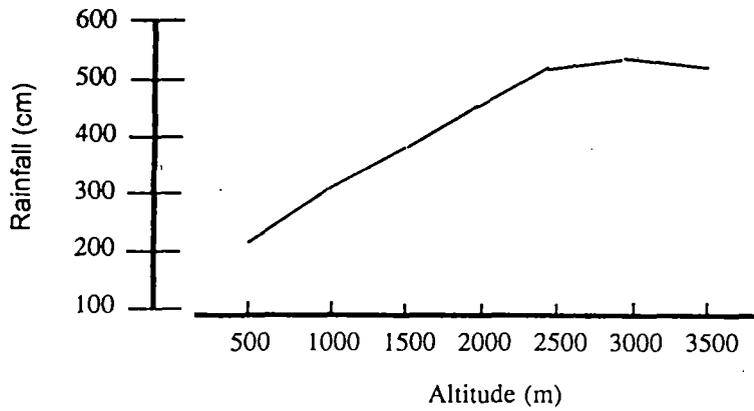


Figure 7.4.1.b Mean annual temperature

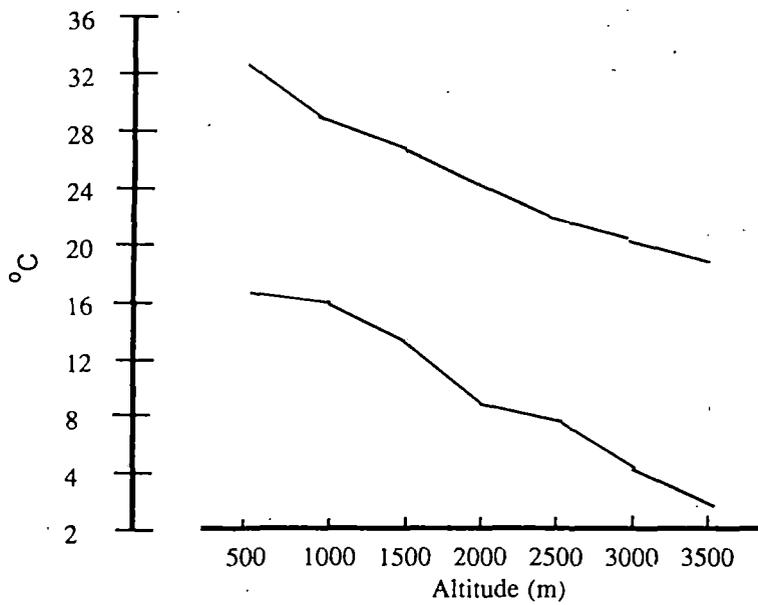
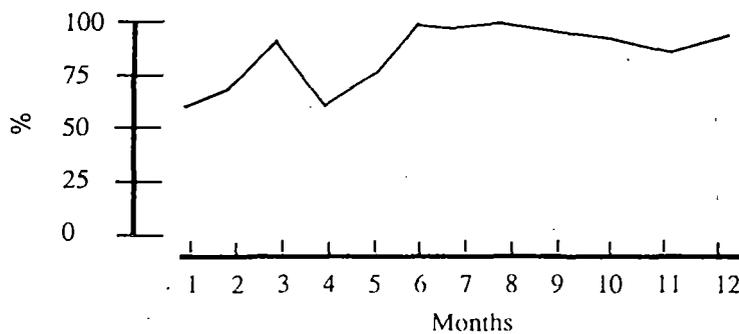


Figure 7.4.1.c Relative Humidity



These factors taken together have divided the district into following climatic zones:- 1. Tropical, 2. Subtropical, 3. Subtemperate, 4. Temperate and 5. Subalpine. The study on the zonewise distribution of the dicot flora has shown that the Temperate zone has the highest diversity in the number of species as well as in habit and habitat groups; but the maximum number of species has been recorded to occur in the subtropical and subtemperate zones (Table 7.4.2).

Table 7.4.2 Dicot flora of Darjeeling District: Zonewise presentation of Taxa, Forms and Habitat group

Zones		Plains & Tropical upto 500m	Subtropical 500-1200m	Subtemperate 1200-1850m	Temperate 1850-3200m (3500m)	Subalpine 3200(3500m) -above
TAXA	Flora					
	Family	105	120	109	102	46
	Genera	433	498	346	320	113
	Species	754	1060	967	734	243
FORMS	Herbs	177	265	313	490	163
	Shrubs	180	228	206	209	47
	Climbers	151	189	133	104	9
	Trees	249	212	183	167	31
HABITAT GROUPS	Epiphytes	6	21	31	46	8
	Parasites	8	13	15	10	1
	Hydrophytes	17	11	4	4	0
	Saprophytes	0	0	0	2	0

The flora of Darjeeling is composed of all forms of plants of herbs, climbers and trees, while almost all habit and habitat groups are represented, including some saprophytes and xerophytes. The cold and dry winter climate of the region has effected the growth of a higher proportion of annuals and geophytes. It is noteworthy that the largest proportion (490 spp., accounting to 66.93%) of herbs form the temperate flora where the subtropical region which shows the highest number of dicot species occurring in the zone, has 265 (34.97 % of herbs) herbs only.

The present records show that the number of genera, families and species are almost equally distributed in tropical, subtropical, subtemperate and temperate zones; among which the highest figure is shown by tropical dicots immediately followed by subtemperate zone. The subtropical zone harbours 1060 species under 498 genera of 120 families. The subalpine zone above 3500m exhibits the presence of 243 species under 113 genera of 46 families, the lowest zonewise figure of the district.

The abundant flourishing of tropical species like *Shorea robusta*, *Dillenia indica*, *Duabanga grandiflora*, *Albizia procera*, *Acrocarpus fraxinifolius*, *Sterculia villosa*, *Terminalia alata*, *Phoebe attenuata*, *Acacia catechu*, *Syzygium ramosissimum* and *Sachharum spontaneum*, *Imperata cylindracea*, *Croton caudatus*, *C. bonplandianus*, *Amaranthus* spp. and dominating flatland grasses characterise the lower (plains and tropical) part of the district with a tropical vegetation indicating the sufficiency of rainfall, although they have to come across a seasonal winter with only occasional rainfall. The highest number of trees in the district occur in this region. The rain green deciduous forest mixed with ever-

green elements is the main character of subtropical hills (Kanai 1967). Most of the tropical species have extended upto this region. The tropical and subtropical families of this zone are Dilleniaceae, Annonaceae, Menispermaceae, Malvaceae, Sterculiaceae, Bombacaceae, Tiliaceae, Burseraceae, Meliaceae, Rhamnaceae, Sapindaceae, Leguminosae, Combretaceae, Myrtaceae, Flacourtiaceae, Lythraceae, Apocynaceae, Loganiaceae, Bignoniaceae, Verbenaceae, Myristicaceae, Euphorbiaceae, which characterise the zone. The larger concentration of species, well represented by climbers, epiphytes and shrubs indicate that the subtropical zone receive the average of climatic condition of the district, influenced by tropical as well as temperate environment. The subtropical zone is remarkable for having highest number of shrubs and climbers (228 and 189 spp., respectively).

One of the most remarkable effects of monsoon climate is the occurrence of evergreen dense forests in the subtemperate and temperate zones and a mixed evergreen forest in the subtropical zone, which constitute an important component of the flora of the district. The high percentage of humidity prevailing in the region gives rise to proliferation of epiphytes, orchids and the humus soil formed of decomposed fallen plant parts at the ground is an ideal environment for the growth of saprophytes. Indicating the equal distribution of rainfall and humidity th temperate zone shows the highest number of epiphytes (46 dicot spp.) in the district. The subtemperate and subtropical zone follow the sequence. Moreover, the temperate flora is characterised by the presence of trees densely clad with mosses and lichens, in addition to epiphytes. Darjeeling flora is well represented by temperate families of other regions e.g., Aceraceae, Aquifoliaceae, Balsaminaceae, Begoniaceae, Berberidaceae, Campanulaceae, Ericaceae, Fagaceae, Gentianaceae, Geraniaceae, Gesneriaceae, Hypericaceae, Juglandaceae, Primulaceae, Ranunculaceae, Rosaceae, Salicaceae, Saxifragaceae, Symplocaceae, Thymeliaceae. There are a number of temperate genera such as *Actinidia*, *Alcimandra*, *Anaphalis*, *Boenninghausenia*, *Brassaiopsis*, *Callitriche*, *Camellia*, *Capsela*, *Cardamine*, *Cerastium*, *Circaea*, *Cotula*, *Daphniphyllum*, *Dicentra*, *Dipsacus*, *Elsholtzia*, *Epilobium*, *Euonymus*, *Fraxinus*, *Galium*, *Helwingia*, *Hoya*, *Lecanthus*, *Leycesteria*, *Lonicera*, *Magnolia*, *Ophiorrhiza*, *Osbeckia*, *Parochetus*, *Pedicularis*, *Persea*, *Persicaria*, *Rhododendron*, *Sambucus*, *Sanicula*, *Sarcophyramis*, *Sassurea*, *Schizandra*, *Scutellaria*, *Skimmia*, *Stellaria*, *Urtica*, *Vaccinium*, *Valeriana*, *Veronica*, *Viburnum*, *Viola*, etc. The temperate zone is characteristic for having largest number of herbs, epiphytes and saprophytes (confined to this zone only). The subtemperate zone which is a meeting centre for temperate and tropical climate harbours the highest number of parasites and an average of other forms and habital groups. The aquatic plant of flowing current *Hydrobryum griffithii* occurs in this zone. The climbers are about equally distributed in the subtropical (highest) subtemperate and temperate zones. The two saprophytes of the district *Monotropa uniflora* and *Monotropastrum humile* are confined to the deep, damp and dense forests of the temperate zone.

The subalpine flora of the district which forms the turban region faces two distinct seasons of the climatic divisions viz., wet rainy season (often windy) and a dry winter with intervening snowfall. The presence of grassland meadow of herbs, dwarf trees, the least representation of climbers and absence of saprophytes characterise the climatic condition of the zone. The representing genera are *Anaphalis*, *Androsace*, *Anemone*, *Gentiana*, *Pedicularis*, *Primula*, *Ranunculus*, *Rheum*, *Rhododendron*, *Rubus*, *Salix*, *Sassurea*, *Sedum*, with monocots like *Juncus*, *Carex* and Gymnosperms. The *Juniperus*, *Tsuga*, *Abies*, etc. The climate of the zone with a chill winter renders the plants a slow growth rate. The flowering takes place before the advent of winter and the fruits take a few months for ripening. However, there are plants which also flower at the end of winter. The *Rhododendron* seeds mature only after 5 or 6 months after of flowering in April-May.

In general consideration, this region has a favourable climatic conditions aided by altitudinal factors for all forms of plants, distributed to all corners of the area. The migratory elements can settle

suitably in the region. The characteristic of the region are the evergreen forests represented by under-mentioned elements (Table 7.4.3). The deciduous trees and shrubs, mostly located in the subtropical zone (with total nude appearance at one season of the year) have been characteristic of the zone while semideciduous trees shrubs and climbers partly shedding leaves in summer and late winter are common throughout (Table 7.4.3).

Table 7.4.3 Examples of Evergreen, Deciduous and Semideciduous dicots of Darjeeling District.

Evergreen	Distinct Deciduous	Semideciduous
<i>Acer laevigatum</i>	<i>Alstonia neriifolia</i>	<i>Ailanthus integrifolia</i>
<i>A. thomsonii</i>	<i>Bauhinia variegata</i>	<i>Alangium alpinum</i>
<i>A. campbellii</i>	<i>Betula alhoidea</i>	<i>Alnus nepalensis</i>
<i>Acacia</i> spp.	<i>B. utilis</i>	<i>Alstonia scholaris</i>
<i>Albizia lucidior</i>	<i>Bombax ceiba</i>	<i>Bauhinia purpurea</i>
<i>Alcimandra cathcartii</i>	<i>Cassia fistula</i>	<i>B. vahlii</i>
<i>Agapetes</i> spp.	<i>Cotoneaster</i> spp.	<i>Bridelia</i> spp.
<i>Antidesma acidum</i>	<i>Dalbergia sissoo</i>	<i>Cassearia glomerata</i>
<i>Anthocephalus chinensis</i>	<i>Desmodium</i> spp.	<i>Celtis tetrandra</i>
<i>Ardisia</i> spp.	<i>Firmiana colorata</i>	<i>Chukrasia tabularis</i>
<i>Artocarpus lacucha</i>	<i>Gmelina arborea</i>	<i>Duabanga grandiflora</i>
<i>Baccaurea sapida</i>	<i>Hovenia acerba</i>	<i>Daphne</i> spp.
<i>Beilschmiedia</i> spp.	<i>Leea</i> spp.	<i>Elaeocarpus sikkimensis</i>
<i>Brassaiopsis</i> spp.	<i>Magnolia campbellii</i>	<i>Engehardia spicata</i>
<i>Buddleja</i> spp.	<i>Oroxylum indicum</i>	<i>Exbucklandia populnea</i>
<i>Callicarpa</i> spp.	<i>Populus gambleii</i>	<i>Fraxinus floribunda</i>
<i>Calotropis gigantea</i>	<i>P. glauca</i>	<i>Garcinia stipulata</i>
<i>Chisocheton cumingianus</i>	<i>Prunus cerasoides</i>	<i>Garuga pinnata</i>
<i>Choerospondias axillaris</i>	<i>Rhus succedanea</i>	<i>G. floribunda</i>
<i>Cinnamomum</i> spp.	<i>R. chinensis</i>	<i>Heteropanax fragrans</i>
<i>Castanopsis</i> spp.	<i>Shorea robusta</i>	<i>Horsfieldia kingii</i>
<i>Edgeworthia gardneri</i>	<i>Spondias pinnata</i>	<i>Hypericum gracilipes</i>
<i>Elaeocarpus lanceifolius</i>	<i>Sterculia villosa</i>	<i>H. hookerianum</i>
<i>Entada rheedii</i>	<i>Terminalia bellirica</i>	<i>Kydia calycina</i>
<i>Eriobotrya petiolata</i>	<i>Tetrameles nudiflora</i>	<i>Lagerstroemia reginae</i>
<i>Eurya</i> spp.	<i>Salix</i> spp.	<i>Leucosceptrum canum</i>
<i>Euonymus</i> spp.	<i>Vernonia volkameriifolia</i>	<i>Lindera neesiana</i>
<i>Ficus benjamina</i>	<i>Zanthoxylum nitidum</i>	<i>Michelia</i> spp.
<i>F. hispida</i>	<i>Z. ovalifolium</i>	<i>Meliosma pinnata</i>
<i>F. subincisa</i>		<i>Myrsine</i> spp.
<i>Gaultheria</i> spp.		<i>Olea dioica</i>
<i>Glochidion hirsutum</i>		<i>Premna</i> spp.
<i>G. oblatum</i>		<i>Rhododendron arboreum</i>
<i>Helicia nilagirica</i>		<i>R. falconeri</i>
<i>Ilex</i> spp.		<i>Sapindus mukorossi</i>

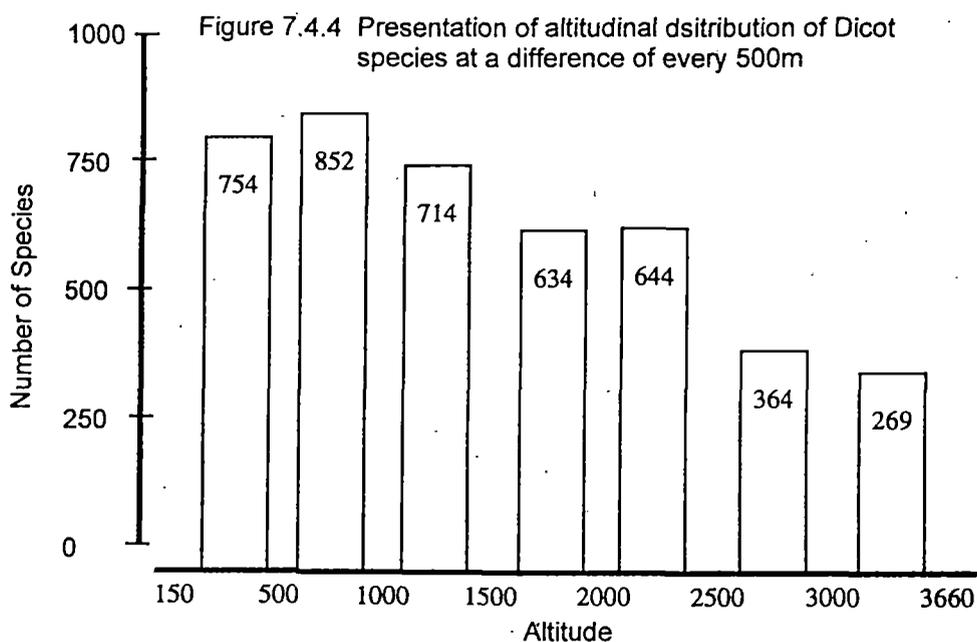
Juglans regia
Lantana camara
Lithocarpus spp.
Litsea chartacea
L. sericea
Macaranga indica
M. pustulata
Mallotus spp.
Maesa spp.
Mangifera sylvatica
Nyssa javanica
Ostodes paniculatus
Pentapanax fragran
Persea fructifera
P. glaucescens
Phoebe lanceolata
P. attenuata
Pterospermum acerifolium
Quercus lamellosa
Rhododendron spp.
Semecarpus anacardium
Streblus asper
Symplocos spp.
Terminalia myriocarpa
Trema tomentosa
Vaccinium spp.
Viburnum spp.
Vitex negundo

Schima wallichii
Saurauja spp.
Sorbus spp.
Stereopermum acerifolium
Sygygium spp.
Terminalia alata
T. chebula
Toona ciliata
Wrightia spp.

One of the interesting feature of the district is the climatic difference between north facing and south east facing slopes. The valleys and gorges of curved or wavy geosurface often forming V-shapes which face north and the Himalayan mountains receive lesser sunlight. There are many places in the district eg. Simkuna-Rangayrung, Munsong, Samalbong, and several such others that receive only a few hours' sunlight in a day. Therefore, on a closer observation these slopes display a different ecological structure. A dense ground vegetation including Bryophytes and Pteridophytes flourish in north facing slopes. The descending down of certain species from subalpine to lower temperate zone and temperate to subtropical zone has a special relation to these slopes and such species prefer grow on the north facing slopes. Evergreen character or at least with extended period of leaf abscission and prolonged life cycle of annuals have been noted in these zones, in contrast to the similar zone nearby but facing south-east. Certain species like *Agapetes* spp., *Ardisia* spp., *Aristolochia* spp., *Betula alnoides*, *Beilschmiedia* spp., *Boeninghausenia albiflora*, *Calamus* spp., *Codonopsis* spp., *Corydalis* spp., *Daphniphyllum chartaceum*, *Euonymus* spp., *Leycesteria formosa*, *Loxostigma griffithii*, *Magnolia globosa*, *Monotropa uniflora*, *Monotropastrum humile*, *Panax pseudoginseng*, *Persea* spp., *Plectocomia himalayensis*, *Prunus napaulensis*, *Rosa serica* (hilltops), *Salix salwinensis*, *Symplocos* spp., *Tinospora cordifolia*, *Vaccinium* spp., *Viburnum mullaha*, and Epiphytes and many herbs are noted to have their specific preference for north facing climatic slopes. However, most of the dicot species need sufficient sunlight and flourish on south east facing slopes.

A number of fast growing species like *Eupatorium adenophorum*, *E. odoratum*, *Lantana camara*, *L. indica*, *Mikania micrantha* etc. are difficult weed of the subtropical zone, while complete dominance of *Arundinaria maling*, *A. aristata*, *A. hookeriana* in several forests of temperate zone of Neora valley, Raman-Phalut, Kalapokhari and Sandakphu spurs have adversely effected the eco-climate for other undergrowths to thrive. *Cryptomeria japonica*, *Tectona grandis* (of plantation forests) and *Arudinaria* spp. and *Dendrocatamus hookeri* (of natural regeneration) from there own microclimate which is hostile to the other plants communities in association.

With a similar physiography of sharp and abruptly arising hills, the Darjeeling Himalayas differ distinctly from Western Himalayas in having greater diversity and denser vegetation, broad-leaved forest elements, lesser wind velocity, greater humidity and a tropical vegetation characterised by *Shorea robusta*, *Chukrasia tabularis*, *Acrocarpus fraxinifolius*, *Syzygium* spp., showing their marked absence in the Western Himalayas. A study of vegetation group at an altitudinal difference of every 500m gives an idea of the altitude wide distribution of dicot species (fig 7.4.4.). It is observed that the highest number of species occur between 500-1000m, while lowest figure is recorded between 3000-3660m. The 'about even' distribution is recorded between 150-500m, 1000-1500m, 1500-2000m, and 2000-2500m.



7.5 Plants with wide distribution

Where the climatic and altitudinal factors have effected the flora for their restriction in the district climatic zones, there are a number of dicot species which show a wide range of distribution. Such species can be identified in two distinct altitudinal zones-(1) Tropical to temperate and (2) Temperate to subalpine, and thus, such plants show their own kind of climatic adaptability. Such category of plants are mostly common and abundant but their distribution outside Darjeeling district shows a mixed occurrence. Elements of Himalayan, Sinohimalayan, S.E.Asian and Malaysian, as well as Cosmopolitan and Pantropic occurrence show such distributions. Therefore, nothing specific can be interpreted on wide range of distribution except their strong climatic adaptation capability. Moreover,

even if their distribution ranges to different climatic zones their actual concentration , in case of several such species, again has a specific zone. As for example *Phyasalis peruviana*, *Schima wallichii*, *Rubus ellipticus*, *Ricinus communis*, *Hemidesmus indicus*, *Rotala mexicana*, *Buddleja asiatica* which form conspicuous groups in tropical or subtropical zones are sparsely represented in temperate zone. But species like *Solanum nigrum*, *Drymaria villosa*, *Ageratum conyzoides*, *Eupatorium adenophorum*, *Persicaria hydropiper*, *Stellaria media*, *Sagina procumbens*, *Galinsoga parviflora*, have their common distribution from tropical to temperate zones. The list of such dicot species has been stated below:

Tropical to Temperate

1. *Abutilon indicum*
2. *Adenostemma lavenia*
3. *Ageratum conyzoides*
4. *A. houstonianum*
5. *Agrostema sarmentosum*
6. *Alangium chinensis*
7. *Albizia chinensis*
8. *A. lebeck*
9. *Amaranthus lividus*
10. *Anisomeles indica*
11. *Bidens pilosa*
12. *Borreria pusilla*
13. *Buddleja asiatica*
14. *Cannabis sativa*
15. *Chenopodium ambrossoides*
16. *Crotalaria alata*
17. *Cynoglossum lanceolatum*
18. *Datura metel*
19. *D. stramonium*
20. *Datura suaveolens*
21. *Dicliptera bupleuroides*
22. *Drymaria cordata*
23. *D. villosa*
24. *Dumasia villosa*
25. *Eupatorium adenophorum*
26. *Flemingia macrophylla*
27. *Galinsoga parviflora*
28. *Hemidesmus indicus*
29. *Hypericum japonicum*
30. *Lindernia ruellloides*
31. *Litsea cubeba*
32. *L. glutinosa*
33. *Macrosolen cochinchinense*
34. *Mosla dianthera*

Temperate to subalpine

1. *Ajuga lobata*
2. *Ainslea aptera*
3. *Anaphalis contorta*
4. *A. triplinervis* var. *intermedia*
5. *Begonia sikkimensis*
6. *Carpesium trachelifolium*
7. *Chrysplenium nepalense*
8. *Cotoneaster microphyllus*
9. *Daphniphyllum himalense*
10. *Debregeasia longifolia*
11. *Duchesnea indica*
12. *Elaeagnus caudata*
13. *Epilobium wallichianum*
14. *Fragaria nubicola*
15. *Galium asperuloides*
spp. *hoffmeisteri*
16. *Gaultheria trichophylla*
17. *Geranium donianum*
18. *Hemiphragma heterophylla*
19. *Hypericum wightianum*
20. *Impatiens discolor*
21. *Indigofera cylindracea*
22. *Lindera neesiana*
23. *Lysimachia prolifera*
24. *Lyonia ovalifolia*
25. *Merrilopanax alpinus*
26. *Myriactis nepalensis*
27. *Neillia rubiflora*
28. *Panax pseudoginseng* var. *angustifolia*
29. *P. pseudoginseng* var. *bipinnatifidaus*
30. *Plantago erosa*
31. *Pedicularis pantlingii*
32. *Peracarpa carnosia*
33. *Pilea symmeria*
34. *Piptanthus nepalensis*

- | | |
|--------------------------------------|---------------------------------|
| 35. <i>Morus australis</i> | 35. <i>Potentilla leuconota</i> |
| 36. <i>Mucuna nigricans</i> | 36. <i>P. lineata</i> |
| 37. <i>Ostodes paniculatus</i> | 37. <i>P. polyphylla</i> |
| 38. <i>Oxalis corniculata</i> | 38. <i>Prunus undulata</i> |
| 39. <i>Neanotis calycina</i> | 39. <i>Rosa macrophylla</i> |
| 40. <i>Peperomia pellucida</i> | 40. <i>Rubia wallichiana</i> |
| 41. <i>Persea clarkeana</i> | 41. <i>Rubus fockeanus</i> |
| 42. <i>Persicaria posumbu</i> | 42. <i>R. inopertus</i> |
| 43. <i>P. hydropiper</i> | 43. <i>R. niveus</i> |
| 44. <i>Porana racemosa</i> | 44. <i>R. splendidissimus</i> |
| 45. <i>Psychotria erratica</i> | 45. <i>Sambucus adnata</i> |
| 46. <i>Potentilla supina</i> | 46. <i>Sorbus insignis</i> |
| 47. <i>Physalis peruviana</i> | 47. <i>S. nigricans</i> |
| 48. <i>Ricinus communis</i> | 48. <i>Spirea bella</i> |
| 49. <i>Rotala mexicana</i> | 49. <i>Verbascum thaspus</i> |
| 50. <i>Rubus ellipticus</i> | 50. <i>Veronica cana</i> |
| 51. <i>Sajina procumbens</i> | |
| 52. <i>Schima wallichii</i> | |
| 53. <i>Smithia ciliata</i> | |
| 54. <i>Solanum nigrum</i> | |
| 55. <i>S. myriacanthum</i> | |
| 56. <i>Sonchus asper</i> | |
| 57. <i>Stellaria media</i> | |
| 58. <i>Torenia asiatica</i> | |
| 59. <i>T. violacea</i> | |
| 60. <i>Trichosanthes wallichiana</i> | |
| 61. <i>Vernonia cinerea</i> | |
| 62. <i>V. anthelmintica</i> | |
| 63. <i>Vicia sativa</i> | |
| 64. <i>Viscum liquidambaricolum</i> | |
| 65. <i>Vitis heyneana</i> | |

In the present study there are 65 dicots species with their distribution from tropical to temperate zones and 50 dicots in the temperate to subalpine zones. In the tropical-temperate group the longest range of distribution is shown by *Hypericum japonicum*, *Oxalis corniculata*, *Persea clarkeana*, *Smithia ciliata*, *Solanum nigrum*, *Torenia asiatica* and *Vitis heyneana* which climb as high as upto 2500m in their distribution. In the temperate-subalpine group the longest ranging species are *Begonia sikkimensis*, *Chrysplenium nepalense*, *Duchesnea indica*, *Epilobium wallichianum*, *Hemiphragma heterophylla* and *Myriactis nepalensis*. These species descend down as low as upto 1500m altitude from subalpine region. An exception, even to these groups, *Lyonia ovalifolia* shows the longest range of adaptability in the district. Growing in different soil conditions and different habit forms this species ranges from about 800m in the subtropical zone to 3500m in the subalpine zone, exhibiting the minimum of ecological variations in its characters.

7.6 ENDEMIC VALUE OF THE FLORA

The restricted distribution of genera and species in the Himalayan and North East Indian hills forms another interesting field of study. In contrary to J.D. Hooker's contention (1849, 1906) that Indian flora is a representation of migratory elements from surrounding countries, D. Chatterjee (1940, 1960) cited that 60% of the Indian flora are of the Indian origin and 40% of them are endemic to the country. The study of D. Chatterjee stands true to and has been supported by the Himalayan and N.E. Indian and Myanmari flora in particular. However, many plants e.g. *Aemanthera*, *Nardostachys*, *Eriophyton*, *Cortia* accounted by Chatterjee (1940) has been now, found to have their distribution in China. In the present study there are 405 dicot species in total, which show their different confinement zones, but occur between Eastern Himalaya and N.E. India including North Myanmar; and has been represented in Darjeeling district too. In this respect, Darjeeling has very distinctly contributed to the endemic flora of India.

The pattern and range of distribution of plants in the diverse Himalayan geographical conditions deserve categorised treatments and the following category of taxa are recognisable in the district:

1. Taxa restricted within Darjeeling
2. Taxa restricted within Darjeeling and Sikkim
3. Taxa restricted within Eastern Himalayas
4. Taxa distributed between Eastern Himalayas and N.E. India

In the present study 29 dicot species have been found to be endemic to Darjeeling alone while another 29 species are confined between Darjeeling and Sikkim. The restriction of species in other two wider zones show a larger number where 144 (excluding Darjeeling and Sikkim endemics) species are restricted within Eastern Himalayas and 203 species are distributed from E.Nepal to N.E. India and N. Myanmar (Table 7.6).

Table 7.6 Dicotyledonous species of Darjeeling with restricted distribution between E. Himalaya to N.E. India

Zones	No. of Species	% of total dicots
Darjeeling district	29	1.54
Darjeeling-Sikkim	29	1.54
E. Himalayas (E.Nepal-Arunachal Pradesh)	144	7.67
E.Himalayas to N.E.India	203	10.81

The taxa recorded to be endemic to Darjeeling and Darjeeling Sikkim zones are expected to be recorded from outside these zones in future studies. Therefore, it is better to consider them as Eastern Himalayan elements rather than Darjeeling and Darjeeling-Sikkim elements. But as is true in other 2 remaining wider zones also, the systematic survey of distribution plant species in other regions with their comparative assessment, will only reveal the real picture of their endemic status. The zone-wise enumeration of taxa having restricted distribution dealt here, has been made below.

A. ENDEMIC TO DARJEELING

29 species i.e 1.54% of the dicots are endemic to Darjeeling district alone. Some of these species such as *Siraitia sikkimensis*, *Rubus senchalensis*, *Streptocaulon sylvestre*, *Hoya longifolia* var. *darjeelingensis* are rare or endangered. The following enumeration has been made:

1. *Acer osmantonii*
2. *Ageratum eupatorifolium*
3. *Baliospermum calycinum* var. *nepalense*
4. *B. calycinum* var. *racemiferum*
5. *Beilschmiedia clarkei*
6. *Carlemannia congesta*
7. *Cestrum arboreum*
8. *C. odorum*
9. *Chrysoplenium singalilense*
10. *Codonopsis affinis*
11. *Cotoneaster sandakphuensis*
12. *Geum sikkimense*
13. *Hedyotis kalimpongensis*
14. *Hoya longifolia* var. *darjeelingensis*
15. *Hydrocotyle acutiloba*
16. *Lassiococca symphyllifolia*
17. *Lugularia pachycarpa*
18. *Macaranga gamblei*
19. *Maytenus sikkimensis*
20. *Mycetia stipulata*
21. *Panax pseudoginseng* var. *angustifolius* f. *serratus*
22. *P. pseudoginseng* var. *bipinnatifidus* f. *neoraensis*
23. *Persicaria microcephala* var. *wallichii*
24. *Phoebe hainesiana*
25. *Populus gamblei*
26. *Rhus succedanea* var. *himalaica*
27. *Rubus senchalensis*
28. *Siraitia sikkimensis*
29. *Streptocaulon sylvestre*

B. ENDEMIC TO DARJEELING-SIKKIM HIMALAYAS

Since the district of Darjeeling shares its border for a long range, from Singalila mountains to Rachela across River Teesta, with Sikkim, the physiographic and climatic conditions do also show their similarity with occasional exceptions. In this case Darjeeling-Sikkim Himalayas, rather form a distinct unit of physiography and plant ecology. Therefore, it is expected that the region harbours a good number of endemic species which show their distribution in both Sikkim and Darjeeling. The following 29 dicot species (1.5%) have been found as endemic to this region:

1. *Ardisia involucrata*
2. *Begonia flaviflora*
3. *B. satrapis*
4. *B. xanthina*
5. *Chisocheton cumingianus*
6. *Chirita calva*
7. *Cissus spectabilis*
8. *Clematis acuminata* var. *sikkimensis*
9. *Clematis tongluensis*
10. *Derris microptera*
11. *Dittoceras andersonii*
12. *Hypericum gracilipes* (upto E. Nepal)
13. *Impatiens graciliflora*
14. *I. pradhanii* (upto E. Nepal)
15. *I. uncipectala*
16. *Kadsura heteroclita*
17. *Miliusa longifolia*
18. *Persea fructifera*
19. *Rhododendron arboreum* var. *cinnamomeum*
20. *Sonerilla kurzii*
21. *Sorbus insignis*
22. *Stellaria lanata*
23. *Strobilanthus oligocephalus*
24. *S. urophyllus*
25. *Swertia pedicellata*
26. *Tachelosperm axillare*
27. *Tripterospermum nigrobaccatum*
28. *Tournefortia hookeri*
29. *Vigna clarkei*

C.RESTRICTED WITHIN E. HIMALAYA

Of the three phytogeographical divisions of the Himalayas (Chatterjee 1959), the Eastern Himalayas have been identified from Eastern Nepal to Arunachal Pradesh (North Assam), Darjeeling, Sikkim and Bhutan (chronologically) fall in between. A large number of plants (144 dicot species as 7.67% of dicots) occurring in Darjeeling alone show their restricted distribution to this region. The following enumeration shows the dicot species of this category:

1. *Acanthus carduaceus*
2. *Acer hookeri*
3. *A. pectinatum*
4. *Actinidia strigosa*
5. *Agapetes hookeri*
6. *A. saligna*
7. *Agapetes smithiana*
8. *Ajuga macrosperma*
9. *Arenaria debilis*
10. *Argyrea atropurpurea*
11. *Aristolochia griffithii*
12. *A. nakaoui*
13. *Asarum himalaicum*
14. *Aster sikkimensis*
15. *A. tricephalus*
16. *Astragalus sikkimensis*
17. *A. stipulatus*
18. *Asystasia macrocarpa*
19. *Begonia gemmipara*
20. *B. nepalensis*
21. *B. rubella*
22. *B. sikkimensis*
23. *Beilschmiedia gammieana*
24. *Berberis hookeri*
25. *Berchemia flavescens*
26. *Biswaraea tonglensis*
27. *Boehmeria macrophylla* var. *canescens*
28. *Brassaiopsis mitis*
29. *Buddleja colveili* var. *nepalensis*
30. *Cacalia mortoni*
31. *Callicarpa vestita*
32. *Cardamine yunnanensis*
33. *Cathcartia villosa*
34. *Chirita primulacea*
35. *Cicerbita macrantha*
36. *Cinnamomum tenuipilis*
37. *Cirsium wallichii*
73. *I. puberula*
74. *I. stenantha*
75. *Lonicera myrtilloides*
76. *Lysionotus atropurpureus*
77. *Mahonia napaulensis*
78. *Marsdenia calesiana*
79. *Maytenus kurzii*
80. *Merrilliopanax alpinus*
81. *Microsisymbrium axillare*
82. *Mussaenda roxburghii*
83. *Neanotis gracilis*
84. *Ophiorrhiza nutans*
85. *O. succirubra*
86. *O. thomsonii*
87. *Pedicularis flexuosa*
88. *Persea clarkeana*
89. *Phyllanthus glaucus*
90. *Pilea approximata*
91. *P. bracteata* var. *oxydon*
92. *P. ternifolia*
93. *Piper chuyva*
94. *Pogostemon tuberculosus*
95. *Populus glauca*
96. *Porana grandiflora*
97. *P. stenoloba*
98. *Potentilla peduncularis*
99. *Pouzolzia sanguinea*
100. *Premna bracteata*
101. *P. latifolia* var. *gamblei*
102. *Primula irregularis*
103. *P. rotundifolia*
104. *P. scapigera*
105. *Pteracanthus agrestis*
106. *Pueraria sikkimensis*
107. *Pyrolaria edulis*
108. *Randia sikkimensis*

38. *Codonopsis inflata*
 39. *Combretum wallichii*
 40. *Conyza angustifolia*
 41. *Corydalis geraniifolia*
 42. *Cremanthodium reniforme*
 43. *Daphne bholua* var. *glacialis*
 44. *Decaisnea insignis*
 45. *Derris cuneifolia*
 46. *Didymocarpus albicalyx*
 47. *D. andersonii*
 48. *D. pseudocarpus*
 49. *D. pulcher*
 50. *Dipsacus atratus*
 51. *Echinacanthus attenuatus*
 52. *E. longistylus*
 53. *Elaeagnus caudata*
 54. *Elatostema caveanum*
 55. *E. nasutum*
 56. *E. sikkimense*
 57. *E. subincisum*
 58. *Eranthemum splendens*
 59. *Eriobotrya dubia*
 60. *E. hookeriana*
 61. *Fragaria daltoniana*
 62. *Garcinia stipulata*
 63. *Gynocardia odorata*
 64. *Heracleum wallichii*
 65. *Hoya serpens*
 66. *Impatiens cathcartii*
 67. *I. cristata*
 68. *I. discolor*
 69. *I. falcifer*
 70. *I. longipes*
 71. *I. kingii*
 72. *I. occultans*
 109. *Reevesia pubescens*
 110. *Rheum acuminatum*
 111. *Rhododendron arboreum*
 spp. *cinnamomeum* var. *roseum*
 112. *R. fulgens*
 113. *R. maddenii*
 114. *Rubia charaefolia*
 115. *Rubus fragarioides*
 116. *R. griffithii*
 117. *R. inopertus*
 118. *R. splendidissimus*
 119. *Rungia himalayensis*
 120. *Salmonia cantoniensis*
 121. *Sauropus quadrangularis*
 122. *Scrophularia urticifolia*
 123. *Sedum griffithii*
 124. *Sloanea dasycarpa*
 125. *S. tomentosa*
 126. *Sorbus arachnoidea*
 127. *S. foliolosa*
 128. *S. hedlundii*
 129. *S. Kurzii*
 130. *S. rhamnoides*
 131. *S. wallichii*
 132. *Stellaria sikkimensis*
 133. *Strobilanthus thomsonii*
 134. *Symplocos pyrifolia*
 135. *Syzygium venosum*
 136. *Tetrastigma corymbosum*
 137. *Thunbergia lutea*
 138. *Trigonotis ovalifolia*
 139. *Vernonia subsessilis*
 140. *Viola hookeri*
 141. *V. paravaginata*
 142. *V. wallichiana*
 143. *Vitex heterophylla*
 144. *Wendlandia coriacea*

D. DISTRIBUTED FROM E. HIMALAYA TO N.E. INDIA

The restricted distribution of a number of taxa within the North Eastern India indicates a separate identity of the zone in the vegetational map. A large number of such plants show their range of occurrence from Eastern Himalayan regions. In the present consideration the taxa restricted between Eastern Himalayas and N.E. India, including Northern Myanmar have been taken, and it is observed

that 203 dicot species (10.81% Of dicots) of this group occur in Darjeeling district. The enumeration is as follows:

- | | |
|---------------------------------------|--|
| 1. <i>Acer thomsonii</i> | 103. <i>I. trilobata</i> |
| 2. <i>Actinodaphne angustifolia</i> | 104. <i>I. tripetala</i> |
| 3. <i>A. longipes</i> | 105. <i>Ixora corymbosa</i> |
| 4. <i>A. sikkimensis</i> | 106. <i>I. undulata</i> |
| 5. <i>Aeschynanthus gracilis</i> | 107. <i>Jasminum anastomosans</i> |
| 6. <i>A. sikkimensis</i> | 108. <i>J. nepalense</i> |
| 7. <i>Agapetes auriculata</i> | 109. <i>Knema erratica</i> |
| 8. <i>A. serpens</i> var. <i>alba</i> | 110. <i>K. tenuinervia</i> |
| 9. <i>Aglaia perviridis</i> | 111. <i>Lasianthus sikkimensis</i> |
| 10. <i>A. spectabilis</i> | 112. <i>L. biermanni</i> |
| 11. <i>Ailanthus integrifolia</i> | 113. <i>Leea aequata</i> |
| 12. <i>Alangium alpinum</i> | 114. <i>L. indica</i> |
| 13. <i>Alchornea mollis</i> | 115. <i>Lindera assamica</i> |
| 14. <i>Ampelocissus sikkimensis</i> | 116. <i>L. hamiltonii</i> |
| 15. <i>Ardisia thyrsoiflora</i> | 117. <i>L. pulcherrima</i> |
| 16. <i>Aralia armata</i> | 118. <i>Litsea albescens</i> |
| 17. <i>A. foliolosa</i> | 119. <i>L. hookeri</i> |
| 18. <i>Argyreia hookeri</i> | 120. <i>L. panamanja</i> |
| 19. <i>A. roxburghii</i> | 121. <i>L. salicifolia</i> var. <i>polyneura</i> |
| 20. <i>A. wallichii</i> | 122. <i>Lithocarpus elegans</i> |
| 21. <i>Aristolochia cathcartii</i> | 123. <i>L. pachyphyllus</i> |
| 22. <i>A. platanifolia</i> | 124. <i>Loranthus odoratus</i> |
| 23. <i>Artabotrys caudatus</i> | 125. <i>Lycianthes biflora</i> |
| 24. <i>Aucuba himalaica</i> | 126. <i>Mallotus roxburghianus</i> |
| 25. <i>Baliospermum calycinum</i> | 127. <i>Mesua floribunda</i> |
| 26. <i>Bauhinia wallichii</i> | 128. <i>Microchites elliptica</i> |
| 27. <i>Begonia dioica</i> | 129. <i>Microtropis discolor</i> |
| 28. <i>B. hatacoa</i> | 130. <i>Milletia glaucescens</i> |
| 29. <i>B. josephii</i> | 131. <i>Morinda angustifolia</i> |
| 30. <i>B. ovatifolia</i> | 132. <i>Mussaenda incana</i> |
| 31. <i>B. roxburghii</i> | 133. <i>Munronia pinnata</i> |
| 32. <i>Beilschmiedia dalzellii</i> | 134. <i>Ophiorrhiza fasciculata</i> |
| 33. <i>B. roxburghiana</i> | 135. <i>O. treulteri</i> |
| 34. <i>Beaumontia grandiflora</i> | 136. <i>Orthosiphon incurvis</i> |
| 35. <i>Berberis insignis</i> | 137. <i>Osbeckia nutans</i> |
| 36. <i>Blumea myrioccephala</i> | 138. <i>Parthenocissus semicordata</i> |
| 37. <i>Brassaiopsis hispida</i> | 139. <i>Passiflora geminiflora</i> |
| 38. <i>Broussonetia kurzii</i> | 140. <i>Pedicularis furfuracea</i> |
| 39. <i>Butea buteiformis</i> | 141. <i>Persea kurzii</i> |
| 40. <i>Capparis olacifolia</i> | 142. <i>P. minutiflora</i> |
| 41. <i>Casearea kurzii</i> | 143. <i>Phoebe attenuata</i> |

42. *C. vareca*
43. *Castanopsis lanceifolia*
44. *Cayratia japonica* var. *mollis*
45. *Chonemorpha griffithii*
46. *Cinnamomum glaucescens*
47. *C. tamala*
48. *Clerodendrum bracteatum*
49. *Corydalis chaerophylla*
50. *C. leptocarpa*
51. *Croton himalaicus*
52. *Cryptocarya amygdalina*
53. *Cyclea bicristata*
54. *Daphne sureil*
55. *Desmodium confertum* var. *gracilifolia*
56. *D. volubilis*
57. *Dicentra roylei*
58. *Dobinea vulgaris*
59. *Docynia indica*
60. *Dodecadenia grandiflora*
61. *Drypetes assamica*
62. *D. indica*
63. *D. subsessilis*
64. *Dufrenoya granulata*
65. *Dunbaria circinalis*
66. *D. debilis*
67. *Dysoxylum excelsum*
68. *D. mollissimum*
69. *D. reticulatum*
70. *Ehretia wallichiana*
71. *Elaeagnus conferta*
72. *E. pyriformis*
73. *Elaeocarpus sikkimensis*
74. *Elatostema reptans*
75. *Embelia vestita*
76. *Enkianthus deflexus*
77. *Eriobotrya petiolata*
78. *Garcinia anomala*
79. *G. xanthochymus*
80. *Gardneria angustifolia*
81. *Garuga floribunda*
82. *Gaultheria fragrantissima*
83. *G. griffithiana*
84. *G. pyroloides*
144. *Photinia arguta*
145. *Pieris formosa*
146. *Pilea cordifolia*
147. *P. hookeriana*
148. *Piper khasicum*
149. *P. sylvaticum*
150. *Pogostemon brachystachyus*
151. *Protium serratum*
152. *Prunus rufa* var. *tricantha*
153. *Psychotria erratica*
154. *Pueraria lobata* var. *thomsonii*
155. *Randia fasciculata*
156. *Rhabdosia lophanthoides*
157. *Rhododendron campylocarpum*
158. *R. dalhousiae*
159. *R. decipiens*
160. *R. falconeri*
161. *R. wallichii*
162. *Rhus griffithii*
163. *R. hookeri*
164. *Rhynchodia wallichii*
165. *Rhynchosia harae*
166. *Rubia sikkimensis*
167. *Rubus calysinoides*
168. *R. efferatus*
169. *R. paniculatus*
170. *Salacia salacioides*
171. *Sarchochlamys pulcherrima*
172. *Sarcosperma arboreum*
173. *Sauropus repandus*
174. *Saurauja punduana*
175. *S. roxburghii*
176. *Sideroxylon hookeri*
178. *Spiraea micrantha*
179. *Solanum barbisetum*
180. *Stephania glandulifera*
181. *Sterculia lanceifolia*
182. *Stixis graveolens*
183. *Styrax hookeri*
184. *Syzygium balsameum*
185. *S. kurzii*
186. *S. ramosissimum*

- | | |
|----------------------------------|--------------------------------------|
| 85. <i>Glochidion khasicum</i> | 187. <i>S. wallichii</i> |
| 86. <i>G. oblatum</i> | 188. <i>Tetrastigma bracteolatum</i> |
| 87. <i>G. sphaerogynum</i> | 189. <i>I. campylocarpum</i> |
| 88. <i>G. thomsonii</i> | 190. <i>I. rumiscispermum</i> |
| 89. <i>Goldfussia capitata</i> | 191. <i>Trichosanthes truncata</i> |
| 90. <i>G. colorata</i> | 192. <i>Treuttera insignis</i> |
| 91. <i>Helicteres elongata</i> | 193. <i>Uncaria macrophylla</i> |
| 92. <i>H. plebeja</i> | 194. <i>U. sessilifructus</i> |
| 93. <i>Horsfieldia kingii</i> | 195. <i>Uvaria lurida</i> |
| 94. <i>Hoya globulosa</i> | 196. <i>Vaccinium nummularia</i> |
| 95. <i>Hydocotyle himalaica</i> | 197. <i>V. retusum</i> |
| 96. <i>Hypericum hookerianum</i> | 198. <i>V. vacciniaceum</i> |
| 97. <i>Ilex crenata</i> | 199. <i>Vernonia extensa</i> |
| 98. <i>Impatiens bracteata</i> | 200. <i>V. talaumifolia</i> |
| 99. <i>I. drepanophora</i> | 201. <i>Viola thomsonii</i> |
| 100. <i>I. jurpia</i> | 202. <i>Wendlandia wallichii</i> |
| 101. <i>I. pulchra</i> | 203. <i>Zanthoxylum oxyphyllum</i> |
| 102. <i>I. radiata</i> | |

7.7 EXOTIC ELEMENTS IN THE FLORA

The exotic elements are one of the important features in the flora of Eastern Himalayas. They form a good percentage of the flora of Darjeeling. Many exotics have either naturalised or are in the way of naturalisation. The exotic plants have been either introduced for providing additional plant resources for food, fibre, fruits, flowers and drugs or migrated through human transports or natural dispersal. Some of the latter category of exotics have abundantly naturalised.

The great Himalayan mountain system with its altitude, width, physiography and nature of permanent snow cover acts as a natural barrier to free migration of plants from outside, and, for that matter effects endemism in the Himalayan flora. However, natural migration has taken place from three directions: (1) Comparitively low altitude hills of North East India allowed the entry of South East Asiatic plants. (2) The European elements migrated through the mountain systems in different parallel lines. (3) Different tropical and subtropical plants of Deccan and Peninsular India migrated through vast plains of Central India. The natural migratory process has effected the entry of numerous plants from Malaysian, Chinese, Australian and North African regions (Champion & Seth 1968). Many of these plants have naturalised here and thus became integral part of the flora and vegetation. Biswas (1940), Hara 1966, 1971; Ohashi (1975), Mathew (1981), Yonzone *et al.* (1970), Das (1984, 1986), Bhujel & Yonzone (1985), Bhujel & Das (1995) have further recorded exoitic plants in the East-ern Himalayan region including Darjeeling.

The migration took place during pleistocene period. Different geological phenomena aided to this process creating a continuous process. Land bridge connections and marine carriages could probably be accounted as the migratory route between Malaysia, Sri Lanka, the Andamans and South India. The route could also have been circuitous (Puri 1960). For a number of plants, migration was a long process. The exotics after arriving, acclamatisation, propagation and naturalisation have even further differentiated to give yield to new species and varities (Bhujel, 1995).

Along the migration of different civilisation, exotic species entered this region. Establishment of British colonies, Tea gardens and Llyod Botanical Garden in Darjeeling prompted the incoming of several exotics through human agencies. Most of the exotic weeds have found their entry along with food grains carried to the region by missionary services. The ornamental and edible exotics, however, were brought to the region on purpose.

In the height of these points the exotic plants may be grouped to - (a) Migratory species, and (b) Introduced species.

It seems, necessary to clarify here that exotic plants are **native of a particular region/nation and of known origin outside Himalayas** which have entered to this region recently and directly. They have a distinction with naturally migrating and immigrating species which spread and arrive following stepwise distribution pattern, and through the process that has taken place since, ages not clearly known to us. The latter category of plants have a wider distribution whose status of origin, in fact, seems to be a doubtful case owing to the incomplete information.

The migratory exotics (Table 7.7) considered here are those species which have indirectly taken help of human agencies for their entry e.g. through marine carriage, food grains, clothes and others.

The introduced exotics may again be divided to following groups (Table 7.7):

- (1) Ornamental plants
- (2) Edible fruit plants
- (3) Other economically useful plants

Among the exotics there are a large number of plants restricted to cultivation only, which cannot be taken into the category of naturalised species. Therefore, for the sake of providing a distinct category and standing true to the nature of this floristic work **only the naturalised species have been considered here.**

Most of the exotic elements of this region are American in origin. However, Chinese, Australian, European and Siberian plants have been recorded. A categorical enumeration has been made as follows (Table 7.7):

Dicotyledonous Exotic species of Darjeeling District

A. North and Central American

Name of the species	Family	Probable means of entry	Purpose/usefulness
1. <i>Anaphalis margaritacea</i>	Compositae	M	-
2. <i>Ceiba pentandra</i>	Bombacaceae	I	Orn/Timber
3. <i>Cestrum aurantiacum</i>	Solanaceae	I	Orn
4. <i>C. nocturnum</i>	"	I	-
5. <i>Crassocephalum crepidioides</i>	Compositae	M	-
6. <i>Duranta repens</i>	Verbenaceae	I	Orn
7. <i>Erigeron canadensis</i>	Compositae	I	-
8. <i>Eupatorium adenophorum</i>	"	M	-
9. <i>E. ligustrinum</i>	"	M	-

10. <i>E. odoratum</i>	"	M	-
11. <i>Euphorbia pulcherrima</i>	Euphorbiaceae	I	Orn.
12. <i>Hyptis suaveolens</i>	Labiatae	I	Orn
13. <i>Jatropha curcas</i>	Euphorbiaceae	I	Orn/Hedge pl.
14. <i>Rotala mexicana</i>	Lythraceae	M	-
15. <i>Scoparia dulcis</i>	Scrophulariaceae	M	-
16. <i>Solanum mauritianum</i>	Solanaceae	I	Orn
17. <i>Synedrella nodiflora</i>	Compositae	M	-

B. Tropical and South American

18. <i>Argemone mexicana</i>	Papaveraceae	M	-
19. <i>Asclepias curassavica</i>	Asclepiadaceae	I	Orn
20. <i>Borreria alata</i>	Rubiaceae	M	-
21. <i>Cathranthus roseus</i>	Apocynaceae	M	-
22. <i>Corchorus aestuans</i>	Tiliaceae	M	-
23. <i>Crotalaria pallida</i>	Leguminosae	I	Orn
24. <i>Croton bonplandianus</i>	Euphorbiaceae	M	-
25. <i>Datura metel</i>	Solanaceae	I	Orn.
26. <i>D. stramonium</i>	"	I	-
27. <i>D. suaveolens</i>	"	I	-
28. <i>Drymaria villosa</i>	Caryophyllaceae	M	-
29. <i>Galinsoga parviflora</i>	Compositae	M	-
30. <i>Gomphrena celosioides</i>	Amaranthaceae	I	Orn
31. <i>Lantana camara</i>	Verbenaceae	I	Hedge plant
32. <i>Martynia annua</i>	Pedaliaceae	M	-
33. <i>Mikania micrantha</i>	Compositae	M	-
34. <i>Mirabilis jalapa</i>	Nyctaginaceae	I	Orn
35. <i>Nicandra physaloides</i>	Solanaceae	M	-
36. <i>Oxalis corymbosa</i>	Oxalidaceae	M	-
37. <i>O. latifolia</i>	"	M	-
38. <i>Pithecelobium dulce</i>	Leguminosae	I	-
39. <i>Physalis peruviana</i>	Solanaceae	I	Orn
40. <i>Plumeria rubra</i>	Apocynaceae	I	Orn
41. <i>Solanum aculeatissimum</i>	Solanaceae	I	Orn
42. <i>S. myriacanthum</i>	"	I	-
43. <i>S. jasminoides</i>	"	I	-
44. <i>Tridax procumbens</i>	Compositae	M	-

C. Mexican

45. <i>Achimenes longiflora</i>	Gesneriaceae	I	Orn
46. <i>Ageratum houstonianum</i>	Compositae	M	-
47. <i>Calceolaria gracilis</i>	Scrophulariaceae	M	-

48. <i>Erigeron karvinskianus</i>	Compositae	I	Orn
49. <i>Galinsoga quadriradiata</i>	Compositae	M	-
50. <i>Oxalis tetraphylla</i>	Oxalidaceae	M	-
51. <i>Tithonia diversifolia</i>	Compositae	M	-

D. Chinese

52. <i>Jasminum mesneyi</i>	Oleaceae	I	Orn
53. <i>Ligustrum lucidum</i>	"	I	-
54. <i>Primula melacoides</i>	Primulaceae	M	-
55. <i>Saxifraga sarmentosa</i>	Saxifragaceae	M	-

E. Tropical African

56. <i>Borreria repens</i>	Rubiaceae	M	-
57. <i>Evolvulus nummularioides</i>	Convolvulaceae	I	Orn
58. <i>Passiflora foetida</i>	Passifloraceae	I	Orn
59. <i>Ricinus communis</i>	Euphorbiaceae	I	Ed. oil.
60. <i>Sanicula elata</i>	Umbelliferae	M	-
61. <i>Vigna umbellata</i>	Leguminosae	I	-
62. <i>Zizyphus mauritiana</i>	Rhamnaceae	I	Ed. Fr.

F. European and Temperate Eurasian

63. <i>Cardamine flexuosa</i>	Cruciferae	M	-
64. <i>C. hirsuta</i>	"	M	-
65. <i>Linaria cymbalaria</i>	Scrophulariaceae	M	-
66. <i>Thlaspi arvense</i>	Cruciferae	M	-
67. <i>Trifolium pratense</i>	Leguminosae	M	-

G. European-American

68. <i>Mentha arvensis</i>	Labiatae	I	Ed. pl.
69. <i>Potentilla abruscula</i>	Rosaceae	M	-
70. <i>Stellaria media</i> var. <i>procera</i>	Caryophyllaceae	M	-

H. Afro-European

71. <i>Cleome ruidosperma</i>	Capparaceae	M	-
72. <i>Lepidium sativum</i>	Cruciferae	M	-
73. <i>Trifolium repens</i>	Leguminosae	M	-

I. Tropical Asaitic -Australian

74. <i>Cleome viscosa</i>	Capparaceae	M	-
75. <i>Hydrocotyle sibthorpioides</i>	Umbelliferae	M	-
76. <i>Melia dubia</i>	Meliaceae	I	Orn

77. *Tabernaemontana divaricata* Apocynaceae I Orn

J. Afro-Asiatic

78. *Nasturtium officinale* Cruciferae M -

79. *Vicia sativa* Leguminosae M -

K. Others

80. *Cannabis sativa* Cannabaceae I Narcotics (Central Asiatic)

81. *Deutzia crenata* Saxifragaceae I Orn (Japanese)

82. *Lantana indica* Verbenaceae M - (Central Indian)

83. *Euphorbia antiquorum* Euphorbiaceae I Orn

84. *Ipomoea carnea* Convolvulaceae M - (New World Tropics)

85. *I. purpurea* " I Orn (New World Tropics)

86. *Solanum torvum* Solanaceae M - (West Indies)

Abbreviations: I= Introduced; M=migrated; Orn=ornamental; Ed=edible; Pl=plant

In the category of naturalised exotics there are 86 species in the flora of Darjeeling (enumeration Table 7.7). 39 species are introduced while 47 species have migrated. Among introduced species, it has been found that 33 species are ornamentals and the remaining seven species carry either edible or medicinal value.

In addition, there are a good number of exotics introduced for ornamental uses, edible value or for fruit plants and are restricted to cultivations. The common species like *Abelmoschus esculentus*, *Al-lamanda cathartica*, *Bixa orellana*, *Bougainvillea glabra*, *Brassica juncea*, *B.oleracea*, *B.rapa*, *Callistemon citrinus*, *Carica papaya*, *Cinchona ledgeriana*, *C.calisaya*, *Cinnamomum camphora*, *Cyphomandra betacea*, *Delonix regia*, *Dianthus chinensis*, *Eucalyptus saligna*, *Glycine max*, *Guizotia abyssinica*, *Hibiscus rosa-chinensis*, *Malus baccata*, *Mentha piperita*, *Nerium indicum*, *Nicotiana glauca*, *Opuntia dillenii* and other spp., *Prunus persica*, *Psidium guajava*, *Pyrostegia venusta*, *Pyrus communis*, *Raphanus sativus*, *Sechium edule*, *Tagetes patula* and many others are cultivated exotics on economic and/or ornamental purposes.

On the influence of exotic plants on the vegetation of Darjeeling Biswas (1940) estimated the presence of about 50% exotics in the area. The contention, however, does not stand true in the natural flora. In the present study only 4.5% of naturalised dicotyledonous species are recorded as exotics.

The influence of exotic plants have not become good in many occasions, on the ecological grounds. The new entrants to the Darjeeling flora particularly the abnoxious weeds have become the factors to upset ecological balance and create unhygeinic atmosphere. The dominant and aggressive exotics like *Lantana camara*, *L.indica*, *Eupatorium odoratum*, *E.adenophorum*, *Cestrum aurantiacum*, *Tithonia diversifolia*, have become difficult elements to do away with. In addition to removing the local and basic flora in many places these exotics have created their own forests and microclimate in those places. A number of other exotic weeds have dominated the ground flora or even formed pure communities. Such species are *Ageratum conyzoides*, *A.houstonianum*, *Borreria alata*, *B.repens*, *Cannabis sativa*, *Erigeron karvinskianus*, *Galinsoga quadriradiata*. The alarming propagation rate of these exotics is, in a way, a threat to the environmental conditions of the hills as a whole, especially due to their adverse effect on the local flora.

7.8 FLOWERING AND FRUITING PERIODS

On a broad consideration and seasonwise grouping the flowering and fruiting periods cannot give a distinct account. There will be several cases of overlapping. Depending upon the climatic zones the same species flowers at different months/periods at different altitudes, as for example *Rhododendron arboreum* flowers in February-March around 2000m altitude and in April-May above 3000m. It is observed that even the peak periods of flowering and fruiting vary as per altitude. The common weeds such as *Ageratum conyzoides*, *Galinsoga parviflora*, *Solanum nigrum* flower throughout the year at the same place. Therefore, a detailed record of the flowering and fruiting periods of these plants is of tremendous value in many other fields of science. In the description of individual dicot species (Chapter VI), the flowering and fruiting periods have been recorded individually, for this purpose.

However, the seasonwise consideration will show the maximum and minimum concentration of flowering and fruiting of plants for a particular season for the district of Darjeeling. This will be helpful to the botanists, plant collectors and foresters to work out their excursion and other field programmes and especially so for those distant and overseas visitors who are coming to this region for the first time.

7.8.1 FLOWERING SEASONS

It will be convenient to divide a flowering year into four seasons taking the flowering months:

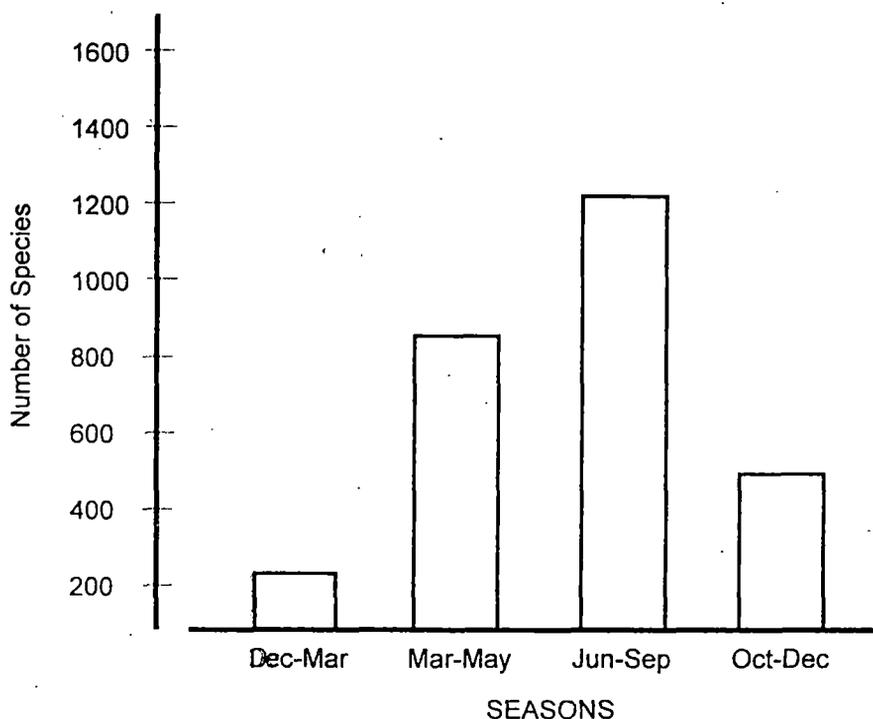
- (1) December-March, Dry cold winter.
- (2) March-May, Dry hot season.
- (3) June-September, Monsoon/Rainy Season.
- (4) October-December, Autumn and beginning of Winter
(Species avoiding heavy rain for flowering).

In this pattern of observation the maximum of flowering concentration has been observed in Monsoon season (June-September), while the least is recorded in Dry cold Winter (December-March). The approximate number of flowering dicots are as follows:

Dec-Mar	= 0224 species
Mar-May	= 0886 "
Jun-Sep	= 1305 "
Oct-Dec	= 0493 "

There are a good number of flowering in the hot summer (with frequent or irregular rain). A large number of plants, especially herbs remain in flowering conditions for more than one season while some of them flower throughout the year. The flowering of such plants have been accounted in all seasons (inclusive). The season-wise flowering of dicotyledonous species in Darjeeling district can be diagrammatically represented as in figure 7.8.1.:

Figure 7.8.1 Season-wise presentation of flowering periods of dicots in Darjeeling



I

7.8.2 FRUITING

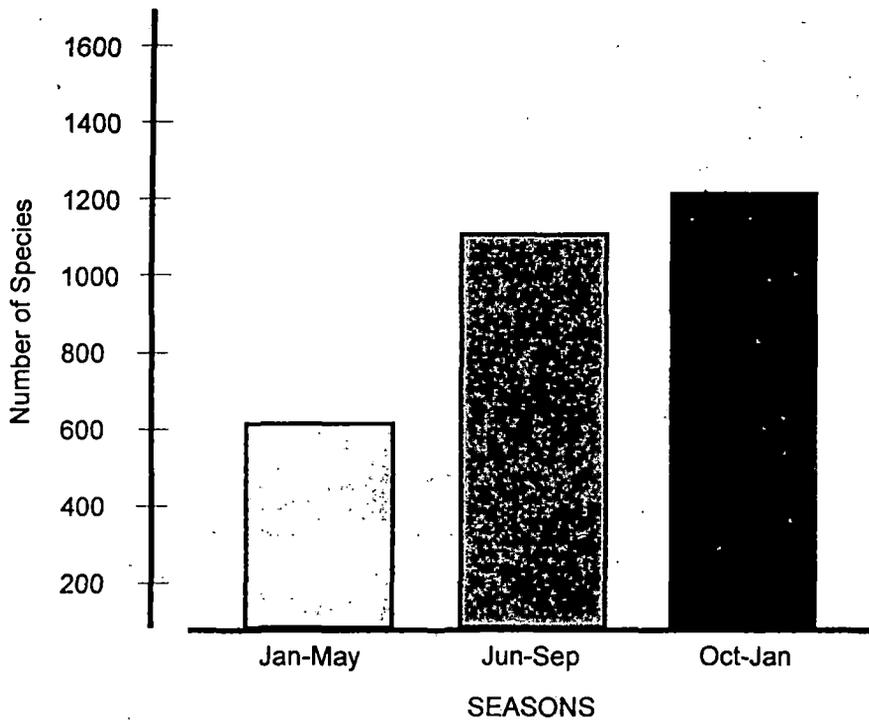
The fruiting periods can be clearly categorised into three seasons only. They are :

1. Winter = Oct-Jan
2. Late Winter and Summer = Jan-May
3. Monsoon = Jun-Sep

The fruiting period demarcation is not distinct for autumn, winter and late winter, and thus represent a mixed interpretation. Moreover, the diverse manner of fruiting, among dicot species, stands against such a groupwise treatment. Many dicots such as *Rhododendron*, *Terminalia*; *Quercus* and other species, especially of subalpine region bear the fruits much later after flowering. The species like *Exbucklandia populnea*, *Lithocarpus pachyphyllus* and the common weeds bearing the flowers on all seasons, are seen to bear the fruit on them throughout the year. The fruits of some species like *Alnus nepalensis* and *Shorea robusta* bear the seeds which are viable for only a few days or at maximum, a few weeks.

The maximum number of dicots in the fruiting conditions is observed during October-January (1258 species). Many species producing flowers in the monsoon, extend their fruiting period to this season, while several late fruiting species are also included. An almost equally high number of species (1165 species) are found to bear fruit in the monsoon season. The least number (603 species) is recorded for late winter and summer (January-May). It should again be noted that many species remain in fruiting conditions for more than one season and are countable accordingly. The diagrammatic representation (figure 7.8.2) is given below:

Figure 7.8.2 Season-wise fruiting periods : a diagrammatic presentation for the dicto of Darjeeling district



7.9 RECORDS OF THE THREATENED PLANTS

The 'International Union for Conservation of Nature and Natural Resources' (IUCN) have estimated that about 10% of the world's vascular plant species totalling about 20,000-25,000 species are under varying degrees of threat (Nayar & Shastry 1987). Studies undertaken in several parts of the world in the past 2-3 decades have shown that many plant species are in danger of extinction while some have already succumbed to this category. The awareness towards saving and protecting such category of plants has however, been growing worldwide.

Under the study of the dicotyledonous flora of Darjeeling the survey and recording of such category of plants were simultaneously carried out during 1984-1994. The data is based on repeated visits to the locality of occurrence and study of their distribution, frequency and present status within the district of Darjeeling.

The classification of these species under IUCN categories is based on the following definitions of terms (in accordance to Nayar & Shastry 1987):

Extinct (Ex): Taxa which are no longer known to exist in wild condition, after repeated searches of type and other known localities, but known to exist only in cultivation, fall in this category.

Threatened(T): The term is used in conservation context for species which are either *Endangered*, *Vulnerable* or *Rare*.

Endangered (E): Taxa in danger of extinction and whose survival is unlikely if the causal factors continue to be operating. They are deemed to be in immediate danger of extinction.

Vulnerable (V): Taxa likely to move into the Endangered category in near future if the causal factors continue operating. Taxa with still abundant population but under serious threat throughout their range from adverse factors, such as over exploitation, extensive destruction of habitat and/or environmental disturbance, fall in this category.

Rare (R): Taxa with small 'world population' that are not at present endangered or vulnerable but are at risk. These taxa are located within the restricted geographical area and are thinly distributed over more extensive range.

Out of Danger (O): Taxa formerly included in one of the above categories but now relatively considered secure.

Indeterminate (I): Taxa that are suspected of belonging to categories of either Extinct, Endangered, Vulnerable or Rare but without sufficient information to confirm the category, fall in this category.

In the present environmental conditions as many as 156 (8.31%) dicotyledonous species have been found to belong to different categories of threatened plants.

The factors responsible for putting these species to the degree of threat and rarity are more than one. The obvious factors in operation (as per the specification of Nayar & Shastry 1987) are:

1. **Ecological:** Standing true to Darwin's theory of 'survival of the fittest' a species or a group of them is replaced by a competitive species/groups. In addition, many Himalayan plants are subject to:
 - a. Poor/Slow natural regeneration in the environment.
 - b. Climatic variation (for certain species requiring stable habitat).
 - c. Physiographic effects (confining a number of species to a certain locality, thereby restricting the dispersal of fruits and seeds).
2. **Biological:** The loss of chances of cross pollination leading to loss of gene flow is brought about by decimation of many pollen vectors which are specific to a certain plant species, especially due to loss of habitat.
3. **Pathological:** Plant diseases are not uncommon but any distinct threat to a wild species has not been recorded in the present work. But the disastrous effect has been brought about by monoculture plantations. The allelopathic effect caused by the secretion of acids from the roots of *Cryptomeria japonica* is a common example. Moreover, the planted forests create their own microclimate, unsuitable for the other plant groups to thrive.
4. **Habitat destruction:** The growing human population has become a curse to the forests. The induction of changes by man in the form of buildings, forestry plantations, tourism, roads, poaching and installation of water and hydroelectric projects, in effect, has threatened many plant species.
5. **Over exploitation:** Man is responsible for direct destruction of several plant species. The evergrowing greed of man has given a sinister effect to the plant population world wide. The regional causes are as follows:
 - (1) Indiscriminate felling of timber trees and other useful species (by legal and illegal methods), causing a continuous decline in their population and loss of habitat for the undergrowing plant groups.

- (2) Extensive and haphazard collection of wild plants by commercial collectors (mainly medicinal and ornamental species).
- (3) Haphazard cattle grazing.
- (4) Installing of forest villages (at par to shifting cultivation).
- (5) Setting forest fire.

The threatened dicot species of Darjeeling district may be accounted to following categories (Table 7.9):

Table 7.9 Threatened Dicot Angiosperms of Darjeeling District

Category	No. of Species	% of total Dicots
Endangered	15	0.79
Vulnerable	26	1.38
Rare	82	4.36
Out of danger	24	1.27
Indeterminate	9	0.47
Total	156	8.31

Endangered: The dicot species of this group are collected from one or few places only to which they are confined. Among these, *Streptocaulon sylvestre* thought to have become extinct, has been rediscovered (Das 1995) from the plains of the district. *Mesua floribunda* considered as non-existent/wiped out, has been recorded from Jaldhaka (Bhujel 1995). *Beumontia grandiflora* expected to be a common climber is located in wild condition at two places only; however, this species is planted in a few nursery gardens. Existence of *Macaranga gamblei* including its specific status is still doubtful. The following is the list of the endangered species:

Name of the Plant	Family	Locality of Collection
1. <i>Ceropegia longifolia</i> var. <i>darjeelingensis</i> Bhujel & Das	Asclepiadaceae	Rungdung valley, 1200m (Darjeeling)
2. <i>Balanophora involucrata</i> Hook.f.	Balanophoraceae	Jaributti, 2250m. (Neora valley)
3. <i>B. polyandra</i> Griff.	"	Labha 1500m.
4. <i>Beumontia grandiflora</i> Wall.	Apocynaceae	Tarkhola 500m(Kalimpong)
5. <i>Macaranga gamblei</i> Hook.f.	Euphorbiaceae	Bamunpokhari 200m
6. <i>Mesua floribunda</i> (Wall.) Kostermans	Guttiferae	Jaldhaka 450m
7. <i>Rhododendron vaccinioides</i> Hook.f.	Ericaceae	Pankhasari 2300m
8. <i>Rheum acuminatum</i> Hook.f. & Thoms.	Polygonaceae	Phalut 3500m.
9. <i>Rubus senchalensis</i> Hara	Rosaceae	Senchale 2300m.
10. <i>Siraitia sikkimensis</i> (Chakrabarty) Jeffrey	Cucurbitaceae	Nazoke forest 400m.
11. <i>Streptocaulon sylvestre</i> Wt.	Asclepiadaceae	N.B.U. Campus 170m.
12. <i>Swertia pedicellata</i> Banerji	Gentianaceae	Aloobari 2400m.
13. <i>Tripterospermum nigrobaccatum</i> Hara	Gentianaceae	Raman Samanden 2500m.
14. <i>Valeriana jatamansi</i> Jones	Valerianaceae	Victoria fall 2000m.
15. <i>Viscum album</i> L.	Loranthaceae	Simkuna 2200m.

The medicinally valued plant *Valeriana jatamansi* is being cultivated at Ghoom Bhanjyang, Darjeeling along with *Panax pseudoginseng*, by the department of forests but the propagation rate and its

adaptation to this condition is far away from giving it an "out of danger" status. *Rubus senchalensis* is restricted to one locality near Senchale lake, where as, *Balanophora* spp., *Swertia pedicellata*, *Ceropegia longifolia* var. *darjeelingensis*, *Rhododendron vaccinioides*, *Rheum acuminatum* and *Tripterospermum nigrobaccatum* are ecologically threatened plants. The endangered parasitic species *Viscum album* has fallen victim to medicinal plant collectors in addition to its odd ecological habitat pattern. *Siraitia sikkimensis* collected by Chakrabarty (1959) has been located at one place only and this, is in the verge of extinction.

Vulnerable: This group of plants are under a continuous decline in population when in turn they are already rare, indicating a worse future status. In case of the species like *Naravelia zeylanica* (plant of ethnic myth), *Aconitum* spp. (Medicinal), *Mesua ferrea* (timber), *Rhododendron anthopogon* (incense), *Juglans regia* (timber), *Sapindus mukorossi* (saponiferous fruit wall), the threat has been brought about by man. It is surprising to note that *Swertia chirayita* (medicinal) a common herb of yester years has become vulnerable due to over exploitation by commercial collectors. The plants like *Euphorbia sikkimensis*, *Loxostigma griffithii*, *Panax pseudoginseng* var. *bipinnatifidus*, *Salix sikkimensis* are succumbing to the loss of habitat. The following list states the vulnerable plants in the district.

Name	Family	Locality of collection
1. <i>Aconitum bisma</i> (Hamilt.) Rapaics	Ranunculaceae	Kalapokhari 3300m
2. <i>A. spicatum</i> (Bruhl) Stapf	"	Sandakphu 3600m
3. <i>Aeschynanthus gracilis</i> Parish ex Clarke	Gesneriaceae	Yangmakum 800m
4. <i>A. parviflora</i> (D. Don) Sprengel	"	Baggaonra 2000m
5. <i>Bauhinia scandens</i> L.	Leguminosae	Lathpanjar 1000m
6. <i>B. wallichii</i> Macbride	"	Sukuna 350m
7. <i>Callicarpa rubella</i> Lindl.	Verbenaceae	Guling forest 900m
8. <i>Clematis tongluensis</i> (Bruhl) Tamura	Ranunculaceae	Jaunbari 2900m
9. <i>Colquhounia coccinea</i> Wall.	Labitae	Palmajua 2200m
10. <i>Euphorbia sikkimensis</i> Boiss	Euphorbiaceae	Jalapahar 2200m
11. <i>Ficus drupacea</i> Thunb.	Moraceae	Samsing 850m
12. <i>Juglans regia</i> L.	Juglandaceae	Sukiapokhari 2100m
13. <i>Loxostigma griffithii</i> (Wight) Clarke	Gesneriaceae	Aloobari (Darjeeling) 2100m
14. <i>Magnolia globosa</i> Hk. f. & T.	Magnoliaceae	Gairibas 2800m
15. <i>Mesua ferrea</i> L.	Guttiferae	Rongo 800m
16. <i>Naravelia zeylanica</i> (L.) DC.	Ranunculaceae	Lesh khola 500m
17. <i>Panax pseudoginseng</i> var. <i>bipinnatifidus</i> a. form <i>bipinnatifidus</i>	Araliaceae	Neora valley 2300m
b. form <i>neoraensis</i> Bhujel, Rai & Das	"	2200m
18. <i>Prunus cornuta</i> (Royle) Steudel	Rosaceae	Sandakphu 3400m
19. <i>Rhododendron anthopogon</i> D. Don	Ericaceae	Gosha 3600m
20. <i>Rubia charaefolia</i> Wall. ex G. Don	Rubiaceae	Munsong 1200m
21. <i>Salix sikkimensis</i> Anderson	Salicaceae	Phalut 3300m
22. <i>Sapindus mukorossi</i> Gaertner	Sapindaceae	Guling forest 800m

23. <i>Swertia chirayita</i> (Roxb. ex Fleming)	Karsten	Gentianaceae	Sukiapokhari 2200m
24. <i>Thalictrum chelidonii</i> DC.		Ranunculaceae	Kalapokhari 2500m
25. <i>T. cultratum</i> Wall.		"	Tangta 2600m
26. <i>Utricularia scandens</i> var. <i>firmula</i> (Oliver) Subram. & Banerji		Lentibulariaceae	Munsong 1800m

Rare: 82 dicot species constituting 4.36% of the total dicot species belong to the category of rare plants, which is a high figure for the flora of Darjeeling. As has already been mentioned the factors responsible for their status are more than one even for a single species. In the other hand the degree of rarity also varies from one species to the other. The dicot species considered under this head here, may or may not have a common/frequent occurrence in other regions, outside Darjeeling, and this requires a further detailed survey and study. The present list of rare plants have been provided below:

- | | |
|---|--|
| 1. <i>Achyranthes aquatica</i> | 46. <i>Maytenus sikkimensis</i> |
| 2. <i>Acronema tenerum</i> | 47. <i>Michelia doltsopa</i> |
| 3. <i>Agapetes serpens</i> var. <i>alba</i> | 48. <i>M. pterocarpa</i> |
| 4. <i>Anagallis arvensis</i> | 49. <i>Microchites elliptica</i> |
| 5. <i>Anemone rupicola</i> | 50. <i>Monotropa uniflora</i> |
| 6. <i>Ardisia involucrata</i> | 51. <i>Monotropastrum humile</i> |
| 7. <i>Aristolochia platanifolia</i> | 52. <i>Neolitsea foliolosa</i> |
| 8. <i>A. nakaoi</i> | 53. <i>Olea dioica</i> |
| 9. <i>Aster sikkimensis</i> | 54. <i>Panax pseudoginseng</i> var. <i>angustifolius</i>
f. <i>serratus</i> |
| 10. <i>Baliospermum calycinum</i> var. <i>racemiferum</i> (all forms) | |
| 11. <i>Bauhinia variegata</i> | 55. <i>Parabarium hookeri</i> |
| 12. <i>Beilschmiedia gammieana</i> | 56. <i>Periploca calophylla</i> |
| 13. <i>Berberis angulosa</i> | 57. <i>Phlomis macrophylla</i> |
| 14. <i>Boschniakia himalaica</i> | 58. <i>Pilea glaberrima</i> |
| 15. <i>Butea buteiformis</i> | 59. <i>P. racemosa</i> |
| 16. <i>Carlemannia congesta</i> | 60. <i>Primula irregularis</i> |
| 17. <i>Ceropegia longifolia</i> | 62. <i>Quercus acutissima</i> |
| 18. <i>Cestrum arboreum</i> | 62. <i>Q. lanata</i> |
| 19. <i>Chirita primulacea</i> | 63. <i>Randia fasciculata</i> |
| 20. <i>Combretum nanum</i> | 64. <i>R. sikkimensis</i> |
| 21. <i>Corallodiscus lanuginosus</i> | 65. <i>Raphistemma pulchellum</i> |
| 22. <i>Corydalis geraniifolia</i> | 66. <i>Rhododendron campylocarpum</i> |
| 23. <i>C. leptocarpa</i> | 67. <i>R. decipiens</i> |
| 24. <i>Corylus ferox</i> | 68. <i>R. lindleyi</i> |
| 25. <i>Cotoneaster sandakphuensis</i> | 69. <i>R. maddenii</i> |
| 26. <i>Cryptolepis buchanani</i> | |
| 27. <i>Daphne involucrata</i> | 70. <i>R. triflorum</i> |
| 28. <i>Dittoceras andersonii</i> | 71. <i>Rhynchodia wallichii</i> |

29. *Dodecadenia grandiflora*
30. *Engelhardia spicata* var. *integra*
31. *Euonymus grandiflorus*
32. *Euphorbia luteo-viridis*
33. *Galium elegans* var. *glabrisculum*
34. *Gardneria angustifolia*
35. *Geum sikkimense*
36. *Holostemma ada-kodien*
37. *Horsfieldia kingii*
38. *Ilex hookeri*
39. *Jasminum anastomosans*
40. *Litsea panamanja*
41. *Indigofera dosua* var. *tomentosa*
42. *Lonicera myrtilloides*
43. *Mallotus oreophilus*
44. *Mazus delavayi*
45. *M. dentatus*

72. *Rubus griffithii*
73. *Salvia plectranthoides*
74. *Sarcosperma arboreum*
75. *Scopolia stramonifolia*
76. *Sorbus microphylla*
77. *Spiraea arcuata*
78. *Thalictrum rostellatum*
79. *T. saniculaeforme*
80. *Thunbergia grandiflora*
81. *Vaccinium dunalianum*
82. *V. nummularia*

Indeterminate: In the dicotyledonous flora of the district 24 species (1.27%) have been suspected to belong to the category of threatened plants but their identity as either endangered or vulnerable, or rare is not certain. Some of the species such as *Allmanea nodiflora*, *Trifolium dubium* have a wide distribution. In others sufficient information is lacking. Following is the statement of indeterminate dicot plants:

<i>Allmanea nodiflora</i>	<i>Ficus pubigera</i>	<i>Persicaria perfoliata</i>
<i>Aristolochia griffithii</i>	var. <i>maliformis</i>	<i>Persea kurzii</i>
<i>Benthamidia capitata</i>	<i>F. racemosa</i>	<i>Rinorea bengalensis</i>
<i>Blumea riparia</i>	<i>Indigofera hebeptala</i>	<i>Rhododendron arboreum</i>
<i>Canarium strictum</i>	<i>Leucas ciliata</i>	spp. <i>cinnamomeum</i> var. <i>roseum</i>
<i>Chonemorpha griffithii</i>	<i>Ligularia pachycarpa</i>	<i>Rubus fragarioides</i>
<i>Corydalis chaerophylla</i>	<i>Litsea hookeri</i>	<i>Stephania glabra</i>
<i>C. juncea</i>	<i>Mussaenda glabra</i>	<i>Styrax hookeri</i>
		<i>Trifolium dubium</i>
		<i>Verbena officinalis</i>

Out of Danger: Some of the threatened (rare) plants of the district have been categorised here as "out of danger". This categorisation is based on the fresh study of range of distribution, capacity of natural regeneration and viability of artificial propagation. 9 dicot species have been recorded here, in the present study:

Name of the species	Propagation factor
<i>Bergenia ciliata</i>	Artificial propagation
<i>Caltha palustris</i>	Natural propagation
<i>Geranium donianum</i>	Natural propagation
<i>Helwingia himalaica</i>	Natural propagation

<i>Heracleum wallichii</i>	Wide range of distribution
<i>Magnolia campbellii</i>	Natural propagation
<i>Oxalis tetraphylla</i>	Natural propagation
<i>Panax pseudoginseng</i> var. <i>angustifolius</i>	Artificial propagation
<i>Salvia campanulata</i>	Artificial propagation

The species belonging to this category are found to be suitable for artificial propagation in protected fields or domestic farms. *Panax pseudoginseng* var. *angustifolius* is successfully planted in forest medicinal plant gardens where as *Bergenia ciliata* is an ornament of almost every home today.

CONCLUSION AND RECOMMENDATIONS

The resolution adopted in the 'Systematic Botany, Plant Utilisation and Biosphere Conservation Symposium' in Uppsala, 1977, notes "...Our plant knowledge is not adequate to be able to make satisfactory suggestions for plant conservation in any but a few temperate areas of the world.....For many countries....no basic documentation is available on which plant conservation recommendations and action plans can be based with any certainty....It is of utmost importance.... to produce Floras and detailed check lists.... provide training and study... to produce expertise necessary to correct this deficiency".

The species enumerated in this work is substantial and not comprehensive to give a detailed picture. The conservation programmes of these plants have not been taken in this district except the cultivation of about 25 medicinal plants (2 of them being threatened species). Except certain areas in the Singalila and Neora valley national parks the protection of natural forests seem to be far away from the satisfactory. The following recommendations have been made here for the conservation and protection of threatened plants of this region:

1. In the present conditions, the highest priority should be given to habitat preservation for ensuring the survival of threatened taxa. There are several forest areas which need to be reserved as "biosphere sanctuaries".
2. A complete checklist of the threatened and endangered plants (that has fallen due, so far) has to be prepared and their correct ecological status assessed. The quantitative assessment of all threatened plants has to be made. In the process, a detailed information on distribution, size and structure of population, ecological needs, physiological tolerance, breeding system, pollination and dispersal system, germination competitiveness, phenology, data on drug plant species and information on annual extraction and other ecological aspects should be prepared. The data bank should be prepared by the experts in the subject, using skilled manpower.
3. One of the major problems in the Himalayas today, has been the exploitation of wild species for drug & other commercial uses. Unauthorised and illegal collections are being made without ecological & environmental concern. Therefore, the management and monitoring of the forest and forest produces itself needs a thorough recasting. The collection of wild species on commercial purposes should be totally stopped for the present. These species should be practised for cultivation and propagation on suitable climatic fields and all commercial needs should be met with from such artificially propagated farms. Even the collection of plant species which do not fall under the threatened category should be permitted on rotational basis and all such steps should be eco-friendly. Collection of species from natural habitats, whose whole plants, rhizomes or bulbs are used, should be stopped without further delay. The species like *Aconitum bisma*, *A. spicatum*, *Rheum acumi-*

natum, *Panax pseudoginseng*, *Swertia chirayita*, *S. pedicellata*, *Clematis* spp. and several others including orchids, have either already become endangered or going to be so, very soon owing to the haphazard collections.

4. The district of Dajeeling is an attraction for tourists and visitors. The effects of tourism, trekking & mountaineering has been very unfriendly to the wild life in the Singalila mountains. There has to be a systematic and controlled tourism in this belt, avoiding harmful effects to the balance of nature. The rule of the national parks and wild life sanctuaries needs to be observed strictly banning all public interferences in the area. Both the national parks and Senchale wild life sanctuary have been encroached with constructions of tourist houses and massive water supply projects in the main. This has in turn, invited civil encroachment and establishment of fringe villages. These factors, if not dealt with immediately will further worsen the dignity of national parks.

In the conclusion the recoding of 156 species of the dicotyledonous angiosperms in the district of Darjeeling, is a figure that cannot be taken so lightly. This study invites the attention of the planners and competent authority in this line for their care and conservation. The orchids that was recorded to be the dominant plants of the temperate zone by J.D. Hooker (1906) does, no more hold this status and I fear the whole family Orchidaceae shall, some day, be declared as a threatened family in natural habitat. The orchid and flower nursery gardens of Kalimpong sub-division of Darjeeling district has a world wide attraction, but their sinister effects on the wild plants of ornamental value has turned out to be discouraging.

7.10 NEW DISTRIBUTION RECORDS

The district of Darjeeling is a much explored area. However, some new distributional records have been made in the recent past (Bhujel & Das 1995, Das & Chanda 1985, Yonzon *et al.* 1970, 1985). During the present survey some more new distributional records have been made for the flora of Darjeeling. These plants, most of them being common in status had so far, been known from regions outside this district and have been recorded here for the first time. They are as follows:

1. *Abelia triflora* R.Br.ex Wall., (Caprifoliaceae) naturalised in Raniban, Kalimpong (1200-1400 m). The species was earlier reported by C.B. Clarke (1880) from Kashmir to Kumaon and by H. Hara (1979) from Nepal. This is a new report of naturalisation for the state of West Bengal.
2. *Achimenes longiflora* DC. (Gesneriaceae), a native of Mexico and Guatemala, reported for the first time in India (Bhujel & Das 1995), as profusely naturalised throughout Darjeeling Hills, (1000- 1600m)
3. *Agapetes serpens* var. *alba* Airy Shaw (Ericaceae), the variety described by Airy Shaw (1948) and the specimen from Kalimpong referred by Long & Rae (1991) has been reported to occur at Damsang, Kalimpong (1900-2200 m.).
4. *Biophytum reinwardtii* (Zucc.)- Klotzsch (Oxalidaceae), growing in Sukuna (150-400m.), foothills of Kalimpong & Kurseong. The species has its distribution in hotter parts of India, extending upto Garhwal, North China and Japan (Hooker 1874) and reported by Hara (1979) from Garhwal and Nepal.
5. *Cleome rutidosperma* DC. (Capparaceae), a native of Eurasia and Mediterranean regions, naturalised in the plains of south Bengal, Bihar and Orissa, has started spreading recently, in the Terai and the plains of the district and Kalimpong Hills (150-1200m).
6. *Enhydra fluctuans* Lour. (Compositae), Eurasian herb distributed to China and Malaysia, earlier reported by Hooker (1881) from eastern Bengal, Assam and Bangladesh and Prain (1903) from Central and Eastern Bengal, is reported from plains of Siliguri and Terai of Darjeeling (100-300m)
7. *Euphorbia royleana* Boiss (Euphorbiaceae), a spiny shrub or small tree earlier reported from Kumaon to Jhelum (W. Himalaya) by Hooker (1887), from Kumaon to Nepal (Short & Vickery 1982), and Bhutan (Long 1987), has been recorded from Yangmakum, Kalimpong, 800-1500m.
8. *Impatiens cristata* Wall. (Balsaminaceae), reported from Himalaya (Kashmir-Bhutan), by Hooker (1874) and Hara (1979) but excluding Darjeeling region (Gray-Wilson in Grierson & Long, Fl. Bhutan, 1991), is reported to occur at Labha between 1500-2500m, of Kalimpong, frequently.
9. *Lantana indica* Roxb. (Verbenaceae), reported from the plains of India including Bengal (Roxburgh 1832, Clarke 1885) and Nepal (Tebbs 1982), has widely & profusely naturalised in the district of Darjeeling between 200-1200m. It is one of the dominant shrubs in Yangmakum-Nimbong (600-800m)
10. *Lepidium sativum* L. (Cruciferae), a north African and west Asian herb, reported as cultivated in Indian plains and Tibet (Hook. f. & Anderson 1872) and Nepal (Hara 1966, 1979), is reported as naturalised in Darjeeling, 1800-2200m (Yonzon *et al.*

1985).

11. *Mecardonia procumbens* (Mill.) Small (Scrophulariaceae), an American herb reported earlier as occasionally naturalised from Indian plains (Hara 1982), Bihar and Bangladesh (Panda 1990), has been reported from the Terai and plains of Darjeeling (N.B.U. Campus, 150-200m).
12. *Melilotus indica* (L.) All. (Leguminosae), distributed in tropical zones of India, Mediterranean region, Africa, W & C Asia and Himalaya (Kashmir to Nepal) and introduced to Europe, S.E. Asia, Malaysia and Australia (Baker 1876, Hara 1979), is reported from plains and foot hills of Darjeeling (N.B.U. Campus and 150-500m).
13. *Microsymbrium axillare* (Hook. f. & Thoms.) Schulz. (Cruciferae), an Eastern Himalayan element reported earlier from Bhutan and Sikkim (Hook. f. & Anderson 1872, Hara 1966, 1979) is reported from Dhotray-Palmajua, 1800-3000m, in the district.
14. *Mitrasacme pygmaea* R. Br. var. *malacensis* (Wight) Hara (Loganiaceae), a small annual herb, distributed to India, E. Himalaya (Nepal), Myanmar, S. China, Japan, Malaysia and N. Australia, earlier reported from Nepal (Clarke 1883, Chater. 1982), Bihar and W. Bengal (Prain 1903), is reported from the foot hills and plains of Darjeeling district (Ryang and N.B.U. Campus, 150- 800m).
15. *Mitreola petiolata* (Walter ex Gmelin) Torrey & A. Gray (Loganiaceae) a small herb (now pantropic), reported earlier by Clarke (1883) from Central India, Prain (1903) from plains of Bengal and Bihar and Chater (1982) from Nepal, is profusely distributed in the foothills and plains of the district (Sukuna & 150-800m).
16. *Oenanthe javanica* (Blume) DC. (Umbelliferae), a decumbent herb reported earlier from Kashmir-Nepal (Clarke 1879, Cannon 1979) and distributed to India, China, Myanmar, Thailand is located at Nimbong in Kalimpong (1200-1600m).
17. *Passiflora foetida* L. (Passifloraceae), an extensive climber, reported earlier by Masters (1879) in Indian gardens and Prain (1903) from Bangladesh is profusely naturalised in the terai and plains of Darjeeling (140-300m).
18. *Persicaria perfoliata* (L.) H. Gross (Polygonaceae), a Himalayan rambling herb, reported from Nepal, Sikkim, Bhutan and India (Hooker 1886, Hara 1966, 1982), distributed to China, Korea, Japan and Malaysia, is located in sparse occurrence from Durpin, Kalimpong, 1200-1800m).
19. *Pogostemon brachystachyus* Bentham (Labiatae), a straggling plant reported earlier from Assam, Meghalaya & Naga Hills (Hooker 1885) and Sikkim (Gangtok), Murata (1966), is recorded from Munsong, Kalimpong, 1450m.
20. *Streptocaulon sylvestre* Wight (Asclepiadaceae), a highly endangered and endemic perennial undershrub, earlier reported from Northern Bengal and Purnea of Bihar (Clarke, 1883) but considered to have been extinct afterwards, has been rediscovered (Das 1995) from the (N.B.U. Campus) of the district (140-200m).
21. *Tripterospermum nigrobaccatum* Hara (Gentianaceae) a twiner, first described and reported from different localities of E. Nepal (Hara 1965, 1966) has been recorded from Ramam and Samanden of Darjeeling (2500-3000m).
22. *Tropeolum majus* L. (Tropeolaceae), a native of S. America, introduced as an ornamental, has profusely naturalised in the waste places throughout the district

(800-2100m). The plant was earlier reported from Bhutan (Long 1987).

23. *Utricularia scandens* Benjamin var. *firmula* (Oliver) Subraman. & Banerjee (Lentibulariaceae), slender herb earlier reported from Madras (India) by Clarke (1884), Sikkim (Gangtok) and Nepal (Hara 1966,1982) and distributed in Kumaon and Bhutan, Meghalaya, Myanmar and China, has been recorded from Munsong, Kalimpong, 1500-2000m & Darjeeling of the district.
24. *Zornia gibbosa* Spanoghe (Leguminosae), a herb earlier reported from the plains and hills of Kumaon (Baker1876), Bihar and the Bengal plains (Prain 1903) and Nepal (Ohashi 1966, 1975, 1982) has been recorded from the subtropical hills of Darjeeling part of E. Himalaya from an altitude of 200-1350m, (Kalimpong 1300m). The species is distributed to India China, Malaysia and Australia.

7.11 NEW TAXA

In the present work 14 new taxa have been recorded in the district of Darjeeling (species novo=5, variety novo=7 and forma novo=2). Their distinguished characters, detailed description, Latin translation, distribution, illustration and photograph plates have been provided in the systematic treatment (Chapter VI) under respective families. Most of the holotypes have been retained in Kalimpong College Herbarium (KALIM). One holotype has been deposited to Central National Herbarium, Calcutta(CAL), after publishing the report and two holotypes have been deposited to the Herbarium of University of North Bengal(NBU). In these cases the isotopes are deposited in Kalimpong college Herbarium.

A. species novo

A concise list of the new taxa have been given below:

1. *Ageratum eupatorifolium* R.B Bhujel & A.P Das (Compositae), sp. nov., in ed. Location - Bijanbari, Darjeeling, 500-800m.
HOLOTYPE - KALIM
2. *Cestrum arboreum* R.B. Bhujel & G.S. Yonzone (Solanaceae), sp. nov., in ed. Location - Happy Valley, Darjeeling, 2000m.
Holotype - KALIM
3. *Cestrum odorum* R.B. Bhujel & A.P. Das (Solanaceae). sp. nov. in ed. Location- Bong Busty, Kalimpong, 1200-1400m.
HOLOTYPE- KALIM.
4. *Hedyotis kalimpongensis* R.B. Bhujel & A.P. Das (Rubiaceae), sp. nov., in ed. Location - Durpin, Kalimpong 1200-1400m.
HOLOTYPE-KALIM
5. *Hydrocotyle acutiloba* R.B. Bhujel & G.S. Yonzone (Umbelliferae), sp. nov., in ed. Location - Kalimpong, 1200-1500m.
HOLOTYPE-KALIM.

B. *variety novo*

1. *Baliospermum calycinum* Muell-Arg. var. *racemiferum* R.B Bhujel & G.S.Yonzone (Euphorbiaceae), var.nov.in Journ.Econ.Taxon. Bot. 18(3):163.1994. Location - Rungdung Valley, 1050m.
HOLOTYPE-CAL, ISOTYPE-KALIM
2. *Ceropegia longifolia* Wall. var. *darjeelingensis* R.B.Bhujel & A.P.Das (Asclepiadaceae), var.nov. in ed. Location -Rungdung valley, 1200-1500m.
HOLOTYPE-KALIM.
3. *Cestrum aurantiacum* Lindl. var. *heterosepalum* R.B.Bhujel (Solanaceae), var.nov., in ed. Location - Durpin, Kalimpong, 1200-1400m.
HOLOTYPE-KALIM
4. *Cestrum odorum* R.B.Bhujel & A.P.Das, sp.nov., in ed. var. *laxiflorum* R.B.Bhujel, A.P.Das & G.S.Yonzone (Solanaceae), var.nov.in ed. Location - Durpin, Kaim-pog, 1200-1540m.
HOLOTYPE-KALIM
5. *Hydrocotyle acutibola* R.B.Bhujel & G.S.Yonzone, sp.nov., in ed. var. *kalimpongen-sis* R.B.Bhujel, A.P.Das & G.S.Yonzone, var. nov., in ed. Location- Durpin Kalimpong, 1200-1400m.
HOLOTYPE-KALIM
6. *Hydrocotyle sibthorpioides* Lamk. var. *sessilis* R.B.Bhujel & G.S.Yonzone (Umbellif-erae), var.nov.in ed. Location - Suruk- Yangmakum, 600-1000m
HOLOTYPE-KALIM.
7. *Leucosceptrum canum* Smith var. *glabrifolium* R.B.Bhujel (Labiatae), var.nov.in ed. Location - Kalimpong, 1300m.
HOLOTYPE-KALIM.

C. *forma novo*

1. *Panax pseudoginseng* Wall. var. *angustifolius* (Burkill) Li forma *serratus* R.B.Bhujel, P.C.Rai & A.P.Das (Araliaceae) form.nov.in.ed. Location Jaributti, Neora Valley, 2240m.
HOLOTYPE N.B.U. ISOTYPE-KALIM.
2. *Panax pseudoginseng* Wall. var. *bipinnatifidus* (Seem.) Li forma *neoraensis* R.B.Bhujel, P.C.Rai & A.P.Das from.nov.in.ed. Location Jaributti, Neora Valley, 2200m.
HOLOTYPE N.B.U. ISOTYPE_KALIM.

7.12 INTERESTING PLANTS OF BOTANICAL VALUE

The plants with exceptional and other characters, habit or mode of living have a special attraction from the students of Botany. In addition to the wild plants of economic value and threatened/odd characters have always been the target of the plant collectors, explorers and observers in the field. Most of these species have been valued for ornamental domestication while some of them have been introduced to the cultural conditions successfully. The dicotyledonous plants of this category from the

district of Darjeeling have been enumerated below:

1. *Aeginetia indica* L.(Orobanchaceae), a leafless root parasite or sometimes saprophytic (Rungdung, Chungthung Valleys, 650-1800)
2. *Balanophora involucrata* Hook.f.(Balanophoraceae), a leafless root parasite on trees lacking chlorophyll and resembling fungus in appearance (Jaributti Neora Valley 2200-3000 m.)
3. *B.polyandra* Griff.(Balanophoraceae), similar to *B.nivolucrata* (Paktham Labha 1200-1500m)
4. *Boschniakia himalaica* Hook.f.& Thoms. (Orobanchaceae), a leafless parasite herb on the deep forests, Phalut-Ghosa, 3500-4000m)
5. *Cleome gynandra* L.(Capparaceae), a common herb with stamens born at the apex of elongated gynophore (throughout the hills 300-1800m)
6. *Corallodiscus lanuginosus*(DC.) Burt.(Gesneriaceae), a rare herb growing on dry rocks, unlike other members of the family (Dhotray, 2000-2500m). it can be located at monsoon season only.
7. *Cuscuta reflexa* Roxb var.*brachystigma* Engelm.(Cuscutaceae), a yellow coloured, leafless twiner forming dense mat over bushes (Kalimpong & Kursong, 500-1700m).
8. *Drosera burmannii* Vahl(Droseraceae),an insectivorous herb (Sukuna & plains of North bengal, 150-300m)
9. *Euphorbia hirta* L.,*E. hypercifolia* L.,*E. pulcherrima* Klotzsch, *E. sikkimensis* Boiss., *E.thymifolia* L. (Euphorbiaceae), plants with cyathium inflorescence, composed of cup like involucre, flowers without perianth, male flowers having single stamen (different species distributed from 200 to 2500m).
10. *Helwingia himalaica* Hook.f.(Helwingiaceae), a temperate subshrub with flowers on the mid vein on the middle of upper leaf surface , with attractive red colored fruits (Neora valley, Senchale to Gairibas, 2100-3050m).
11. *Hydrobryum griffithii*(Griff.)Tulasna (Podostemaceae) an aquatic plant of running streams forming mat on stones and appearing like crustose lichens (Rungdung-Takdah, 1000-1800m).
12. *Ipomoea purpurea*(L.) Roth (Convolvulaceae),an extensive and common climber with its corolla changing colour at different hours of the day from morning to the fall of the day, gradually, a pH sensitive plant (throughout hills, 1000-2400m).
13. *Mimosa himalayana* Gamble(Leguminosae), a scrambling shrub of subtropical forest with its leaves shrinking or folding back with sunset, an indicator of fall of the day even in cloudy and misty seasons the villagers and forest workers).
14. *Mimosa pudica* L.(Leguminosae),a sensitive, small shrubby plant, with leaves folding to close the upper surface on any external stimuli (throughout subtropical hills, 500-1800m).
15. *Monotropa uniflora* L.(Monotropaceae), a leafless, white saprophytic herb of damp and deep forests (Jaributti, Neora valley, 2300-2500m).
16. *Monotropastrum humile* (D.Don) Hara, similar to *Monotropa uniflora* (Meghma, 2400-3200m).

17. *Mussaenda glabra* Vahl; *M. incana* Wall., *M. roxburghii* Hook.f., *M. treutleri* Stapf (Rubiaceae) are characterised by the modification of one of 5 sepals into white petaloid leafy structure (different species distributed from 500-1800m).
18. *Passiflora foetida* L. (N.B.U, 300-1600m) & *P. geminiflora* D. Don (Lebong 1200-2000m) (Passifloraceae), having distinct extrastaminal raised corona consisting of sterile filaments.
19. *Populus gamblei* Dode (Suruk-Kalimpong, 300-1600m) & *P. glauca* Haines Neora valley, (2400-3000m) (Salicaceae) with naked flower on catkin inflorescence.
20. *Rhynchosyris obliquum* Blume (Gesneriaceae) a herb with glabrous shining unequal lamina and attractive long raceme (Rungdung valley, Yangmakum, Kalimpong, 800-1500m).
21. *Salix salwinensis* Handel-Mazzetti, *S. sikkimensis* Anderson shrubs or trees with naked flowers on catkin inflorescence, without calyx and corolla (species distribution-Singalila mountains (2500-4000m)
22. *Streptocaulon sylvestre* Wight (Asclepiadaceae), a herb (with rotate corolla and connivent anthers fused to stigma) previously considered as extinct after 1885 but rediscovered from the plains of the Darjeeling district (A.P. Das 1995).
23. *Utricularia aurea* Lour., *U. scandens* Benjamin var. *firmula* (Oliv.) Subraman & Baner., *U. striatula* Smith (Lentibulariaceae), the bladderworts with submerged dissected leaves and insect catching bladders (different species distributed from 200-3000m).
24. *Viscum liquidambaricolum* Hayata (Loranthaceae), a leafless parasitic shrub with small flattened stem (Reang, Kalimpong, Rimbick, 200-2200m).

Besides, the members of family Asclepiadaceae (25 species) with stamens connate to a fleshy column and staminal corona and family Aristolochiaceae (6 species) with S-shaped corolla and stamens forming a column (adnate to style), are notable for their rather different floral characters.

7.13 WILD RELATIVES

Along with the progress of plant science the modern world is engaged in finding out plants of better economic potentialities and high yielding varieties for food, medicines and clothings. In the process, the progressive mind now has to look back into nature again for the gene pool and germplasm materials. Therefore the first target, in this connection would be to find out and examine the wild relatives of the cultivated plants in question. In the past decades the cultivation, care and use of the plants with better economic benefit only (most of them being hybrids) have left most of the parent species, the gene bank (original species in the nature) neglected and even rendering many of them go extinct. However, as the situation now demands the science has been looking back for them in nature once again for their preservation and propagation. The wild relatives find an importance at this point of experimental research. The wild relatives taxonomically exhibit a various degree of relative characters to their cultivated allies, some of them very close while others comparatively apart. Therefore, only an intensive study in this field will reveal the useful picture.

The district of Darjeeling harbours a good number of wild relatives. Their degree of relative characters (morphological) shows a similar picture as stated above. A list of dicotyledonous wild relatives has been given below:

Wild Relatives	Cultivated species (With common names)
1. <i>Abelmoschus manihot</i>	<i>A. esculentus</i> (Lady's finger)
2. <i>Abutilon indicum</i>	<i>A. theophrastii</i> (Indian mallon or China jute)
3. <i>Amaranthus viridis</i>	
4. <i>Artocarpus lacucha</i>	<i>A. heterophyllus</i> (Jack fruit)
5. <i>Boehmeria macrophylla</i>	<i>B. nivea</i> (Ramie)
6. <i>Camellia kissi</i>	<i>C. sinensis</i> (Tea)
7. <i>Cinnamomum tamala</i>	<i>C. camphora</i> (Camphor tree)
8. <i>Coccinea grandis</i>	<i>C. cordifolia</i> (Infor scarlet gourd)
9. <i>Coffea bengalensis</i>	<i>C. arabica</i> (Coffee)
10. <i>Corchorus aestuans</i>	<i>C. capsularis</i> , <i>C. olitorius</i> (Jute)
11. <i>Crotalaria pallida</i> and relatives	<i>C. juncea</i> (Sunn hemp)
12. <i>Dolichos tenuicaulis</i>	<i>D. biflorus</i> (Horse gram)
13. <i>Duchesnea indica</i>	<i>Fragaria vesca</i> (Straw berry)
14. <i>Eriobotrya petiolata</i>	<i>E. japonica</i> (Loquat)
15. <i>Fagopyrum dibotrys</i>	<i>F. esculentum</i> , <i>F. tataricum</i> (Buck wheat)
16. <i>Ficus racemosa</i>	<i>F. elastica</i> (Indian rubber)
17. <i>Hibiscus fragrans</i>	<i>H. cannabinus</i> (Brown or Deccan hemp)
18. <i>Ipomoea purpurea</i>	<i>I. batatus</i> (Sweet potato)
19. <i>Lactuca gracilliflora</i>	<i>L. sativa</i> (Lettuce)
20. <i>Mangifera sylvatica</i>	<i>M. indica</i> (Mango)
21. <i>Morus australis</i> , <i>M. macroura</i>	<i>M. alba</i> (Mulberry)
22. <i>Mucuna pruriens</i>	<i>M. cochinchinensis</i> (Lionbean), <i>M. deeringiana</i> , <i>M. pruriens</i> var. <i>utilis</i> (Florida velvet bean)
23. <i>Olea dioica</i>	<i>O. europia</i> (Olive)
24. <i>Oxalis corniculata</i>	<i>O. tuberosa</i> (Oca)
25. <i>Passiflora geminiflora</i>	<i>P. edulis</i> (Purple granadilla)
26. <i>Persea fructifera</i>	<i>P. americana</i> (Avocado)
27. <i>Piper mullesua</i> & relatives	<i>P. betle</i> (Betle vine)
28. <i>P. peepuloides</i> , <i>P. longum</i>	<i>P. nigrum</i> (Black pepper)
29. <i>Prunus napaulensis</i>	<i>P. persica</i> , <i>P. domestica</i> (Plums)
30. <i>Prunus cerasoides</i>	<i>P. avium</i> (Cherry)
31. <i>Rosa sericea</i> , <i>R. macrophylla</i> , <i>R. roxburghii</i>	<i>R. hybrida</i> & several varities (Roses)
32. <i>Rubus calycinus</i> , <i>R. ellipticus</i>	<i>R. lasiocarpus</i> (Raspberry), <i>R. fruiticosus</i> (Blackberry)
33. <i>Rumex nepalensis</i>	<i>R. vesicarius</i> (Bladderdock)
34. <i>Solanum myriacanthum</i>	<i>S. melongena</i> (Brinjal)
35. <i>Solanum nigrum</i>	<i>S. tuberosum</i> (Potato)
36. <i>S. torvum</i>	<i>S. indicum</i> (Bihi)
37. <i>Syzygium operculatum</i>	<i>S. aromaticum</i> (Clove)
38. <i>Syzygium wallichii</i> , <i>S. cumini</i>	<i>S. jambos</i> , <i>S. aequum</i> (Rose apple)
39. <i>Thespesia lampas</i>	<i>Gossypium herbaceum</i> , <i>G. arboreum</i> (Cotton)
40. <i>Trichosanthes ovigera</i>	<i>T. dioica</i> (pointed gourd, also grows in wild form).
41. <i>Trichosanthes wallichiana</i>	<i>T. cucumarica</i> (Snake gourd)
42. <i>Vigna pilosa</i>	<i>V. sinensis</i> (Cowpea)
43. <i>Viola biflora</i>	<i>V. odorta</i> (Sweet violet)
44. <i>Vitis heyneana</i>	<i>V. vinifera</i> (Grapes)