DIVERSITY OF VASCULAR PLANTS OF KANCHENJUNGA BIOSPHERE RESERVE, SIKKIM AND ITS CONSERVATION

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Introduction

Sikkim, the beauty spot of the Eastern Himalayas, lies to the North of West Bengal, gracing it like a crown. The Kanchenjunga peak is the third highest in the world at a height of 8,598 m. Sikkim is the second smallest state of Indian Republic with its mountainous extent of variable height of 244 to 8,598 m extending for about 114 km from North to South and about 60 km from East to West. It is bounded by Darjeeling Gorkha Hill Autonomous Council (DGHAC) of West Bengal in the South, Tibet in the North, Bhutan in the East and the West going over Singalila range of Nepal.

The state lies between 27°04' to 28°07' North Latitudes and 88°01' to 88°55' East Longitudes having a total area of about 7,096 km^2.

The sylvan surroundings stand unrivalled in their natural beauty, befittingly called the jewel in the crown of India. Sikkim is truly under the domain of Buddhist influence of history, culture and the spiritualism as seen by the presence of 198 monasteries and Mani Lakhang all over the four districts and at Gangtok, the capital of the state. The cultural remains, all over the state, influence the social life of Sikkimese that can be seen while travelling through Sikkim.

This tiny state although occupies nearly 0.2% of the total geographical areas of the country but it shelters about 25% of the flowering plants of India. Thus, 2885.02 km^2 of the state now comes under Wildlife Protected Areas (Singh and Singh, 2002). The Wildlife (Protection) Act 1972 as amended up to 2002 is in force in Sikkim since 1976, covering wildlife inside as well as outside the Protected Areas. This region is also rich in many endemic, threatened, rare and hundreds of botanically interesting plant species and thus is demarcateded as one of the 'Hot Spot" areas in India (Nayar, 1996). The Sikkim region is virtually the abode of a rich variety of Rhododendrons, Orchids, Primroses, Lilies, Begonias, Magnolias, Poppies, Saxifragas, Hedychiums, Cobra lilies and several others enthralling plants with horticultural values. At present the state has one Biosphere Reserve and five Sanctuaries.

Kanchenjunga Biosphere Reserve (KBR) is considered one of the virgin pockets in the Sikkim Himalaya, known earlier as National Park since 1977 covering a comparatively smaller area of 1,784 km^2. It is now increased to 2619.92

km^2 and declared as biosphere reserve in 2000 (7th February) to conserve the unique biodiversity of the area. It lies in between 27°15'-27°57' North latitude and 88°02'-88°40' East longitude. The core zone is 1,784 km^2 and the buffer zone area is 835.92 km^2 under four sectors as Buffer Zones I-IV . The biosphere reserve has the boundary of the Lhonak river and Lhonak La in the North and the river Tista in the East. To the South it includes the boundary of various reserve forests above Toong, Tholung valley, Hee, Taryang, Karchi, Yoksum, Lapdeng, Khechipalri, Chhaney up to the Singalila range covering the catchment area of Rongyong, Monmu, Kayam, Relli, Prek, Rimbi and Kalej rivers and streams of South and West Forest Divisions of the state. It is bounded to the West by the Singalila range which forms the international boundary between Sikkim and Nepal. It also has a short stretch of international boundary with China (Tibet) in the North-West corner of the state.

Materials and Methods

The collection of specimens within the KBR was done during 1999 to 2004. The collection trips, of about 10 days duration, during pre- (March-April) and post-monsoon (October-November) and during monsoon (June-August) seasons were done and these collections were mostly in 3 gatherings for each species. All these collections were dried, fumigated, poisoned and finally mounted to prepared herbarium specimens. These herbarium specimens were duly kept in the herbarium of Sikkim Himalayan Circle, Botanical Survey of India, Gangtok, Sikkim (BSHC).

All these collections were identified with the consultation of relevant literature and also the earlier collections deposited both at Central National Herbarium (CAL) and Sikkim Himalaya Circle, Botanical Survey of India, Gangtok, Sikkim (BSHC). In almost all the cases the specimens were matched with the observed characters under simple dissecting microscope or whenever necessary under zoom microscope. In most of the cases flowers are dissected for the identification of collected specimens. An enquiry has been made to the villagers with regards to different uses of plants and plant parts as a document for ethnobotanical important species, major and minor forest products etc.

Topography and Climate

The topography of this biosphere reserve is quite variable. The elevation ranges from 500 to 8,598 m, with almost no flat piece of land anywhere. Mt. Kanchenjunga (8,598 m), the world's third highest mountain, is sacred to the Sikkimese as their guardian deity and considered as the holiest of the holy. The mountains run through North-East to South-West and gradually increasing in height towards North-West. The snow-clad mountains, the lower hills-cover with dense evergreen forests, many rivers and rivulets cascading down from the rocky heights and rippling through the green expanse of the valleys all together constitute a magnificent and graceful panorama.

The soil is predominantly acidic and rich in humus, with dark brown to reddish-brown colour on slopping hills and fine loamy soils with dark greyish brown to dark brown colour occur on steep low hill slopes. Water holding capacity of the soil is medium. The erosion and deposition by streams and rivers have resulted in a sandy

to sandy loam, clayey soil mixed with heterogeneous matrix in some places (Chauhan *et al.,* 2003).

The climate of this Biosphere Reserve has its own peculiarities caused by its geographical location, relief and altitude which varies from place to place. It is burning summer at the foot hills and freezing chills in winter at high mountains. The weather is pleasant during spring and autumn. The Biosphere Reserve area falls under heavy rainfall regions of the country and get 200-500 cm annually. In general the rainfall is heavy and well distributed from June to September, of which June-July are the wettest months, while it is moderate in April and October. The reserve also experiences a wide range of humidity but it generally remains above 70% in most of the time; however, it rises up to 95% in June-July with the annual means being *ca* 82.5% (Bandyopadhyay and Singh, 1998).

KBR has numerous tributaries which originate from the glacial regions in the West and North-West part of the biosphere reserve, flowing down towards the South-East face and ultimately meet the main river of Sikkim, the great Tista, demarcating the eastern boundary line of it. The largest glacier system – Zemu is situated in the North-West corner of this biosphere reserve where from the river Zemu Chu originates and meets the Tista. Rongyong, Monmu, Kayam, Relli, Prek, Rimbi and Kalej rivers are the leading water sources of the reserve. The glacial complexes are the source of water to many of the perennial rivers, mainly present along the Singalila range. Three main glacier complexes are present within this biosphere reserve viz. Lhonak, Zemu and Talung among which, Zemu is the largest. Most of the lakes of this reserve are glacial origin, hence, are confined at high altitude areas. Perhaps the exceptions are the Karthak (*ca.* 1,750 m) and Khechipalri (*ca.* 1,945 m) near Yoksum which are present in the sub-tropical and temperate regions, respectively, and comparatively at low altitudes. Among the high altitude lakes, Kishong and Panch Pokhri are well known. These lakes are sacred to the local people and worshipped by them (Roy and Thapa, 1998).

Vegetation and Forest Types

KBR is considered as one of the richest phytodiversity centres within the Sikkim Himalayas due to its unique geographical position. A wide range of physiography and eco-climatic conditions have adequately expressed themselves in giving rise to rich gene pool of both wild and cultivated plant species, which are growing profusely in this phytogeographical region. Apart from this, many plant species of neighbouring and far off countries viz. Nepal, Bhutan, China, Tibet, Myanmar, Malaysia and to a lesser extent with Penisular Indian affinities as well as a good number of endemic species are met within this reserve. The vegetation of this biosphere reserve can be broadly classified in subtropical, temperate and alpine forest types.

Sub-tropical forest : Sub-tropical forest occurs up to an altitude of about 1,800 m and the floral constituents are quite varied from place to place. These are mainly mixed type forest comprising with the major components of tree species like *Macaranga denticulata*, *Alnus nepalensis*, *Castonopsis tribuloides*, *Rhododendron arbereum*, *Alangium chinense*, *Maesa chisia*, *Malus sikkimensis*, *Ficus semicordata*, *Toricellia tiliifolia*, *Schima*

wallichii, *Saurauia nepaulensis* etc. Usually the tree trunks have luxuriant epiphytic growth of lichens, liverworts, mosses, ferns, orchids and many other angiosperm species. The predominant shrubs are *Dichroa febrifuga*, *Oxyspora paniculata*, *Buddleja asiatica*, *Edgeworthia gardneri*, *Rubus ellipticus*, *Mussaenda roxburghii* etc. Among the climbers dominant genera are *Piper*, *Smilax*, *Tetrastigma*, *Rhaphidophora* etc. The herbaceous species are *Persicaria capitata*, *Houtuynia cordata*, *Gnaphalium affine*, *Eupatorium odoratum*, *Ranunculus diffusus*, *Notochaete hamosa*, *Drymaria villosa*, *Sagina japonica*, *Elatostemma linolatum*, *Plantago erosa*, *Crassocephalum crepidioides*, *Hydrocotyle asiatica*, *Achyranthes bidentata*, *Oxalis corniculata*, *Oxalis griffithii*, *Galinsoga parviflora*, *Bidens pilosa* etc.

Temperate forest : Temperate forest is confined between 1,800 and 4,000 m altitude and can be further sub-divided into two distinct forest types based on the vegetational components. One is mixed broad-leaved temperate forest and the other is evergreen coniferous forest.

The mixed broad-leaved temperate forest is confined within 1,800 to 3,300 m altitude.The broad-leaved temperate forest covers with the prominent trees like *Acer campbellii*, *Exbucklandia populnea*, *Alnus nepalensis*, *Betula utilis*, *Malus sikkimensis*, *Lithocarpus pachyphylla*, *Engelhardia spicata*, *Quercus* spp., *Pieris formosa*, *Lyonia ovalifolia*, *Rhododendron grande*, *Magnolia campbellii,* etc. Shruby vegetation is quite dense and diverse in this forest and comprises *Berberis aristata*, *B. insignis*, *Buddleja colvilei*, *Hypericum hookerianum*, *Sambucus adnata*, *Philadelphus tomentosus*, *Gaultheria* spp., *Mahonia napaulensis,* etc. In temperate zone a number of interesting climbers viz. *Ceropegia pubescens, Aristolochia griffithii*, *Clematis montana*, *C. acuminata*, *C. buchananiana*, *Dicentra scandens*, *Holboellia latifolia* etc. are growing very well.

The dominant herbaceous species are *Aconogonum molle*, *Bistorta vaccinifolia*, *Koenigia nepalensis*, *Euphorbia sikkimensis*, *Pilea anisophylla*, *Gaultheria trichophylla*, *Agapetes incurvata, Panax pseudo-ginseng*, *Rubus fragarioides*, *Arisaema nepenthoides*, *A. griffithii*, *A. jacquemontii*, *A. propinquum*, *Smilacina olerace*, *Roscoea purpurea*, *Hedychium* spp., etc. Near rivers and rivulets and in other moist places *Impatiens* and *Begonias* are very common. The dominant species are *Impatiens bicolor*, *I. longipes*, *I. spirifer*, *I. sulcata*, *Begonia flaviflora*, *B. josephii,* etc.

Other phyto-geographically important taxa like *Boschniakia himalaica*, *Pyrularia edulis* are also found in this region. Besides these, a few insectivorous taxa viz. *Drosera peltata*, *Utricularia brachiata*, *U. wallichiana*, *U. multicaulis* etc. met in these forests.

The temperate forest is very rich in epiphytic orchids, particularly the shady moss-covered tree trunks coupled with high moisture contents due to heavy rainfall switch on for an ideal environment for diverse orchids. The common species are *Gastrochilus* spp., *Liparis* spp., *Dendrobium* spp., *Coelogyne* spp., *Oberonia* spp. etc.

The evergreen coniferous forest is another one confined to the altitude ranging from 3,300-4,000 m and is

dominated by the presence of *Larix griffithii, Cupressus corneyana, Abies spectabilis, Tsuga dumosa, Taxus wallichiana* and the introduced one *Cryptomeria japonica* which has now naturalized and flourishing well within the biosphere reserve. One of the important features of this forest is the association of *Rhododendrons* species with that of conifers to form a unique Conifer-*Rhododendron* forest.

Alpine forest : Alpine forest occurs in between the altitudes of 4,000 m and up to snow line of usually 6,000 m. In the lower altitude there are usually many shrubby species as *Berberis* spp., *Vaccinium* spp., *Rhododendron* spp., *Cotoneaster* spp., *Salix* spp., *Ribes* spp. etc. which grow profusely.

The higher elevation with alpine moorland is almost devoid of any tree species and the plants are forming a bushy dense clumps arresting their higher length and tallness. The common members are *Rhododendron* spp., *Rheum* spp., *Rhodiola* spp., *Potentilla* spp., *Gentiana* spp., *Saxifraga* spp., *Primula* spp., *Sedum* spp. etc.

The gymnospermous members *Juniperus recurva* and *J. squamata* are very common with their stunted growth habit. *Ephedra gerandiana* var. *sikkimensis* of course, occurs in few places. Many of the fern species are also common in this area and some may be in a monospecific strand like *Dryopteris berbigere*, *D. pulcherrima, Polystichum prescottianum* etc.

Faunal Diversity

The faunal diversity of KBR is also remarkable and is the home of the most endangered species of wildlife which are under threat due to habitat destruction. This biosphere reserve shelters about 124 species of mammals, 300 species of birds, 10 species of reptiles, 5 species of amphibians, 8 species of fishes and about 400 species of butterflies. Out of 124 mammalian species, 39 are already regarded as endangered under the Schedule-I of Indian Wildlife Act, 1972. Some of these are Snow Leopard, Tree Shrew, Red Panda, Musk Deer etc. (Gut Lepcha, 1998).

Floristic Diversity : Present status of vascular plant components

KBR encompasses enormous floristic diversity with the different species of Primulas, Rhododendrons, Orchids, Saxifragas, Impatiens, Pedicularis, and a number of medicinal plants, horticultural plants and the taxa of ethnobotanical interest. This biodiversity if further augment by the presence of numerous species of neighboring and far off regions of the world. The North-Eastern region being a centre of active speciation, this reserve is also harbours a good number of endemic taxa. The destruction of forests coupled with some natural barriers like land slides, competition between species especially the exotic or allens etc. have contributed the high number of rare and threatened species to this reserve.

In the last six years study from 1999-2004 about 6500 specimens of vascular plants have been collected from different remote parts of the reserve. A preliminary report by Maity and Chauhan (2002) and finally this study revealed that there were 1580 vascular plant species of which 106 species (1%) belonging to the pteridophytes, 11 (7%) to gymnosperms

Table 1

Estimate of Different Groups of Vascular Plants of KBR

Plant Groups	Family		Genera		Species	
	Previous	Present	Previous	Present	Previous	Present
Pteridophytes	23	35	37	54	57	106
Gymnosperms	5	5	9	9	10	11
Angiosperms	120	135	490	598	1225	1463
Dicotyledons	105	112	379	477	1030	1207
Monocotyledons	15	23	111	121	195	256

Table 2

Comparative Status of different Groups of Vascular Plants

Groups	Status of species strength		
	Sikkim	KBR	% represent
Pteridophytes	362	106	29.38
Gymnosperms	16	11	68.70
Angiosperms	4500	1463	32.50

and 1463 species (92 %) to angiosperms. All these species are of different botanical as well as economic importance. Moreover, this reserve harbours 22 endemic (Table 3) and 22 rare and threatened plants (Table 4). Major timber yielding plant species were 8; species of ethnomedicinal interest 104; edible plant species 45; fodder species 25; dye yielding 6; fiber yielding 8; poisonous 8; plant species used as a source of aromatic odour 4. Apart from this, KBR is one of the native places of novel medicinal plants. Particularly the alpine forest was very rich in pioneer medicinal plants as well as ethnomedicines. It has great potential to become a medicinal plant centre with proper management practices.

Presently within KBR the species of angiosperms are 1,463 under 598 genera distributed within 138 families among which 1,207 are dicots and 256 are monocots (Table 1). Amongst the angiosperms the herbaceous species are maximum followed by shrubs and trees. On the basis of habit and habitat condition, the species of the area were grouped as : 1,007 herbs, 179 shrubs, 119 trees, 102 climbers, 43 epiphytes, 7 parasites, 4 insectivorous plants and 2 hydrophytes. Comparative account of the families, genera and species of both dicots and monocots of this reserve were 115 and 23, 477 and 121, 1207 and 256 respectively.

As assessed, the ten dominant families of KBR, were, Asteraceae with 51 genera and 127 species followed by Orchidaceae (38 genera and 74 spp.), Rosaceae (19 and 74), Scrophulariaceae (16 and 50), Leguminosae (28 and 48), Ericaceae (9 and 48), Poaceae(30 and 47), Ranunculaceae (13 and 45), Saxifragaceae (6 and 43), Primulaceae (5 and 41), Lamiaceae (22 and 37), Cyperaceae (11 and 36), and then Gentianaceae with 9 genera and 36 spp.

With regards to the species diversity of KBR *Saxifraga* was in the first position

Table 3

List of Endemic Plants of KBR

Sl. No.	Name of plants	Family	Locality and altitude (m)
1	*A. hookeri* var. *graminifolium*	Umbelliferae	Zemu & Lachen, 3000-3300
2	*Acronema bellum*	Umbelliferae	Zemu valley, 3300-5000
3	*Angelica nubigena*	Umbelliferae	Yakthang (Jakthang), 3300-4650
4	*Astragalus zemuensis*	Leguminosae	Zemu valley, 3600-4000
5	*Begonia flaviflora*	Begoniaceae	Bakhim-Yoksum, 2350-2500
6	*Catabrosa sikkimensis*	Poaceae	Lhonak, 4300-5650
7	*Codonopsis foetans*	Campanulaceae	Phim La to Thi La, Lhonak, Kishong, 3900-5300
8	*Cremanthodium decaisnei*	Asteraceae	Lhonak, 4000-4400
9	*Didymocarpus aurantiacus*	Gesneriaceae	Tista valley, 600-1300
10	*Elatostema sikkimense*	Urticaceae	Toong, 1300
11	*Eritrichium acaule*	Boraginaceae	Naku La, Lhonak, 5200
12	*Erysium funiculosum*	Brassicaceae	Giagong plain, Naku La, Lhonak, 4265-5200
13	*Lasianthus sikkimensis*	Rubiaceae	Khechipalri, 1875
14	*Listera alternifolia*	Orchidaceae	Zemu, 3000-3300
15	*Oreopteris elwesii*	Thelypteridaceae	Lachen, 3000
16	*Parajaeschkea smithii*	Gentianaceae	Lhonak, 4500
17	*Parrya platycarpa*	Brassicaceae	Lhonak, 4880-5200
18	*Potentilla forrestii* var. *segmentata*	Rosaceae	Lhonak & Lachen, 4000-5000
19	*Saxifraga coarctata*	Saxifragaceae	Yumchho La, 4500-4600
20	*Sibbaldia compacta*	Rosaceae	Lhonak, 4200-4600
21	*Spongiocarpella purpurea* var. *lhonakia*	Leguminosae	Lhonak, 4000-4500
22	*Lactuca pseudoumbrella*	Asteraceae	Muguthang, 4000-4200

to have 33 species and then *Pedicular*is with 29 species, *Primula* 28 species, *Rhododendron* 22 species followed by *Juncus* (21 spp.); *Saussurea* (20 spp.); *Corydalis* (17 spp.); *Gentiana* (16 spp.); *Rubus* (15 spp.); *Potentilla* (15 spp.); *Impatiens* (15 spp.) and *Arenaria* (12 spp.)

A Conspectus of Families showing Diversity of Genera and Species

Pteridophytes : The Pteridophytic flora of

Table 4

List of the Rare and Threatened Plants KBR

Sl. No.	Name of Plants	Families	IUCN Category	Locality	Altitude (m)
1.	*Aconitum ferox*	Ranunculaceae	EN	Kishong	4000
2.	*A. heterophyllum*	Ranunculaceae	EN	Kishong Panchpokhri	3800 4100
3.	*Arisaema echinatum*	Araceae	LR	Lachen	3000
4.	*A. griffithii*	Araceae	VU	Zema – II	2700-3000
5.	*Aristolochia griffithii*	Aristolochiaceae	VU	Lachen	3000
6.	*Balanophora involucrata*	Balanophoraceae	CR	Karchi	2900
7.	*Bryocarpum himalaicum*	Primulaceae	LR	Zema II to Jackthang	3500
8.	*Campylandra aurantiaca*	Liliaceae	EN	Yoksum-Bakhim, Bey-Tholung	2100
9.	*Codonopsis foetans*	Campanulaceae	EN	Muguthang, Thi La	4300
10	*Cypripedium himalaicum*	Orchidaceae	EN	Thi La-Jakthang	4200
11.	*Ephedra gerardiana* var. *sikkimensis*	Ephedraceae	EN	Phim La	4250
12.	*Gentiana prainii*	Gentianaceae	CR	Kishong	4000
13.	*Hypericum filicaule*	Hypericaceae	EN	Zema-II to Jakthang	3300
14.	*Listera alternifolia*	Orchidaceae	CR	Thi La	3800-4100
15.	*Lonicera torphyrantha*	Caprifoliaceae	CR	Zema – II	3100
16.	*Nardostachys grandiflora*	Valerianaceae	CR	Dzongri	4000
17.	*Panax pseudo-ginseng*	Araliaceae	LR	Lachen-Jackthang, Tholung-Kisong	3000 4000
18.	*Podophyllum hexandrum*	Podophyllaceae	EN	Thi La-Jackthang	3400
19.	*Rheum nobile*	Polygonaceae	EN	Dzongri, Kishong, Thi La	4200 4400
20.	*Rhododendron anthopogon*	Ericaceae	VU	Dzongri, Thi La, Kishong	4100 4200
21.	*Rhododendron setosum*	Ericaceae	VU	Dzongri, Thi La, Kishong	4200
22.	*Taxus wallichiana*	Taxaceae	VU	Karchi	3000

CR: Critically Endangered; EN: Endangered; VU: Vulnerable; LR: Lower Risk

KBR is very rich and diverse signify as are shade and moisture loving plants Rocky slopes, particularly in temperate forest, are with luxuriant pteridophytic vegetation. The Pteridophytic flora of KBR is primarily reported by Maity and Chauhan (2002). The present study also reveals more information about the presence of Pteridophytes within this biosphere reserve and presently estimated as 106 species under 53 genera belonging to 35 families. Interestingly, this reserve is with a endemic pteridophyte *Oreopteris elwesii* (Baker) Holtt. belonging to the family Thelypteridaceae. The names of families are arranged in alphabetical sequence with their numbers of genera and species as shown in Table 5.

Table 5

Pteridophytes in KBR

Sl. No.	Names of families	No. of genera	No. of species
1	2	3	4
1	Adiantaceae	1	2
2	Angiopteridaceae	1	1
3	Apleniaceae	1	7
4	Athyriaceae	1	5
5	Blechnaceae	1	1
6	Botrychiaceae	2	4
7	Cheilanthaceae	1	2
8	Cryptogrammaceae	1	1
9	Cyatheaceae	1	1
10	Davalliaceae	1	1
11	Dennstaedtiaceae	1	1
12	Dicranopteridaceae	1	1
13	Dryopteridaceae	3	13
14	Equisetaceae	1	2
15	Gleicheniaceae	1	1
16	Grammitaceae	1	1
17	Hemionitidaceae	1	3
18	Huperziaceae	2	4
19	Hymenophyllaceae	1	1
20	Lindsaeaceae	2	2
21	Loxogrammacaea	1	1
22	Lycopodiaceae	2	2
23	Monachosoraceae	1	1
24	Nephrolepidaceae	1	1
25	Oleandraceae	1	2
26	Onocleaceae	1	1
27	Peranemtaceae	2	3
28	Plagiogyriaceae	1	2
29	Polypodiaceae	11	23
30	Pteridaceae	1	5
31	Pteridiaceae	1	1
32	Selaginellaceae	1	4
33	Sinopteridaceae	1	1
34	Thelypteridaceae	2	3
35	Vittariaceae	1	2
Total	35	53	106

Gymnosperms : The Gymnospermous members are less represented in Sikkim and there are only 16 species under 12 genera distributed within 7 families (Singh and Chauhan, 1997, 1998). The present study is the assessment of 11 species under 9 genera belonging to 5 families found in this biosphere reserve. In comparison of the assessment of gymnospermous members in Sikkim and KBR it is no doubt the best area of their occurrence. However, the genera like *Cycas, Gnetum, Podocarpus* which are growing in the subtropical regions of Sikkim are not yet been collected from the jurisdiction of this biosphere reserve. The assessment of families are arranged in alphabetical sequence with

Table 6

Gymnosperms in KBR

Sl. No.	Names of families	No. of genera	No. of species
1.	Cupressaceae	2	4
2.	Ephedraceae	1	1
3.	Pinaceae	4	4
4.	Taxaceae	1	1
5.	Taxodiaceae	1	1
Total	5	9	11

the number of genera and species as shown in Table 6.

Angiosperms : The angiosperms are with the highest diversity and count amongst these three groups. Total are 1,463 species under 598 genera belonging to 138 families. Families are arranged mostly after Takhtajan (1997) and with concept of some other classifications and presented below along with the mentioning of the number of genera and species (Table 7).

Table 7

Angiosperms in KBR

Sl. No.	Names of families	No. of genera	No. of species
1	2	3	4
Dicotyledons :			
1	Ranunculaceae	13	45
2	Magnoliaceae	3	4
3	Schizandraceae	1	2
4	Aristolochiaceae	1	2
5	Saururaceae	1	1
6	Piperaceae	2	9
7	Lauraceae	5	5
8	Balanophoraceae	1	3
9	Lardizabalaceae	2	
10	Menispermaceae	3	5
11	Berberidaceae	2	10
12	Podophyllaceae	1	1
13	Papaveraceae	2	6
14	Fumariaceae	3	20
15	Phytolaccaceae	1	1
16	Portulacaceae	1	1
17	Caryophyllaceae	9	35
18	Amaranthaceae	2	3
19	Chenopodiaceae	2	4
20	Polygonaceae	10	35
21	Plumbaginaceae	1	1
22	Hemamelidaceae	1	1
23	Daphniphyllaceae	1	1
24	Buxaceae	1	2
25	Fagaceae	3	5
26	Betulaceae	3	3
27	Juglandaceae	2	2
28	Stachyuraceae	1	1
29	Theaceae	3	7
30	Hypericaceae	1	9
31	Droseraceae	1	1
32	Actinidiaceae	1	1
33	Sauraujaceae	1	1
34	Ericaceae	9	48
35	Pyrolaceae	1	1
36	Monotropaceae	1	1
37	Diapensiaceae	1	1
38	Symplocaceae	1	5
39	Myrsinaceae	2	4
40	Primulaceae	5	41
41	Flacourtiaceae	1	1
42	Violaceae	1	9

Contd...

Contd...

1	2	3	4
43	Salicaceae	2	10
44	Myricariaceae	1	1
45	Cucurbitaceae	6	8
46	Begoniaceae	1	5
47	Brassicaceae	19	33
48	Elaeocarpaceae	1	1
49	Tiliaceae	1	1
50	Sterculiaceae	1	1
51	Malvaceae	4	4
52	Moraceae	2	4
53	Urticaceae	17	29
54	Euphorbiaceae	5	10
55	Thymeliaceae	2	4
56	Crassulaceae	2	19
57	Saxifragaceae	6	43
58	Grossulariaceae	1	6
59	Rosaceae	19	74
60	Melastomaceae	5	6
61	Onagraceae	2	12
62	Myrtaceae	1	1
63	Leguminosae	28	48
64	Aceraceae	1	5
65	Sabiaceae	2	2
66	Rutaceae	6	8
67	Coriariaceae	1	2
68	Anacardiaceae	1	1
69	Linaceae	1	1
70	Oxalidaceae	1	3
71	Geraniaceae	1	5
72	Balsaminaceae	1	15
73	Polygalaceae	1	2
74	Parnassiaceae	1	4
75	Celastraceae	2	6
76	Aquifoliaceae	1	3
77	Santalaceae	2	2
78	Loranthaceae	3	4
79	Rhamnaceae	2	4
80	Elaeagnaceae	2	4
81	Vitaceae	1	3
82	Hydrangeaceae	2	6
83	Philadelphaceae	2	2
84	Alangiaceae	1	1
85	Torricelliaceae	1	1
86	Araliaceae	9	12
87	Umbelliferae	20	35
88	Scrophulariaceae	16	50
89	Sambucaceae	1	2
90	Caprifoliaceae	4	21
91	Valerianaceae	2	4
92	Dipsacaceae	4	6
93	Campanulaceae	4	14
94	Lobeliaceae	1	3
95	Asteraceae	51	127
96	Loganiaceae	1	3
97	Gentianaceae	9	36
98	Rubiaceae	15	23
99	Carlemaniaceae	1	1
100	Apocynaceae	1	1
101	Asclepiadaceae	5	12
102	Solanaceae	8	11
103	Convolvulaceae	2	4
104	Boraginaceae	10	20
105	Oleaceae	2	3
106	Orobanchaceae	1	1
107	Gesneriaceae	7	19
108	Plantaginaceae	1	2
109	Acanthaceae	4	4
110	Thunbergiaceae	1	2
111	Lentibulariaceae	2	4
112	Verbenaceae	3	3
113	Lamiaceae	22	37
114	Callitrichaceae	1	2
115	Hippuridaceae	1	1
Total	115	477	1207

Contd...

Sl. No.	Names of families	No. of genera	No. of species
Monocotyledons :			
1.	Melanthiaceae	2	3
2.	Uvulariaceae	3	3
3.	Trilliaceae	2	3
4.	Liliaceae	5	6
5.	Hypoxidaceae	1	1
6.	Orchidaceae	38	74
7.	Alliaceae	1	5
8.	Amaryllidaceae	1	1
9.	Convallariaceae	5	13
10.	Anthericaceae	1	1
11.	Smilacaceae	1	4
12.	Dioscoreaceae	1	3
13.	Zingiberaceae	4	9
14.	Commelinaceae	4	5
15.	Eriocaulaceae	1	1
16.	Juncaceae	2	23
17.	Cyperaceae	11	36
18.	Poaceae	30	47
19.	Juncaginaceae	1	1
20.	Potamogetonaceae	1	1
21.	Araceae	4	14
22.	Acoraceae	1	1
23.	Sperganiaceae	1	1
Total	23	121	256

Thus it is observed in the present study that there are the representative of 32.5% angiosperms, 68.7% gymnosperms and 29.38% pteridophytes which show a prominent diversity of species strength in respect to Sikkim flora (Table 2).

Endemic Plants : The North-Eastern region being a centre of active speciation harbours large number of endemic taxa (Rao, 1994; Hajra and Mudgal, 1997; Singh and Singh, 2002). As far as KBR is concerned, the endemic species are mainly confined to the regions of Zemu, Lhonak, Lachen valleys, etc. The endemic taxa found in Sikkim Himalaya are also flourishing well within the biosphere reserve and are appended in the Table 3.

Rare and Threatened Plants : Sikkim Himalaya has been identified as one of the "Hot Spot" regions of the country. However, this rich plant diversity is threatened due to various natural and biotic factors. While incidences of flood, earth quakes, land slides, biological factors such as natural competition between species etc. have contributed to some extent to alteration of vegetation types. It is man-made threats such as destruction of natural habitats for agriculture, mining, urbanization, grazing and over-exploitation of germplasm etc. are responsible for the rapid transformation of landscape in the region. The destruction of forest and high rate of soil degradation are the threats towards loss of the species diversity. Consequently, the population of several taxa have been departed considerably and some of the native plants are under great danger (Rai *et al*., 1998; Bansnet, 1998; Maity and Chauhan, 2002). A list of such taxa is given in the Table 4.

Major Timber Yielding Plants : The forest of KBR, particularly the broad-leaved evergreen forest and then sub-tropical forest have rich timber yielding elements and have the potential to become a source of rich economy to the inhabitants in and around the biosphere reserve, only after the scientific management. These people are directly depending on the reserve regarding their building construction and furniture. The major timber yielding elements are 8 under both gymnosperms and angiosperms (Table 8).

Table 8

List of the Major Timber Yielding Plants of KBR

Sl. No.	Name of the Plants	Families	Vernacular/Local Names
1.	*Abies densa*	Pinaceae	-
2.	*Alnus nepalensis*	Betulaceae	N = Utis
3.	*Castanopsis hystrix*	Fagaceae	N = Dhalnay Katus
4.	*Cryptomeria japonica*	Pinaceae	N = Dhupi
5.	*Juglans regia*	Juglandaceae	N = Okhar
6.	*Macaranga denticulata*	Euphorbiaceae	-
7.	*Michelia doltsopa*	Mangoliaceae	N = Chanp
8.	*Tsuga dumosa*	Pinaceae	-

N= Nepali

Major Medicinal Plants : KBR is one of the native places of novel medicinal plants; particularly the alpine forest is very rich in pioneer medicinal species as well as ethnomedicines. It has great potential to become a medicinal plant centre after proper management. Careful exploitation of medicinal plants growing in this region provide an opportunity for local development. But heavy extraction of these plants from the wild, loss of habitat by deforestation and excessive grazing pressure in the high altitude pastures now threatened their survival. Some of the plant with great medicinal values are, *Taxus wallichiana, Podophyllum hexandrum, Digitalis purpurea, Nardostachys grandiflora, N. jatamansi, Picrorhiza scrophulariiflora, Aconitum* spp. etc. which are already been exploited by the pharmaceutical companies.

Plants of Ethno-botanical Interest : As the ethnic communities of India are traditionally using the plant resources for their food, shelter and for health care as medicinal uses, the tribal communities of Sikkim also have well inherited with rich traditional knowledge of wild plants as the natural resources for their food, shelter, medicines, fodder, fibre, etc. Sikkim is a cornucopia of ethnic people, including Lepchas, Sherpas, Bhutias, Nepalese etc. They live in the fringe areas of the reserve and almost entirely depend on the forest resources. The ethnobotanically important species used by the people in and around the reserve are about 200; out of which ethnomedicine 104 (51%), edible 45 (23%), fodder 25 (13%), dye 6 (3%), fibre 8 (4%), poisonous 8 (4%) and incense 4 (2%).

The local medicine man, popularly known as 'Jaributi man' is well trained up about the identity of medicinal plants. Any confusion in identity is generally confirmed by testing the usable parts of particular plants. They harvest the plants and prescribed for treatment after proper processing and often properly stored for future uses. During the survey 104 species have been recorded as ethno-medicinal plants. Regarding the usable plant parts whole plant is used in 8 (6%) cases, root

and rhizome 41 (30%), root nodule 1 (1%), root bark 3 (2%), stem bark 4 (3%), oleoresin 1 (1%), shoot or stem 14 (11%), leaf and petiole 34 (25%), green bract 1 (1%), flower 5 (4%), fruit 17 (13%), seed 3 (2%) and necteriferous scale 1 (1%). They use these plants or plant parts/ products to cure the diseases like bodyache, toothache, stomach ache, joints pain, breast pain, fever, cold and cough, diarrhoea and dysentery, cut and wounds, nasal bleeding, skin treatment, menstrual disorder, throat pain, bone fracture, leprosy, heart diseases, arthritis, gastric impaction, piles, vomiting, urinary track infection, hydrocyl, liver disorder, expectorant, anthelmintic, constipation, antiseptic, obesity, excessive seminal discharge, constipation, jaundice, to increase sexual potency, asthma, food poisoning, snake bite, rheumatism etc. which are very common to their daily life (Jana and Chauhan, 2000; Maity and Chauhan, 2002, Maity *et al.,*2003; Maity *et al.,* 2003; Maity *et al.,* 2004).

Exotic Plants : During the survey works it was observed that there were many exotic plant species which had invaded in this biosphere reserve. However, they were more in the subtropical region and less in temperate regions and absent in alpine forest region. The exotics, whenever they are invasive in nature, cause competition towards establishment and successful colonization. Once established then suppress or prey on native species causing displacement and destruction of plant diversity. It sometimes change the vegetational pattern and the significant loss of species for the grazing of domestic animals. One of the important reason of the entry of exotic is tourism and inadequate quarantine. During present study, 12 exotic species were observed out of which 8 species were more invasive in nature (Table 9).

Ornamental Plants of Horticultural Importance : A large number of wild

Table 9

List of Exotic Species of KBR

Sl. No.	Name of Plants	Families	Place of Origin
1.	*Achyranthes aspera*	Amaranthaceae	Tropical America
2.	*Ageratum conyzoides**	Asteraceae	South America
3.	*Bidens pilosa**	Asteraceae	America
4.	*B. biternata**	Asteraceae	America
5.	*Calceolaria mexicana**	Scrophulariaceae	Mexico
6.	*Crassocephalum crepidioides**	Asteraceae	Tropical America
7.	*Erigeron karvinskianus**	Asteraceae	Mexico
8.	*Eupatorium adenophorum*	Asteraceae	Mexico
9.	*E. odoratum**	Asteraceae	Mexico
10.	*Galinsoga parviflora**	Asteraceae	South America
11.	*Oxalis latifolia*	Oxalidaceae	Central America
12.	*Solanum viarum*	Solanaceae	South America

* Invasive in nature

beautiful plants occur in this biosphere reserve. Local people have successfully domesticated some wild plants as ornamentals in their gardens. The angiosperms were usually accepted for their beautiful flowers. Some of these were Magnolias, Orchids, Primulas, Rhododendrons, Hedychiums, Potentilas, Impatiens, Begonias etc. Pteridophytes are used for their beautiful foliages architecture. The well known ornamental taxa include *Alsophila spinulosa, Adiantum* sp., *Vittaria sp., Pyrrosia sp., Asplenium* sp., *Phlegmariurus phlegmaria,*etc. The orchids are the most important horticultural plant for their beautiful aristocrat arrangement of flowers which alone have the capacity to change the rural economy of the villagers in and around the biosphere reserve.

Additional Elements to the Flora of Sikkim or India

New taxa : This biosphere reserve is a treasure house to the taxonomists. During the floristic study some new taxa were described from this area, which were new to the science. These are *Lactuca pseudoumbrella* D. Maity et G.G. Maiti-Asteraceae (*J. Econ. Taxon. Bot.* 25(3) : 748.2001), *Craniotome furcata* (Link) Kuntze var. *sikkimensis* D. Maity et G.G. Maiti-Lamiaceae (*J. Econ. Taxon. Bot.* 27(Suppl.): 1240.2003), *Craniotome furcata* (Link) Kuntze var. *urceolata* D. Maity et G.G. Maiti-Lamiaceae (*J. Econ. Taxon. Bot.* 27(Suppl.) : 1242.2003), *Spongiocarpella purpurea* (Li) Yakovlev var. *lhonakia* D.Maity et A.S.Chauhan-Fabaceae (*J. Econ. Taxon. Bot.* 28(1): 71.2004), a new variant of *Pleione praecox*-Orchidaceae (*Orchid Review* 113(1264): 212.2005), *Myrmechis bakhimensis* D. Maity, N. Pradhan et G.G. Maiti-Orchidaceae (*Acta Phytotax. Sin.* 45(3) : 321-323.2007).

New distributional record : The extensive exploration helps to locate two interesting angiosperm species one of which was new to the country and another to the state. *Stebbinsia umbrella* (Franch.) Lip. (Asteraceae) (*J. Bombay Nat. Hist. Soc.* 104(1) : 119-120.2007) is new to India and *Nervilia infundibulifolia* Blatt. & Mc Cann (Orchidaceae) (*J. Bombay Nat. Hist. Soc.* 102(3) : 368-369.2005) is new to Sikkim.

New combination and new status : In the time of floristic survey few interesting specimens have been collected, which help to terminate the taxonomic controversy of two species and ultimately reduce to infraspecific level. These are *Osbeckia nepalensis* Hook. var. *nutans* (Wall. ex C.B.Clarke) D.Maity (Melastomataceae) (*J. Econ. Taxon. Bot.* 27(Suppl.):1236.2003.) and *Euphorbia stracheyi* Boiss. subsp. *sharmae* (U.C.Bhattacharyya) D.Maity et N.P.Balar. (Euphorbiaceae) (*J. Econ. Taxon. Bot.* 30 (1) : 186-189.2006).

Discussion

This biosphere reserve is surrounded by villages to its southern part of the buffer regions particularly to Yoksum, Karchi, Khechipalri etc. Similarly in the eastern part of buffer region it is surrounded by the villages like Namprik, Lingja, Bey, Chung Thang, Chhaten, Lachen, Thungu etc. The inhabitant are still in practice of grazing of animals to the temperate and alpine regions. The grazing fields of the temperate regions are particularly Bakhim, Tsoka, and Lachen. In the alpine region the specific grazing fields are Thangu, Dzongri, Samiti, Kishong and Thi La, etc. The mass grazing often destroys

the vegetation and thus contribute to the rarity of species. Over-exploitation was observed within the boundaries of biosphere reserve by the local inhabitats as well as by tourism.

There were so many beautiful flowering plants and horticultural plants like *Gentiana* sp., *Pedicularis* sp., *Primula* sp., *Hedychium* sp. many orchids and many medicinal plants. Emphasis on tourism in the area is also adversely affecting the natural vegetation. In addition over exploitation for commercial purpose has caused the depletion of some species within natural vegetation. It is reported that during 1990-91, nearly 1,000 kg of *Nardostachys grandiflora,* 1,070 kg of *Aconitum* spp. and 6,200 kg of *Picrorhiza srcophulariiflora* had been extracted from the wild habitat of North Sikkim (Singh and Chauhan, 1998). According to another estimation given by Rai *et al.* (2000), 7,880 and 1,740 kg *Aconitum heterophyllum,* 26,160 and 3,240 kg *Nardostachys jatamansi,* 4,840 and 00 kg *Picrorhiza srcophulariiflora* was harvested from Lachen and Thangu respectively during 1990-1991. The regular medicine practitioners of Nepal, are also involved in collection of many medicinal plants for their regular and future practices (Maity *et al.*, 2003; Maity *et al*., 2003, Maity *et al*., 2004). Thus this practice involves the loss of species or the rarity of occurrence of species.

Tourism is probably the fastest growing industry in the present century. In an analysis it was revealed that in 1980 only 15,434 tourists had visited Sikkim and since 1984 there has been a steady increase in tourists flow. The adventurists, students of life sciences and applied sciences are frequently coming to this area. Moreover, tourists for recreation, as trekker, and the domestic tourists are frequently visiting this area. That inflow was nearly 46,416 in 1989 and in 1998 to nearly 1,50,000 (Rai *et al*., 1998). The famous trekking route, Yoksum-Bakhim-Tsoka-Dzongri-Samiti-Gocha La is situated in this reserve. Such inflow is also responsible for the destruction of this magnificent plant wealth in different way and caused adverse effect on the management practices. Frequently the exotic species are probably coming with them causing the changing pattern of ground vegetation.

The sub-tropical, temperate forests regions are with bulk of many important plant species concentration and these are no doubt the existence of the zones of genetic diversity of the regions. On the other hand these are species of much horticultural importance. The best position occupied by the orchid genera as *Bulbophyllum* (43 spp.), *Dendrobium* (36 spp.), *Calanthe* (17 spp.), *Coelogyne* (17 spp.), *Cymbidium* (10 spp.) etc. Similarly other important genera are *Primula* (56 spp.), *Pedicularis* (43 spp.), *Rhododendron* (37 spp.), *Juncus* (36 spp.), *Saussurea* (30 spp.), *Gentiana* (23 spp.), *Swertia* (19 spp.). In Sikkim within this biosphere regions the estimation of species diversity of many genera were observed based on the present study. These were *Saxifraga* (33 spp.), *Pedicularis* (29 spp.), *Primula* (28 spp.), *Rhododendron* (22 spp.), *Juncus* (21 spp.), *Saussurea* (20 spp.) etc. Thus this biosphere reserve can be considered as a genetic resource centre of species diversity. Sikkim itself is a home of orchids and this biosphere reserve is sharing very much having its immense genetic resource (Basnet, 1998).

Threats : The common threats to the phytodiversity of biosphere reserve could be classified into two groups i.e. man made and natural. The man made threats responsible for deterioration and dwindling of plant resources are rapid urbanization, large scale collection of timber and fire wood by the people inhabiting in fringes as well as within the reserve. The human are the users and exploiters of the plant resources of this area as elaborated under discussion. In the southern part of the biosphere reserve there are the habitations of 2 villages with a population of nearly 50. Moreover, the neighbouring areas on the eastern and southern parts are also populated surrounding the buffer regions of it. These inhabitants are regularly using the forest resources as their traditional practices. The grazing by domestic animals is another cause responsible for depletion and erosion of the flora. The medicinal plants have been exploited to such an alarming rate that certain taxa need immediate protection. Besides, in the southern part of the reserve tourism is a big attraction for domestic and foreign tourists. All the tourism related activities as well as development of network of roads for transportation purposes also have quite adverse affects on vegetation of this biosphere reserve. Apart from this the natural causes like land slides, natural competition between exotic and indigenous species, diseases, forest fire etc. are also responsible for depletion of certain species.

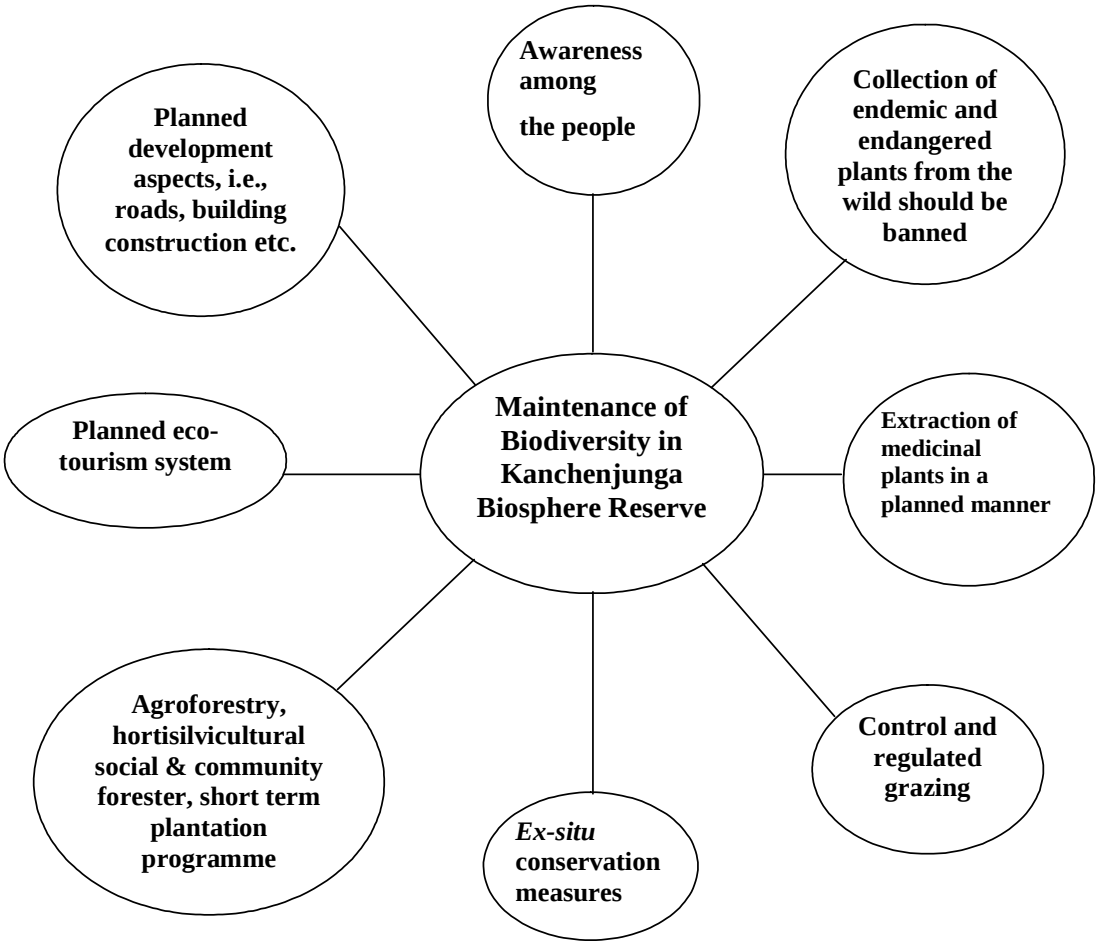
Conservation : Throughout Sikkim one aspect of increasing interest in traditional resource management is a growing recognition of the extent and importance of religious sanctuaries and sacred places. These community based living repositories provide an important contribution to the conservation of biological diversity (Ramakrishnan, 1996). Similar sacred landscapes are also present in Yoksum and Norbugang. 'Neysol' is an area below Mount Kanchenjunga in West Sikkim, referred to as Demojong, is the most sacred of all, being the abode of Sikkim's deities (Ehrenfeld, 1991). This region has a number of glacial lakes in a higher reaches. These are sacred lakes. The Rathong Chu, itself a sacred river, is said to have its source in nine holy lakes close to the mountain peaks in the higher elevation. Moreover, the river in the Yoksum region is itself considered to have nearly 109 hidden lakes. Both the visible and the less obvious national lakes identified by religious visionaries and said to have presiding deities, representing good and evil (Ramakrishnan, 1996). It is indeed conserving this rich tradition deemed to be significant for the peace, harmony and welfare of a region in one hand and preserving diversity of natural wealth on the other hand.

Over-exploitation is reported for some of the important medicinal plants like *Nardostachys grandiflora, N. jatamansi, Picrorhiza srcophulariiflora, Aconitum heterophyllum,* etc. and that should be protected through management or imposing some laws by the Government. On the other hand, based on the demand through cultivation the productivity should be increased with the participatory management of the local people, which will assure them the financial assistance and let them avoided the exploitation of the medicinal plants from nature and the other economic resources of the area.

Tourism is a troublesome problem to preserve this plant wealth of this

Fig. 1

Maintenance of Biodiversity of Kanchenjunga Biosphere Reserve in the following way :



region particularly in the southern part (Yoksum - Bakhim - Tsoka - Dzongri - Samiti - Gocha La route). So the restricted and planned tourism can be allowed for future strategy to preserve and to minimize the disturbances of this region.

Efforts are needed to conserve and maintain gene, species and ecosystem for the sustainable use and management of the biological resources. The *in-situ* conservation of biological and genetic resource can help in using biological resources sustainably.

The species identified as rare and threatened can be multiplied through *ex-situ* conservation techniques like tissue culture and rehabilitation in botanic gardens. Similarly, the over exploitation of medicinal plant species can also be

regulated. The cultivation of medicinal plants must be encouraged among the local people to meet the desired supply of raw material to the pharmaceutical industries who are mostly dependent directly on forest resources.

The Joint Forest Management (JFM) can be practiced towards the higher productivity of forest trees, other minor forest resources of economic value and lastly the cultivation of almost all the orchids, and many of the high demand medicinal plants like *Nardo-stachys grandiflora, N. jatamansi, Picrorhiza srcophulariiflora, Aconitum hetero-phyllum, Digitalis purpurea* etc. to ensure the financial assistance of the local people.

The sustainable utilization through proper management can be able to uplift the life style of the people in and around the biosphere reserve as well as the state.

The aspects are stated in Fig. 1 for proper management and sustainable maintenance of biodiversity of KBR.

The administration, local support and involvement of people in and around the biosphere reserve and other machineries working in the areas are essential to come together and bring about an integrated eco-development as a challenging task. At the same time the efforts should also be made from the involved departments as State Forest Deptt., Rural Development, Agriculture, Horticulture, Husbandry, Tourism, Health Service and the Finance. Finally, awareness among the people is probably the best way to conserve the unique biodiversity of this biosphere reserves.

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SUMMARY

Kanchenjunga Biosphere Reserve (KBR), the virgin pockets of the forests, in the Sikkim Himalaya, was known earlier as National Park since 1977 covering 1,784 km². It is now increased to 2619.92 km² and declared as biosphere reserve in 2000 (7th February) to conserve the unique biodiversity of the area. It lies between 27°15'-27°57' North latitude and 88°02'-88°40' East longitude. The core zone is 1784 km² and the biffer zone is 835.92 km² under four sectors as Buffer Zone I-IV. The vascular plant diversity of KBR is remarkable having 1580 vascular plants distributed as pteridophytes, gymnosperms and angiosperms 106, 11 and 1,463 species respectively. As a result of the last six years study 6 new taxa have been described, two species discovered as new record, one for the state and one for the country and two new combinations have been made based on the collected specimens from the reserve. Floristically it belongs to temperate and alpine forest, then subtropical enriched with major components of herbs then shrubs and trees. This reserve has 22 endemic and 22 rare and threatened plants besides large number of horticultural elements. The other important accounts are 8 major timber yielding plants; 104 ethnomedicinal interest; 45 edible; 25 fodder; 6 dye yielding; 8 fiber yielding; 8 poisonous; 4 used as source of aromatic odour.

Key words **: Kanchenjunga Biosphere Reserve, Vascular plant diversity, Conservation.**

कांचनजंघा जीवमण्डल संरक्षित–क्षेत्र में वाहि–पादपों की विविधता और उसका संरक्षण

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सारांश

सिक्किम हिमालयी भूभाग के वनों के अक्षुण्ण लघु भाग, कांचन जंघा जीवमण्डल संरक्षित क्षेत्र, जिसे पहले 1977 से राष्ट्रीय उपवन कहा जाता रहा था, का क्षेत्रफल 1784 किमी² है। इसे अब बढ़ाकर 2619.92 किमी² कर दिया गया है और इस क्षेत्र की विलक्षण जैवविविधता को संरक्षित करने के लिए (7 फरवरी) 2000 से जीवमण्डल संरक्षित क्षेत्र घोषित कर दिया गया है। यह क्षेत्र 27°15' –27°57' उत्तरी अक्षांश और 88°02' –88°40' पूर्वी देशान्तर के मध्य पड़ता है। इसका आन्तरिक क्षेत्र 1784 किमी² तथा बर्हिवर्ती क्षेत्र 835.92 किमी² है जिसे बहिर्वर्ती क्षेत्र I-IV चार सेक्टरों में बांटा हुआ है। कांचनजंघा संरक्षित क्षेत्र के वाहि पादपों की विविधता उल्लेखनीय है जिसमें 1580 वाहि पादप है जो क्रमशः 106, 11, और 1463 जातियों के पर्णागोद्भिद, नग्नबीजा और संवृतबीजा में बंटे हुए हैं। विगत छह वर्षो तक किए गए अध्ययन के परिणामस्वरूप यहां मिली 6 नई जातियों को वर्णित किया गया है जिनमें से दो जातियां नए आलेख रूप में, एक राज्य के लिए तथा एक देशभर के लिए नई है तथा इस संरक्षित क्षेत्र से संग्रहीत नमूनों के आधार छह नए संयोग भी बनाए गए हैं। पादपीय दृष्टि से यह क्षेत्र समशीतोष्ण और आल्पीय वन फिर उपोष्ण वन में आता है जिसके बड़े घटक शाकों फिर क्षुपों और वृक्षों वाले हैं। इस संरक्षित क्षेत्र में 22 यही पर स्थानसीमित, तथा 22 दुर्लभ और संकटापन्न जातियां, बागबानी तत्वों के अतिरिक्त मिलती हैं। अन्य महत्वपूर्ण वर्णनों में 8 बड़े प्रकाष्ठ प्रदायी पादप, 104 जाति औषध दिलचस्पी के 45 खाद्य, 25 चारा, 6 रंग प्रदायक, 8 रेशा प्रदायक, 8 विषैले और 4 ऐसे पेड़े पौधे आते हैं जिन्हें सौरभिक गन्ध के स्रोतस्वरूप उपयोग किया जाता है।

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