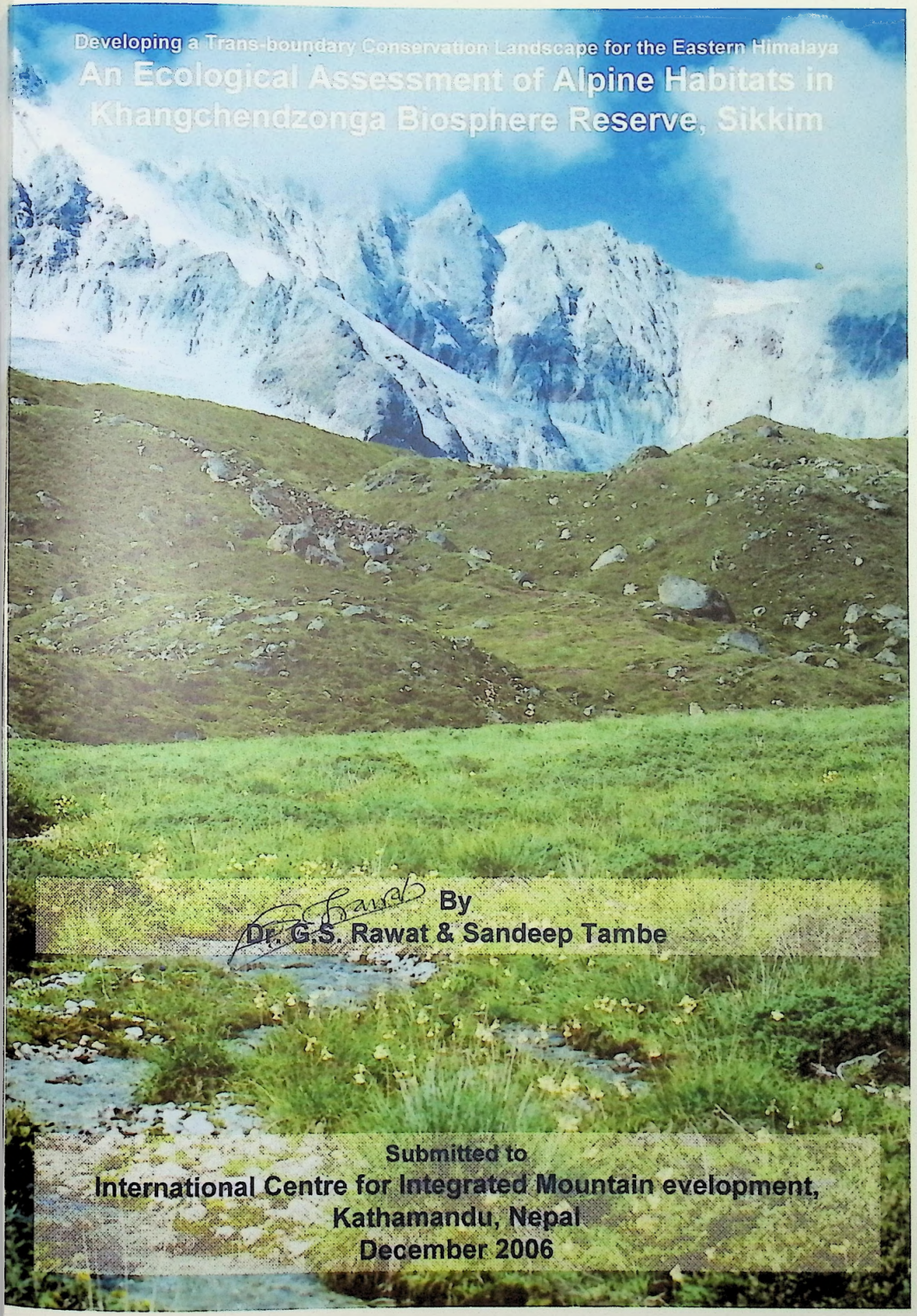
Developing a Trans-boundary Conservation Landscape for the Eastern Himalaya

An Ecological Assessment of Alpine Habitats in Khangchendzonga Biosphere Reserve, Sikkim



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EXECUTIVE SUMMARY

Alpine areas of Khangchendzonga Biosphere Reserve (KBR), Sikkim were surveyed during summer-monsoon of 2006 with the following objectives: (i) Conduct a rapid survey of alpine vegetation communities / physiognomic units vis-a-vis alpine habitats, (ii) Characterize and classify the alpine habitats for major faunal groups and assess the anthropogenic pressures and grazing by the domestic livestock, (iii) Identify key floral assemblages / threatened plants of high conservation significance, and (iv) Suggest a zonation plan and measures for long term conservation and monitoring of alpine habitats and review the trans-boundary issues.

The alpine zone in KBR is spread over Greater and trans-Himalaya and covers nearly 48 % of the reserve. This area harbours a large number of rare and threatened mammals such as Himalayan musk deer (Moschus chrysogaster), Himalayan tahr (Hemitragus jemlahicus), blue sheep (Pseudois nayaur), snow leopard (Uncia uncia) and a variety of avifauna. The land use practices in the BR and adjoining areas of Nepal include traditional livestock (yaks, cow-yak hybrids, horses and sheep) grazing, collection of medicinal and aromatic plants and tourism. The area is contiguous with the Kanchenjunga Conservation Area of Nepal. Both the areas, altogether, promise an excellent potential for a trans-boundary peace park.

Broad vegetation types and alpine habitats have been classified and described in detail. Based on broad physiognomy and land forms following broad habitat types have been identified in the alpine zone of KBR: Krummholtz Zone, Alpine Scrub, Alpine Meadows, High Altitude Lakes, Moranic Environs, Inaccessible rocky and cliff areas, Riverine Habitats, and Special Habitats (caves, tallus,

colluvial deposits). Dominant vegetation types, human use and wildlife within each habitat have been given.

Based on the earlier literature and extensive floral survey a tentative list of vascular plants in alpine areas of KBR has been prepared (Appendix – 2) giving their habit, altitudinal zone and threat status. Several plant species of high conservation value have been identified e.g., Schizandra grandiflora (a primitive climber with flowers like miniature Magnolia), Helwingia himalaica (bearing flowers at the center of the leaf and endemic to the Eastern Himalaya), Circaeaster agrestis (Chloranthaceae of uncertain affinity), Pinguicula alpina (an insectivorous plant), Triosteum himalayanum (endemic to Himalaya),and Brachycaulos simplicifolius (an unusual herb of Rosoaceae) among others.

Various trans-boundary issues in the KBR including trans-boundary cultural ties, trade in medicinal plants, pastoralism, historical barter system, etc have been identified and discussed. Based on the detailed analysis of the issues and field surveys of selected areas along with the frontline staff of KBR various management recommendations have been given which include more multi-disciplinary surveys in the KBR, training programmes for the frontline staff of KBR and Himal Rakshaks, notification of botanical hotspots within KBR for future monitoring, and better management of trail and camping sites in KBR. The authorities of Kanchenjunga Conservation Area in Nepal, and PA Managers in India need to begin a dialogue afresh to revive Singalila Trans-border Eco-tourism and set up a long term trans-border peace park for joint protection and management involving the local communities.

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- Authors

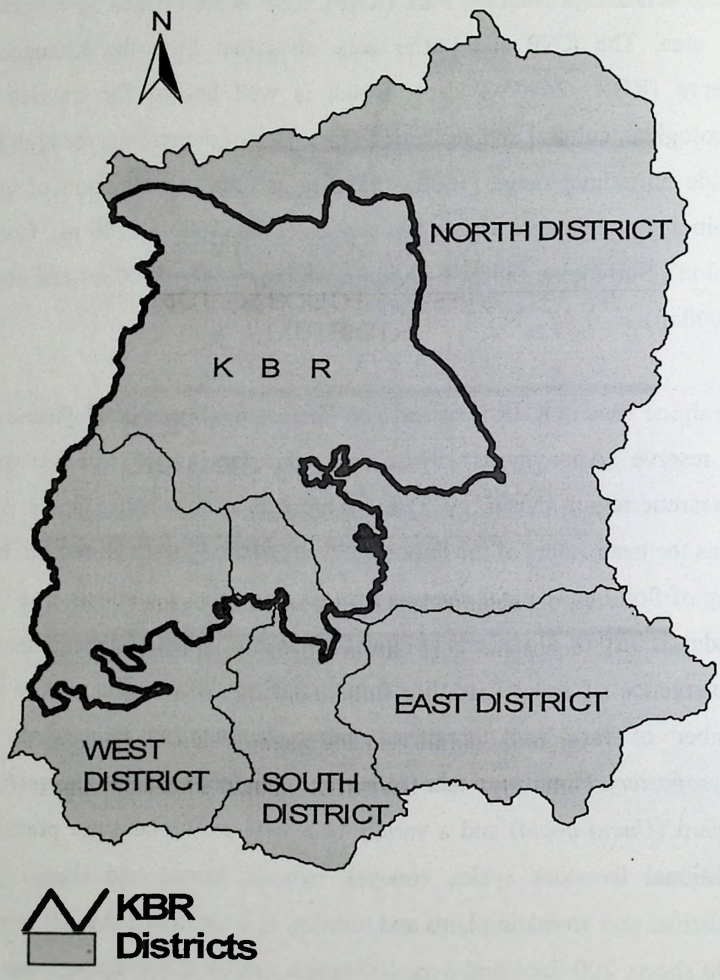
1.0 INTRODUCTION

The Khangchendzonga Landscape, spread over eastern part of Nepal and western Sikkim, represents one of the important localities of conservation significance in the Himalaya owing to its biogeographic location at the junction of Palaearctic and Oriental realms. Within the state of Sikkim, a large proportion of this landscape (ca 1784 km^2) has been set aside as Khangchendzonga National Park (KNP). KNP is surrounded by a buffer zone of about 835 km^2 area. The KNP and buffer zone altogether form the Khangchendzonga Biosphere Reserve (KBR; 2619.92 km^2), which is well known for its rich floral, faunal, geo-hydrological, cultural and aesthetic values. One of the reasons for high biological diversity is a wide altitudinal range (1600 – 8598 m asl) and compression of various climatic zones within a short distance *viz.*, warm temperate (ca. 1600 – 2500 m), Cool Temperate (2500 – 3300 m), Sub-alpine (3300 – 4000 m), Alpine (4000 – 5000 m) and aeolian and cold deserts (>5000 m).

The alpine zone in KBR is spread over Greater and trans-Himalaya and covers nearly 48 % of the reserve (Anonymous 1994). This zone lies at the extreme southern fringe of the Palaearctic region (Mani, 1978) and represents an interesting biome. This life-zone not only forms the headwaters of the important rivers of the Eastern Himalaya but also supports a rich array of floral and faunal communities. Ecologically, the alpine zone is of much interest due to adaptability of organisms to climatic extremes, vegetation processes, phytogeography and convergence of specialised life forms. Besides, this region serves as habitat for a large number of rare and threatened mammals such as Himalayan musk deer (*Mochus chrysogaster*), Himalayan tahr (*Hemitragus jemlahicus*), blue sheep (*Pseudois nayaur*), snow leopard (*Uncia uncia*) and a variety of avifauna. The land use practices in the BR include traditional livestock (yaks, cow-yak hybrids, horses and sheep) grazing, collection of medicinal and aromatic plants and tourism. It is estimated that till recently about 2500 yaks, 1000 sheep, 200 dzos and over 100 horses grazed in the alpine areas of KBR (Singh et al., 1999; Tambe 2002). The number of yaks in the greater himalayas part has gone down recently due to persistent intervention by the Forest Department, Sikkim. Detailed ecological information on the status of alpine habitats within the KBR is lacking. A status survey of such habitats or management units is a prerequisite for research, monitoring and management. Such information would also be useful for preparation of a zonation plan and setting aside areas for traditional land use practices and for wildlife. Similarly, information on

the local peoples' dependency from the areas adjacent to Nepal would help in identifying the key issues of trans-boundary management.

KBR in Sikkim



The alpine zone of KBR is flanked in the west by Kanchenjunga Conservation Area (Nepal), and by vast stretch of Tibetan Plateau in the north. This landscape also supports a large number of local and migratory pastoral communities who use the area for livestock grazing and collection of medicinal and aromatic plants during summer (Rai *et al.*, 2000). Historically, the alpine landscape within KBR was used by the pastoral and trading

communities from India, Nepal and Tibet for exchange of commodities and culture. Currently the KBR management is in the process of evolving a management plan for the reserve which would require sound ecological backing and an analysis of trans-boundary issues. This study aims at providing some insights into these aspects (Appendix – 1). The report also dwells upon a brief analysis of trans-boundary issues pertaining to alpine eco-region.

2.0 OBJECTIVES

i. Conduct a rapid survey of alpine vegetation communities / physiognomic units *vis-a-vis* alpine habitats in the north-western parts of KNP,

ii. Characterize and classify the alpine habitats for major faunal groups and assess the anthropogenic pressures vis-a-vis use by the domestic livestock,

iii. Identify key floral assemblages / threatened plants of high conservation significance, and

iv. Suggest a zonation plan and measures for long term conservation and monitoring of alpine habitats and review the trans-boundary issues.

3. MATERIAL & METHODS

The study pertaining to above aspects was carried out in two phases. During March – June 2006 extensive review of literature on the conservation issues in the alpine landscape was conducted. We designed a questionnaire for the trans-boundary issues and also collected information on the trans-boundary issues from selected localities (western and northern parts of KBR). During July 2-11 we conducted rapid ecological survey of the Zemu Valley exclusively for the assessment of alpine vegetation and interaction with the field staff for the management issues. This valley was initially explored by Sir J.D. Hooker during 1846 -1849 and later by Smith and Cave (1911). General methodology for data collection on various aspects was as follows:

3.1. Survey of alpine vegetation

The alpine zone was delineated using a combination of remote sensing data and Survey of India topo-sheets. In Sikkim and much of the eastern Himalaya, the alpine zone begins

around 4000 ± 200 m asl (marked by a distinct treeline). However, depending upon the exposure of the slope and topography a few elements of the alpine region begin to appear even in sub-alpine areas i.e., around 3500 m asl. For the purpose of this work we used information collected during previous surveys (Tambe and Rawat 2006; Tambe & Rawat 2006 unpublished data) and conducted a rapid survey of Zemu Valley in the northern fringe of KBR. We stopped at regular intervals along the survey route to enumerate distinct habitat types, followed by assessment of vegetation composition and past and present grazing patterns and threats if any. Angiosperms were enumerated systematically along the route. Various land forms and physiognomic units were noted along the survey route. Species composition within major physiognomic units (*Krummholtz*, alpine scrub, herbaceous formations, sedge meadows, fell-fields and pioneer environments) were noted along the survey route.

3.2 Assessment of habitats and relative use by domestic livestock and wildlife

The term habitat is referred to in this report to mean broad categories of landscape units with distinct sets of floral and faunal assemblages, which could serve as a unit for conservation management. e.g. the zone between natural tree line and alpine scrub indicates a zone of stunted rhododendron forest (*Krummholtz*) which supports certain faunal groups such as Himalayan Musk Deer and Blood Pheasant. Along the survey route we noted the following parameters for characterization of wildlife habitats: (i) Extent of human use in terms of livestock grazing, collection of non-timber forest produce, (ii) direct and indirect evidences of wild mammals, (iii) General assessment of wildlife habitat for major faunal communities and identification of critical habitat features, if any.

3.3 Identification of plants of high conservation significance

The vascular plants enumerated from the alpine area of KBR were further grouped under various categories viz., species of ethno-botanical value, important forage species for the wild herbivores, species of botanical interest and rare endemic plants. Most of the plants were identified closest to the genera and species in the field using the regional floras available (Flora of Bhutan 3 volumes), Flowers of Himalaya (Polunin & Stainton 1987). Voucher specimens of unidentified plants were collected and later verified from other monographs and Herbaria at Dehra Dun. Native uses of plants were noted from the local field guides.

3.4 Zonation plan and measures for long term conservation

The field trip to Zemu valley was conducted in collaboration with the Department of Forest, Environment and Wildlife Management, Government of Sikkim, The Mountain Institute-India, ICIMOD and WWF-India. The field staff of KBR were oriented in alpine flora, fauna and habitat classification. On site discussions were held with the field staff regarding the conservation and management of alpine landscape in the Zemu valley and adjacent areas including zonation plan.

4. OBSERVATIONS

4.1. The Alpine Vegetation of KBR in General

Based on the topographic map it is revealed that nearly 1341 km^2 (ca 51% of the total geographical area) of KBR falls above 4000 m above sea level. Of this, nearly 732 km^2 area lies between the elevation ranges 4000 -5000 m asl that supports the alpine vegetation. In terms of major physiognomic units within the alpine vegetation *Krummholtz*, Rhododendron scrub, Juniper scrub and herbaceous vegetation (including sedge meadows) comprise about 30, 11, 9 and 50 % area respectively (Tambe & Rawat 2006 unpublished data). General structure and composition of these categories are as follows:

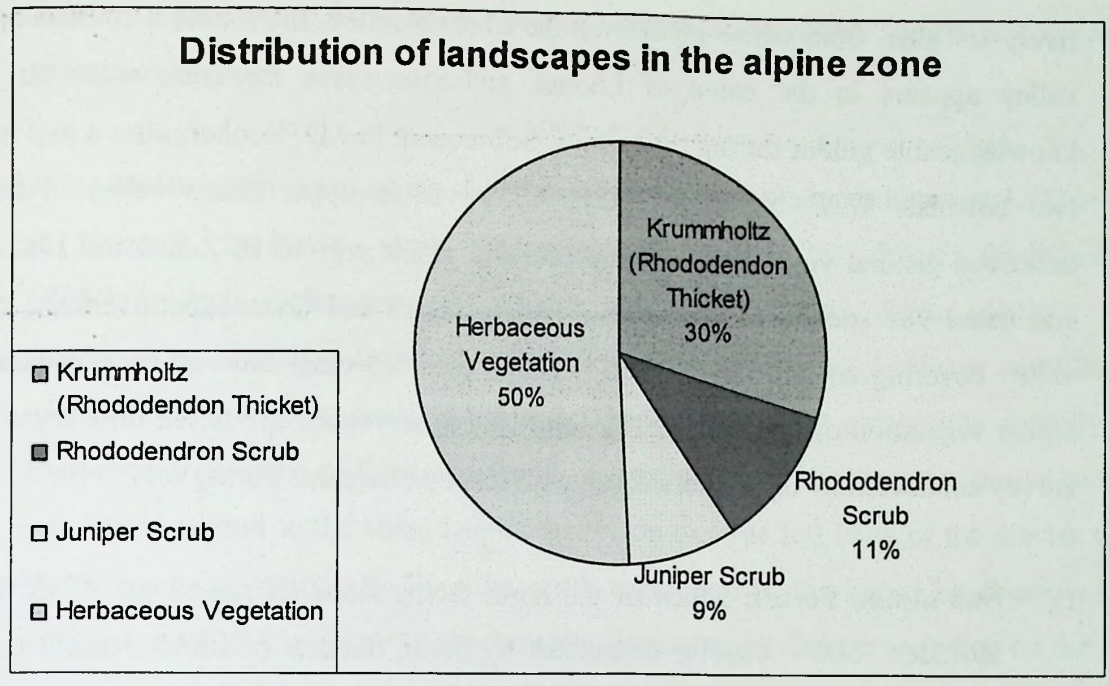
a. Krummholtz Zone: The following associations are easily identifiable within *krummholtz* zone viz., *Rhododendron wightii – R. fulgens, R. thomsonii, R. hodgsonii, R. lanatum* and *R. campanulatum*. These associations are usually found between 3500 - 4200 m asl on rocky and shady moist slopes. General height of the vegetation varies between 2 – 2.5 m and most of the formations are thick and impenetrable. Ground vegetation is dominated by mosses and lichens. Only along the stream courses or openings a few other species such as *Cassiope fastigata, Bistorta vaccinifolia*, and species of *Gaultheria, Rubus, Lonicera* and *Salix* can be seen.

b. Dwarf Rhododendron scrub: Beyond the *Krummholtz* zone on shady moist slopes (up to 4500 m asl) one comes across extensive patches of dwarf rhondodendrons *viz., R. anthopogon, R. setosum, R. lepidotum* and *R. nivale*. These species vary in height between 30

-50 cm. Within the clearings of dwarf rhododendrons a few grasses and herbs such as *Potentilla peduncularis, P. coriandrifolia, Primula macrophylla, Taraxacum officinale, P. caveana,* and several other species can be seen.

c. Juniper scrub: Generally, south facing warmer and exposed slopes between 4000 – 4500 m asl are dominated by a prostrate juniper (*Juniperus indica*). Juniper scrub is rather patchily distributed and limited in extent (ca. 9 %) within KBR. According to the local guides most of the Juniper slopes were subjected to sheep and goat grazing, cutting and burning by the shepherds in the past. Common associates of *Juniperus indica* are *Thalictrum cultratum, Fragaria nubicola, Potentilla peduncularis, Berberis angulosa, Lonicera myrtillus, Spiraea bella, S. arcuata, Parnassia nubicola, Erigeron multiradiatus, Bistorta vivipara,* and *Aletris pauciflora.*

d. Herbaceous meadows: The herbaceous formations within alpine zone include tall forbs around treeline gaps, mixed (dwarf) herbaceous communities amidst openings of *krummholtz* and dwarf scrub, *Kobresia* meadows on higher slopes (>4600 m asl) and pioneer communities at higher altitudes and stable moraines. A number of associations and specialized growth forms which exhibit a great deal of seasonal variation and adaptations to extreme climatic conditions. The meadows are dominated by the members of Asteraceae, Rosaceae, Ranunculaceae, Scrophulariaceae, Poaceae and Cyperaceae. The local people recognize a number of medicinal and aromatic plants in the meadows. Besides several sedges and grasses of high forage value (locally known as Buki) grow gregariously in the meadows of Greater Himalaya e.g., Bhalu buki *(Kobresia duthiei*), Kesari buki *(Kobresia nepalensis), Sun buki (Kobresia capillifolia*), Rani buki *(Festuca vallesiaca),* Suire buki *(Juncus sp.).* Other associates of Buki include Kenjo *(Rheum nobile),* Harkat *(Carex nivalis),* Shyamphul *(Pleurospermum sp)* and *Potentilla peduncularis.*



B. Observations on the vegetation of Zemu Valley:

The Zemu valley lies on the north-eastern flank of KBR which forms a transitional zone between the Greater and Trans-Himalaya. The most prominent physical feature in the valley is the Zemu glacier which is the largest glacier in the state that spans over a length of about 26 kms and width of 1 – 1.5 kms. It forms the source of Zemu river, a major tributary of Tista, which joins latter near Zema Samdong about 5 kms upstream from Lachen village. Owing to restrictions for the common public till recently and remoteness, this valley has remained nearly pristine and free from anthropogenic pressures. Reportedly, a limited sheep grazing used to take place in some parts of the valley prior to 1960. Among the mountaineers and trekkers the upper end of Zemu valley is known as 'Green Lake'. This name is attributed to presence of a few glacial lakes which could have reflected blue / green hue in the past but presently these lakes have virtually dried and silted.

First botanist to explore the part of Zemu valley was Sir John Dalton Hooker, the author of seven volume *Flora of British India*. He visited Zemu valley in June 1849 when no other outside traveler or naturalist had ventured in this mystique land. Hooker, in his Journal, writes that the vegetation of Lachen valley is of great interest because it is located nearly equidistant from the tropical forests of Terai and the sterile mountains of Tibet, for which reason representatives both of the dry central Asiatic and Siberian and of the humid Malayan floras meet here. Hooker spent about one week around the confluence of Lhonak and Zemu

rivers at Talem from where he entered the Lhonak valley. In Hooker's Journal upper Zemu valley appears in the name of Lhonak and vice versa for there were no maps and knowledgeable guides during those days. Subsequent to J.D. Hooker, after a gap of 60 years, two botanists W.W. Smith and G.H. Cave visited upper Zemu valley. These authors described general vegetation of temperate and alpine regions of Zemu and Lhonak valleys and listed 982 species of seed plants (Angiosperms and Gymnosperms) from upper Tista valley covering an altitude of 4000 – 16000 feet. No other description is available on the alpine vegetation of this valley. The following observations are based on a rapid ecological survey conducted by the authors along with other participants during July 2-10, 2006:

i. **Sub-alpine Forest:** Much of the north facing slope on right bank of Zemu between altitudes 3500 – 4000 is dominated by dense thickets of Rhododendrons. Smith and Cave had reported very dense and impenetrable thickets of *Rhododendron hodgsonii* around the confluence of Zemu and Lhonak rivers. It took them half an hour to cross the rhododendron thicket from the confluence and reach an open camping ground where they came across one camp of sheep herders. However, this area seems to have been changed much since then largely due to a massive flash flood which has deposited enormous boulders and debris around Talem. Presently this area has dense growth of *Salix sikkimensis*, rather stunted *Rhododendron thomsonii, R. lepidotum, Pieris formosa*, and *Cotoneaster* spp. *R. hodgsonii* was more abundant beyond the shepherds camp at Talem. There exists a well established trail towards Zemu glacier along the left bank of Zemu river.

The *krummholtz* zone towards interior of the valley (Yabuk) exhibits heterogeneous landscape comprising rocky outcrops, marsh meadows, stream courses and landslides. Common understorey species among *krummholtz* were *Smilacina purpurea, Smilacina oleracea, Paracaryum glochidiatum* and *Arisaema nepenthoides*.

At places one comes across scattered strands of *Juniperus indica, Betula utilis*, and a dwarf bamboo (*Himalayacalamus falconerii*). Snow debris and avanlanche traps often bring the alpine plants in the sub-alpine zone. For example, on the opposite slope of Jakchen camp (3500 m) there is a narrow trail leading to the base of a waterfall and avalanche swept ground. This site was laden with a variety of alpine herbs including *Saussurea obvallata, Swertia hookerii, Actaea spicata, Anemone* spp., *Androsace* sp.,

Primula sikkimensis, Primula involucrata, Rheum acuminatum, and a few species of grasses and sedges.

ii. **Alpine moist scrub**: Most of the shady moist (north facing) slopes between 4200 to 4600 m support extensive scrub vegetation dominated by dwarf rhododendrons (*Rhododendron anthopogon, R. ciliatum* and *R. lepidotum*), *Ribes glaciale, Ribes acuminatum, Berberis angulosa, Spiraea arcuata, S. bella, Lonicera myrtillus, L. obovata, Rosa sericea, Salix sikkimensis*. The zone of moist scrub ends abruptly near the terminal moraine of Zemu glacier (2 kms from Yabuk). From the terminal moraine one has to ascend to the upland alpine valley on the true left bank of the glacier where the alpine scrub reappears. Here the scrub vegetation is dominated by *Rhododendron anthopogon* and *R. setosum* in shady moist places and by *Juniperus indica* on the south facing exposed slopes. A few slopes had gregarious patches of stunted *Rhododendron campanulatum*. The stabilized lateral moraines which retain snow for a long period are characterized by carpets of *Cassiope fastigiata* and *Gaultheria trichophylla.* Other associates in such sites include *Diplarche multiflora, Diapensia himalaica, picrorhiza kurrooa,* and *Salix lindleyana.*

iii. **Alpine mixed herbaceous formations**: Most of the valley bottom amidst the moist scrub and flat meadows harbours a variety of herbaceous species. Most prominent species include *Anaphalis xylorhiza, Ranunculus pulchellus, Meconopsis simplicifolia, Meconopsis paniculata, Hedysarum sikkimensis, Astragalus kongrensis, Chesneya nubigena, Potentilla arbuscula, Lagotis kunawarensis, Sibbaldia purpurea, Gentiana* spp., *Saxifraga* spp., *Rhodiola* spp., *Aster diplostephoides, Senecio* spp., *Primula* and *Pedicularis* spp. Snow swept and freshly eroded slopes are dominated by *Anaphalis xylorhiza, Leontopodium jacotianum, L. monocephalum, Saxifraga flagellaris, Epilobium reticulatum, Gymnadenia orchidis* (Panch Amle) and *Delphinium caeruleum*. A few species of grasses e.g., *Trisetum spicatum*, *Poa* spp. *Agrostis* spp., *Festuca valesiaca* and members of Cyperaceae and Juncaceae are also frequent among the herbs.

Certain localities in the upland valley support gregarious growth of medicinal herbs such as *Aconitum ferox* (also poisonous), *Podophyllum hexandrum*, *Corydalis* spp. One of the most striking plants in the valley, i.e., *Rheum nobile* is confined to much higher

(>4800 m) slopes. *Ephedra gerardiana* and *Nardostachys grandiflora,* two important medicinal plants were confined to only few localities.

iv. ***Kobresia* meadows**: Higher up (4600-5000 m) especially south facing stable slopes are dominated by various species of sedges i.e., species of *Kobresia* (*K. capillifolia, K. nepalensis, K. curtipes*) and grasses *viz.*, *Festuca valesiaca, Calamogrostis emodensis*, and *Trisetum spicatum*. The *Kobresia* meadows can be regarded as climax formations and support good population blue sheep (*Pseudois nayaur*), an important wild herbivore of KNP. This formation at the higher, snow and wind swept slopes (>5000 m) is gradually replaced by genera such as *Draba, Arenaria, Rhodiola, Waldhemia* and *Saussurea.*

4.2 Alpine Habitats

Based on the broad physiognomic units and major land forms the following habitat types are discernible in the alpine zone of KBR:

a. Krummholtz Zone
b. Alpine Scrub
c. Alpine Meadows
d. High Altitude Lakes
e. Moranic Environs
f. Inaccessible rocky and cliff areas
g. Riverine Habitats
h. Special Habitats (caves, tallus, colluvial deposits)

Characteristic features of vegetation, current biotic pressures and wildlife use within terrestrial habitats are as follows:

Broad Habitat Types	Dominant Species	Biotic Pressure	Wildlife Use
Krummholtz (Rhododendron Thickets) 3600m – 4200m	*Rhododendron wightii, R. fulgens, Rhododendron lanatum, Rhododendron campanulatum*	Firewood collection especially of Rhododendron by herders and trekking support staff	Musk Deer, Himalayan Tahr, Himalayan serow, Blood Pheasant, Satyr Tragopan, Himalayan Monal
Alpine Scrub	a. Juniperus scrub (3700 – 4400 m asl; South Facing slopes): *Juniperus recurva, Juniperus indica, Rhododendron lepidotum*	Firewood collection especially of Juniper by herders and trekking support staff, Collection of branches for incense, grazing by herders and setting fire to large patches with an intention to increase fodder availability	Blue Sheep, Himalayan Tahr, Musk Deer, Voles, Himalayan Monal, Red Fox
	Dwarf Rhododendron Scrub (3900m – 4400m; North Facing) *Rhododendron anthopogon, R. setosum, R. lepidotum*	Firewood collection by herders and trekking support staff	Nesting habitat for birds like Finches, Pipits, Accentors etc
Alpine Meadow	*Descampsia* Marsh Meadow 4300m – 4700m Lake basin, River courses *Descampsia sp.(Chamrey)*	Camping by Trekkers and disposal of solid waste (garbage) also sacred sites for pilgrimage	Blue Sheep Snow Partridge, Himalayan Monal, Accentors, Pipits, Grandala, Snow Leopard, Snow Partridge and Snow Cock
	Mixed Herbaceous Meadow 4300m – 4700m *Potentilla peduncularis (Namle Jhaar)*	Heavy grazing and trampling by yaks and sheep in western parts till recently. Currently yak population has been reduced by the park management. In northern parts viz., Zemu and lower Lhonak valley there is no livestock grazing.	
	Kobresia Sedge Meadow 4300m – 4800m *Kobresia capillifolia (Sun buki), Carex nigra (Harkat), Festuca valesiac (Rani buki)*		
Moranic Environs	*Potentilla fruticosa* and *Rhododendron lepidotum* 4200m – 4800m Glaciated Valleys along lateral and terminal moraines *Potentilla fruticosa, Rhododendron lepidotum, Kobresia capillifolia, Bistorta vaccinifolium*	Moderate grazing and trampling by yaks and sheep. No grazing in upper catchment of Zemu.	Blue Sheep Snow Partridge, Himalayan Monal, Accentors, Pipits, Grandala, Snow Partridge, Snow Cock, Snow Leopard, Pika
Rocks and Cliffs	Sparse vegetation Mostly mosses, lichens, *Kobresia capillifolia, Juncus sp.*	Nil	Golden eagle, Choughs, Buzzards, Rock chats, Thrushes, Snow pigeon, Snow Partridge, Snow Cock, Blue Sheep during summer
Riverine	Willow Thicket on banks, *Myricaria* Scrub on River Bed and Mosses and Lichen on rock Adjacent to river course *Salix sikkimensis, Sorbus sp., Myricaria rosea, Oxyria digyna, Epilobium wallichianum, Polygonum sp.*	Camping by tourists resulting in spread of garbage along the popular trekking trails.	Thrushes, Blood Pheasant, White capped Redstart, White Throated Dipper
Special Habitats	Caves, Caverns, Den trees, Snag, Rocky Overhands, Crevices *Kobresia Kobresia capillifolia (Sun buki), Carex sp., Juncus sp.*	Camping by trekking support staff, poachers, sheep herders and sacred sites for pilgrimage	Himalayan Black Bear, Red Fox, Pika and shelter during inclement weather for Blue Sheep

4.3. Plants of high conservation value

A tentative list of alpine plants (Gymnosperms and Angiosperms) is given as Appendix -1 along with a few local names, local uses and remarks (endemic, rare or of other conservation significance. As the socio-economic conditions of the local people in and around KBR is improving rapidly, there is very little commercial extraction of medicinal plants from KBR at present. Hence KBR can be considered as one of the important sites for *in-situ* conservation of various plant groups including rare endemics, species of botanical interest and species of local ethno-botanical values. Species of high conservation value and botanical interest in sub-alpine and alpine areas of KBR include *Schizandra grandiflora* (a primitive climber with flowers like miniature Magnolia), *Helwingia himalaica* (bearing flowers at the center of the leaf and endemic to the Eastern Himalaya), *Circaeaster agrestis* (Chloranthaceae of uncertain affinity), *Pinguicula alpina* (an insectivorous plant), *Triosteum himalayanum* (endemic to Himalaya), *Brachycaulos simplicifolius* (an unusual herb of Rosoaceae) among others.

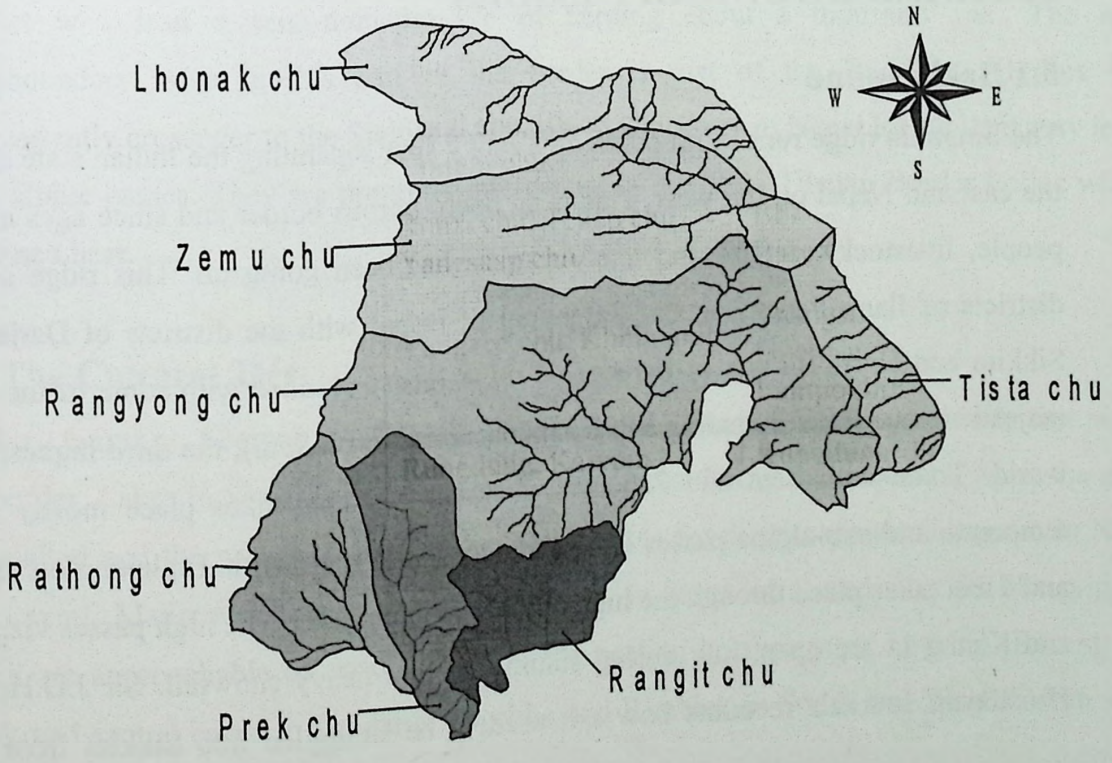
Few more alpine plants need special mention for their high conservation significance e.g., the wild poppies (*Meconopsis* spp.) which bear spectacular flowers and have several medicinal properties, species of *Corydalis, Rhodiola, Pleurospermum, Saussurea, Primula, Gentiana, Swertia, Pedicularis, Polygonatum* and several ground orchids. Among the rhubarb species *Rheum nobile* is particularly vulnerable owing to its striking inflorescence which is often plucked by the herders and local communities to make pickles. The KBR authorities need to issue a plea to the local people for its protection. A detailed analysis of narrow endemics confined to alpine areas of Sikkim needs to be done. To begin with, the species named after the state (*sikkimensis* plants) need to be inventoried and documented in terms of their current status and distribution. Some of the examples are *Paraoxygraphis sikkimensis, Berberis sikkimensis, Podophyllum sikkimense, Corydalis sikkimensis, Draba sikkimensis, Astragalus sikkimensis, Hedysarum sikkimense, Sibbaldia sikkimensis* and *Saxifraga sikkimensis* to name a few.

4.4: Suggestions for a Zonation Plan for KBR

As per the provisions contained in the Wildlife (Protection) Act 1972, the National Parks are to be kept free from any form of consumptive use of flora and fauna. Hence, for the practical

purposes the current boundary of the KNP is taken as core zone for the KBR. Remaining areas of the KBR include the human use zone, which has been designated as buffer zone of the KNP. For further zonation planning, KBR is divisible into following major watersheds and sub-watersheds:

S. No.	Watershed Name	Micro Watersheds	Important Locations
1	Lhonak chu	Goma chu, Putung chu, Lungma chu	Rasum, Goma, Lungma
2	Zema chu	Thomphyak chu, Siniolchu glacier	Green Lake, Yabuk
3	Lachen chu	Yuktu chu, Yel chu, Fim chu, Rokzang chu	Mensithang, Phimpu
4	Rangyong chu	Ringi chu, Rukel chu, Umram chu,	Kisong, Thepe-la
5	Rathong chu	Runzi chu, Tekep chu, Yangsaap chu	Boktok, Yangsaap, HMI Base Camp
6	Prek chu	Yangzee chu, Khola urar chu	Thangsing, Lamune, Gochela, Areylungchok, Lampokhri
7	Rangit chu	Rungdung, Kaiyum	Rungdung, Jhyuare



For the long term conservation and management of KBR the following guidelines can be taken for developing a zonation plan:

i. Watershed and micro-watershed approach should be taken to delineate the critical wildlife habitat areas (as mini-cores), Eco-tourism and buffer zones.

ii. Featured species of fauna viz., snow leopard, blue sheep, Himalayan musk deer, Himalayan tahr, serow, red panda, blood pheasant, Himalayan monal, and tragopan may be taken for delineation of critical habitats. The Govt. of Sikkim has already designated Musk deer conservation zone and Himalayan tahr conservation zone.

iii. Within each watershed the botanical hotspots or the sites of threatened medicinal plants will have to be identified in order to notify them and regularly monitor.

iv. Tourism zone need to be further divided into open (community based tourism zones) restricted tourism, camping sites, trekking routes and all the trails need to be designated in terms of upper limit of visitors.

v. Patrol routes of KBR need to be evolved in consultation with the Himal Rakshaks (these routes will have to be restricted only to the team leaders and the Field Director).

vi. Site specific recommendations for the Zemu valley were given separately.

5. TRANS-BOUNDARY ISSUES

5.1 Background

The Singalila ridge runs north-south on a rocky spur separating the Indian state of Sikkim on the east and Nepal on the west. This is an open, porous border and since ages movement of people, livestock, wildlife and lately tourists has been going on. This ridge separates the districts of Ilam, Panchthar and Taplejung of Nepal with the districts of Darjeeling, West Sikkim and North Sikkim of India. This ridge is also studded with some of the highest and majestic snow peaks including Mt. Khangchendzonga (8585m), the third highest peak in the world. Trade with Ilam and Panchtaar districts of Nepal takes place mostly through the temperate and sub-alpine passes below 3500m while trade with Taplejung district of Nepal and Tibet takes place through the high altitude alpine passes. The high passes viz., Boktok La and Khang la are open only during summer before heavy snowfall. Sir J.D.Hooker in his Himalayan Journals recounts how salt used to be smuggled into Sikkim from Tibet after

crossing four high passes, all above 15,000 feet, covering one-third of the circuit of Khangchendzonga and taking more than a month.

The Singalila ridge is not only an international border but also a development divide. Though the ecological and socio-cultural fabric on either side of the border is the same, the economic progress on both sides is different. On the Nepal side the people are primarily engaged in farming and livestock husbandry with limited infrastructure, communication, education and health facilities. While Sikkim is a rapidly developing state with even remote villages boasting of good road connectivity, electricity, drinking water, schools, hospitals, and subsidies on rural infrastructure, essential food items and kerosene oil. Hence it is economical for the people residing in the border villages of Nepal to access goods and services from the border towns of India. Consequently there is a demand for household provisions for a large number of Nepali families which is met from India in a barter trade with mostly dairy products.

To the extreme North West the trans-himalayan Lhonak valley separates Sikkim from China (Tibetan Autonomous Region). According to Smith and Cave (1911) the Lhonak valley served as the summer pastures for the nomadic herders from Sikkim and the Khambajong province in Tibet during early twentieth century. However after the Chinese aggression the international border was sealed and currently there are nine *Dokpas* families in Muguthang hamlet who lead a semi-nomadic life of herding about a thousand yak. The main transboundary issue in this part of the border is that of the Buddhist pilgrims who inadvertently crossover to the Sikkim side while on their way to Nepal losing their way in the high alpine passes. They are promptly intercepted by the Indo Tibetan Border Police who is stationed here.

5.2 The Cultural Ties

Limbus, Gurungs, Sherpas and Bhutias are the ethnic groups which share family ties across the border. Lakes in Singalila are a source of pilgrimage during the summers, when the snow has melted and the passes accessible. Important lakes for pilgrimage are Tingmvo in Nepal and Laxmi, Majur and Doodh Pokhri in Sikkim. In terms of sacred sites for the pilgrims which are approachable by road in Sikkim the healing hotsprings of Legship, Borong and Polok and sacred caves in Labdang, Sopakha and Rimbick in South and West Sikkim are a

big attraction. Similarly the Kali temple at Pathibara in Taplejung and the Changtapu temple in Panchthar are the big pilgrim attractions in Nepal.

5.3 Pastoralism

In Nepal livestock rearing is an important livelihood option and grazing permits are issued from the Forest Department after realizing nominal grazing fees. The incomes from pastoralism and herd size are at subsistence levels and the dairy products are bartered for household provisions from India. There are a large number of herders having an average herd size of about 20 livestock. However now with the initiation of the Transboundary conservation project of The Mountain Institute the following community based regulations are in force by the local community:

- Banning import of yak and yak hybrids from Sikkim into Ilam and Panchthar
- Carrying out large scale plantations in degraded sub alpine areas
- Cultivation of medicinal and aromatic plants in degraded forests
- Opening up of new cattle shed and pastures in the forests is not permitted now
- Ban on the collection of medicinal plants from the wild

Unlike in Nepal the Indian side of the Singalila range is under the protected area network which include Singalila National Park, Barsey Rhododendron Sanctuary and KNP. As per the

Indian wildlife laws, grazing is banned and strict enforcement of this ban is currently ongoing. Due to this law enforcement and availability of other livelihoods options most of the small herders have sold off their livestock. The number of livestock has reduced by more than 75% over the last 5 years and only a few influential herders owning about 500 yaks remain.

Though instances of transborder grazing are less, however the migration route between the summer and winter pastures of the Indian herders lie through Nepal. The Sikkim herders spend a few days in the Nepal side while migrating from their winter pastures to the summer pastures during spring and also while returning during autumn. There is a big demand for dairy products mostly butter and hard cheese in Darjeeling. Also oxen are herded on foot to Darjeeling and Sikkim where they are slaughtered for beef. Wild dogs are reported to be the biggest threat to the yaks especially in winter when the livestock are not looked after by the caretaker. Retaliatory carcass poisoning is prevalent and during the winter of 2005, domestic dogs got accidentally poisoned on the border and died in the Yambong valley of Sikkim. This started a chain of poisoning deaths claiming 37 Himalayan griffon vultures.

5.4 Hunting and Poaching

Historically low volume, high value trans-border musk deer poaching was prevalent and some of the poachers have even been caught and imprisoned. Amongst the wildlife products traded the pod of the musk deer and the bile of the Himalayan black bear was the prized items. It is reported that earlier about 10 pods of musk deer @ Rs 2000-5000 / 10gm and 5 biles of Himalayan black bear used to be smuggled across the Boktok pass annually from Sikkim.

5.5 Medicinal Plants

Before the year 2000, medicinal plants mostly Bikh *(Aconitum ferox),* Kurki *(Picrorhiza kurooa),* Bikhma *(Aconitum spicatum)* and Panchamle *(Gymnadenia orchidis)* were collected from the border districts in Nepal and supplied across the border to the herders on the Indian side. These herders in turn used to link up with the businessmen in the rural towns who had the collection and trade permits. However in 2001 the Sikkim Government viewed with concern the depletion of medicinal plants from the forest areas of Sikkim. With a view to encourage regeneration of areas that are facing depletion of these resources the Government

banned the collection and transit of all medicinal plants for commercial purposes for a period of ten years.

5.6 Singalila Transborder Tourism

The Singlaila trek is a 18 days round trek on the Singalila ridge at an average altitude of 3500m starts from Uttarey village and ends at Yuksam village while passing through the Barsey Rhododendron Sanctuary and the KNP. It is a trans-border trek with 2 days and 1 night stay at Dhor in Nepal. This trek started picking up as a trekking destination from 2000 onwards and resulted in a incomes of about Rs 9 Lakhs for the villagers in 2003 from 400 overseas tourists. However due to security concerns this trek was closed by the Home Ministry, Government of India in early 2005.

5.8 Trade

Since 2002 the border on the India side has been manned by the Special Service Bureau paramilitary forces and even boundary pillars have been erected. The SSB regulate the movement of people and goods across the border. Though most these units do not cause any impediment to this trade, some of them are reported to harass the villagers by resorting to bribes.

6. RECOMMENDATIONS

i. The field staff of KBR and a few local participants were oriented in alpine habitats and alpine plants during ecological survey to Zemu Valley. Such multi-disciplinary surveys need to be organized in different parts of KBR on regular (annual) basis and more training programmes for the rapid survey of rare plants and animals need to be organized for *Himal Rakshaks* . Simple Field Guides depicting common alpine medicinal plants, rare species, birds and mammals need to be developed along with trail maps and detailed do's and don'ts.

ii. Currently the KNP authorities are in the process of writing the management plan. The habitat types and critical wildlife habitats identified for the alpine region in this report are of direct relevance for evolving a zonation plan for the national park.

iii. Key floral species for conservation in the alpine habitat are: *Rheum nobile* (Kenjo), *Gymnadenia orchidis* (Panch Amle), *Nardostachys grandiflora* (Jatamansi), *Ephedra*

gerardiana, *Picrorhiza scrophulariifolia* (Kurki), wild Alliums, Giant Lily (*Cardiocrinum giganteum*), Pseudo-ginseng (*Panax pseudo-ginseng*), *Pleurospermum* spp., Caterpillar-mushroom (*Cordyceps sinensis*) and various endemics listed in the section 4.3 above. A few sites have been identified as botanical hotspots including a *Podophyllum* patch near Marco Polo Camp in upper Zemu valley. Such botanical hotspots need to be listed and special conservation and monitoring measures need to be prescribed in the management plan that is under preparation.

iv. Except in a few parts of western KBR, the pressure of domestic livestock in the alpine rangelands of KBR appears to be at sustainable level. Nevertheless, catchment wise human dependence need to be documented systematically and monitored.

v. The trekking trail to Zemu valley need to be managed more professionally with the help of local (Lachen) communities by creating simple infra-structure for the porters at designated camp sites and also restricting the number of visitors to the valley. In the alpine zone of Zemu only one camping site (below Marco Polo Camp) is recommended so as to keep the 'Green Lake' area as pristine as it is now.

vi. In addition to alpine floral communities, all the high altitude lakes, stream courses and special habitats including wintering ranges of blue sheep, snow leopard and pheasants need to be given special conservation status in the management plan.

vii. The authorities of Kanchenjunga Conservation Area in Nepal, and PA Managers in India need to begin a dialogue afresh to revive Singalila Trans-border Eco-tourism and set up a long term trans-border peace park for joint protection and management involving the local communities.

REFERENCES

Anon., 1994. Forest Cover Mapping through Digital Image Processing of Indian Remote Sensing Satellite data with Special Reference of Sikkim – Procedural Manual and Inventory: Joint Collaboration Project of Forest Department, Government of Sikkim and Regional Remote Sensing Service Centre, Kharagpur, Indian Space Research Organization, Department of Space, Government of India, 1994

Hooker, J.D. 1853. The Himalayan Journal. Notes of a Naturalist. Vo. I & II. Reprint. Natraj Publishers, Dehra Dun.

Lachungpa, U., Tambe, S. and Arrawatia, M. L., 2003. Biodiversity Strategy and Action Plan: Sikkim State, NBSAP: Department of Forest, Environment and Wildlife, Government of Sikkim, 2003.

Mani, M.S., 1978. Ecology and Phytogeography of the High Altitude Flowering Plants of the North West Himalaya. Oxford & IBH Publishing Co., New Delhi.

Poluni, O. and Stainton, A. 1987. A Concise Flowers of the Himalaya. Oxford.University Press.

Grierson, A.J.C., Long, D.G. and Noltie, H.J. 1983-1994. Flora of Bhutan Vols 1-3. Royal Botanic Garden, Edinburgh.

Rai, L. K., Prasad, P., Sharma, E., 2000. Conservation Threats to Some Important Medicinal Plants of the Sikkim Himalaya.

Singh, H. B., Jackson, R. and Sharma, E., 1999. Dynamics of grazing in an alpine meadow of the Khangchendzonga National Park in Sikkim Himalaya. In the proceedings of the VI International Rangeland Congress, Townsville, Australia.

Smith, W.W. and G.H. Cave. 1911. The Vegetation of the Zemu and Llonakh Valleys of Sikkim. Records of the Botanical Survey of India, Vol. IV – No. 5.

Tambe, S., 2002. Ecology, Economics and Equity: A case study of livestock rearing from West Sikkim pp. 153-156 in. South Asia Perspectives on Ecotourism and Conservation. Edited by A.P. Krishna, P.D. Rai and J. Subba, Ecotourism and Conservation Society of Sikkim.

Tambe, S. and Rawat, G.S. 2006. An Ecological Study of Pastoralism in the Khangchendzonga National Park, West Sikkim. The Mountain Institute – India, Sikkim. 51 pp.

Appendix - 1

TERMS OF REFERENCE

Dr Gopal S Rawat, faculty member of Wildlife Institute of India, with his vast experience on biodiversity inventory and an active ICIMOD partner, will be involved for MacArthur Foundation Project entitled " ***Developing a Transboundary Conservation Landscape for the Eastern Himalayas***" **Second phase.** Dr Rawat will work in inventory of biodiversity with special reference to threatened and endemic flora in the north western part of Kangchenjunga Biosphere Reserve of Sikkim, India with the following the TOR:

i. Conduct a rapid survey of alpine vegetation communities / physiognomic units vis-a-vis alpine habitats in the north-western parts of Kangchenjunga Biosphere Reserve,

ii. Assess the conservation status of various plant communities and preferences by domestic livestock and wildlife,

iii. Identify key floral assemblages / threatened plants of high conservation significance

iv. Identify trans-border conservation issues focusing on grazing, illegal medicinal plant trade and other anthropogenic pressures.

v. Suggest a working plan and measures for long-term conservation and monitoring of alpine habitats.

vi. Acknowledge ICIMOD for support in all publications coming out of this support

* * *

Appendix - 2: A tentative list of Vascular Plants recorded from alpine zone of KBR, their vernacular names, uses and plants recorded from Zemu Valley * (July 2006). [Status: C= Common; F = Frequent; R = Rare; ER = Extremely Rare; EN = Endemic]

Family / Scientific Name	Vernacular Name	Use / Remarks	Presence in Zemu Valley (*)	Status
GYMONSPERMS				
Abies densa Griff.	Gobre salla	Timber	*	C
Ephedra gerardiana Stapf. *var. sikkimensis* Stapf.	Tse	Medicinal	*	R, EN
Juniperus indica Bert.		Incense	*	F
Juniperus recurva D. Don	Sikpa	Incense		R
Juniperus squamata D. Don		Fuelwood	*	R
Larix grifithiana Carr.	Barge Salla	Timber	*	F
Tsuga dumosa (D.Don) Eich.	Tengre salla	Timber	*	C
ANGIOSPERMS				
Ranunculaceae				
Aconitum bisma (Ham.) Rapaics	Bikhma	Medicinal / Poisonous	*	R
Aconitum ferox Seringe	Bikh	Extremely poisonous		F
Aconitum gammiei Stapf				F
Aconitum gymnandrum Maxim.				R
Aconitum heterophylloides (Bruhl.) Lauen.				R
Aconitum hookeri Stapf.		Medicinal	*	F
Aconitum laciniatum (Bruehl.) Lauen.				R
Aconitum nakaoi Tamura				R
Aconitum naviculare (Bruehl.) Stapf.				R
Aconitum novoluridum Munz.				R
Aconitum spicatum (Bruhl.) Stapf.	Bikhma	Poisonous		F
Actaea acuminata Royle			*	F
Anemone demissa Hk.f. & T.			*	F
Anemone griffithii Hk.f. & T.				F
Anemone obtusiloba D. Don			*	F
Anemone polyanthes D. Don	Bhutkesh			C
Anemone rivularis DC.				F
Anemone rupestris Hk.f. & T.				F
Anemone rupicola Camb.				F
Anemone smithiana Laune. & Panigr.				R
Anemone trullifolia Hk.f. & T.				F
Callianthemum pimpenelloides (D. Don) Hk.f. & T.			*	R
Caltha palustris L.		Medicinal		F
Caltha scaposa Hk.f. & T.				R
Cimicifuga foetida L.				R
Clematis buchananiana DC			*	F
Clematis montana DC.	Pinashe lahara		*	F
Clematis tongluensis (Bruehl.) Tamura				R
Clematis zemuensis WW Sm.			*	R
Delphinium candelabrum Ostenf.				F
Delphinium caeruleum Camb.			*	R
Delphinium drepanocentrum (Bruhl.) Munz.				R
Delphinium glaciale Hk.f. & T.		Medicinal		R
Delphinium ludlowii Munz.				R
Delphinium viscosum Hk.f. & T.	Jureli phool			F
Oxygraphis endlicheri (Walp.) Bennet & Chandra				R
Paraoxygraphis sikkimensis WW Sm.				R, EN

Ranunculus adoxifolius Hand. - Mazz.				F
Ranunculus brotherusii Freyn.			*	C
Ranunculus hirtellus D. Don				C
Ranunculus pegaeus Hand.-Mazz.				F
Ranunculus pulchellus Mey.	Khorsane phool	Ripened fruit used as chilly	*	F
Ranunculus sarmentosus Adams.				C
Ranunculus sikkimensis Hand.- Mazz.				F, EN
Ranunculus trichophyllus Chaix				F
Ranunculus tricuspis Maxim.				F
Souliea vaginata Franch.		Syn - *Coptis ospriocarpa*		R
Thalictrum alpinum L.			*	C
Thalictrum chelidonii DC.				F
Thalictrum platycarpum Hk.f. & T.			*	F
Thalictrum elegans Wall. ex Royle				F
Thalictrum foetidum L.				F
Thalictrum minus L. var. majus				F
Thalictrum reniforme Wall.				F
Thalitcturn rutifolium Hk.f. & T.				F
Thalictrum secundum Edgew.				F
Thalictrum setulosinerve Hara				R
Thalictrum virgatum Hk.f. &T.				F
Thalictrum sp.1	Paduwa jhaar			F
Trollius pumilus D. Don				F
Berberidaceae				
Berberis angulosa Hk.f. & T.			*	F
B. concinna Hk.f. & T.				R
B. hookeri Lemaire				F
B. insignis Hk.f. & T.	CHUTRO			F
B. macrosepala Hk.f. & T.				R
B. thomsoniana Schneid.				R
B. tsarica Ahrendt.				R
B. umbellata var. branii				F
B. virescens Hk.f.				R
Podophyllaceae				
Podophyllum hexandrum Royle		Medicinal	*	R
Circaeasteraceae				
Ciraeaster agrestis Maxim		Rare; Botanical Interest		ER
Papavaraceae				
Cathcartia villosa Hk.	Sisney phool	Syn - Meconopsis villosa	*	F
Meconopsis bella Prain				R
Meconopsis discigera Prain				F
Meconopsis grandis Prain				F
Meconopsis horridula Hk.f. & T.		Medicinal	*	F
Meconopsis lyrata (Cummins & Prain.) Prain				F

Meconopsis napaulensis DC.			*	C
Meconopsis paniculata Prain				F
Meconopsis simplicifolia (D. Don) Walp.			*	F
Meconopsis sinuata Prain				R
Meconopsis superba Prain				R
Fumariaceae				
Corydalis cashmeriana Royle				R
Corydalis cavei Long				F
Corydalis chaerophylla DC.			*	F
Corydalis changuensis Long				R
Corydalis crispa Prain				R
Corydalis dubia Prain				F
Corydalis filicina Prain				R
Corydalis flaccida Hk.f. & T.				F
Corydalis graminea Prain				R
Corydalis hendersonii Hems.				R
Corydalis juncea Wall.			*	F
Corydalis laelia Prain			*	F
Corydalis lathyroides Prain				F
Corydalis latiflora Hk.f. & T.				R
Corydalis longipes DC.				F
Corydalis meifolia Wall.			*	C
Corydalis ophiocarpa Hk.f. & T.				R
Corydalis polygalina Hk.f. & T.				R
Corydalis sikkimensis (Prain) Fedde				F, EN
Corydalis stracheyi Prain				R
Corydalis trifoliata Franch				F
Fumaria capreolata L.				R
Hypecoum leptocarpum Hk.f. & T.				F
Brassicaceae				
Aphragmus oxycarpus (Hk. f. & T.) Jafri				R
Arabidopsis himalaica (Edgew.) Schulz.			*	C
Arabidopsis lasiocarpa Schulz.				F
Arabidopsis mollissima (Mey) Schulz			*	F
Arabis glandulosa Kar. & Kir.				F
Arabis pterosperma Edgew.				F
Arcyosperma primulifolium (Toms.) Schulz		Syn *Eutrema primulifolium*	*	F
Barbaraea elata Hk.f. & T.				F
Barbaraea intermedia Boreau		Syn B. vulgaris var. sicula	*	C
Braya tibetica Hk. f. & T.				R
Capsella bursa-pastoris (L.) Medik.				C
Cardamine grifithii Hk.f. & T.				F
Cardamine impatiens L.				F
Cardamine loxostemonoides O. Schulz.		Syn C. pratensis L.		F
Cardamine macrophylla Willd.		Used as vegetable	*	C
Cardamine trifoliata				R
Cardamine violacea				R
Christolea himalayensis Camb.				R
Cochlearia himalaica Hk. f. & T.				F
Descuraina sophia (L.) Webb. ex Prantl.		Sisymbrium sophia L.		F

Dilophila salsa Thoms.				R
Dontostemon glandulosus (Kar. & Kir.) Schulz.				R
Draba altaica (C. A. Meyer) Bunge			*	F
Draba cholaensis WW Sm				F
Draba elata Hk.f. & T.				F
Draba ellipsoidea Hk.f. & T.				R
Draba eriopoda Turcz.				F
Draba gracillima Hk. f. & T.				F
Draba humillima O. Schulz				F
Draba lanceolata Royle				F
Draba lasiophylla Royle - 2 vars.				F
Draba oariocarpa O. Schulz				R
Draba oreades Schrenk				F
Draba polyphylla O. Schulz				R, EN
Draba sikkimensis		Syn D. tibetica var. sikkimensis		F
Draba stenobotrys				F
Draba tibetica Hk. f. & T.				F
Erysimum deflexum Hk.f. & T.				R
Erysimum funiculosum			*	F
Erysimum hieracifolium L.				F
Erysimum longisiliquum				F
Erysisum pachycarpum Hk. f. & T.				F
Eutrema deltoideum (Hk.f.&T.) Schulz				F
Eutrema himalaicum Hk.f. &T.				R
Hedinia tibetica (Thoms.) Ostenf.				F
Lepidium apetalum Willd. [L. ruderale]		Used as vegetable		F
Lepidium capitatum Hk. f. & T.				F
Lepidostemon pedunculosus Hk.f. & T.		Syn Cochlearia hobsonii		F
Lignariella hobsonii (Pearson) Baehl.				R
Loxostemon pulchellus Hk.f & T.		Syn Guillenia axillare (Hk.f. & T.) Benne		R
Microsisymbrium axillare (Hk. f. & T.) Schulz.				F
Parrya nudicaulis (L.) Boiss.				F
Parrya platycarpa Hk.f. & T.	Rani phool			F
Pegaeophyton minutum Hara				R
Pegaeophyton scapiflorum (Hk. f. & T.) Marq. et Shaw				F
Pycnoplinthopsis bhutanica Jafri		Syn Pegaeophyton bhutanicum Ham.		R
Sisymbrium himalaicum Hk.f. & T.			*	C
Thlaspi alpestre L.				F
Thlaspi andersonii (Hk. f. & T.) O. Schulz				F
Thlaspi arvense L.				F
Thlaspi cochlearioides Hk. f. & T.				F
Thlaspi montanum L.		T. cochleariforme = T. alpestre		F
Torularia humilis (C. A. Mey) Schulz				F
Violaceae				
Viola biflora L.			*	C
Viola bulbosa Maxim				R
Viola kunawarensis Royle		Medicine		R
Viloa pilosa Bl.			*	F

Caryophyllaceae				
Arenaria bryophylla Fernald			*	C
Arenaria ciliolata Edgew.				F
Arenaria debilis Hk.f. & T.				F
Arenaria densissima Wall.ex Edgew.				F
Arenaria depauperata (Edgew.) Hara				F
Arenaria edgeworthiana Majumdar				F
Arenaria ferruginea Duthie ex Williams				R
Arenaria festucoides Benth.			*	C
Arenaria glanduligera Edgew.				F
Arenaria littledalei Hemsley		Syn A. thangoensis		R
Arenaria melandryiformis Williams				F
Arenaria melandryoides Edgew. & Hk.f.				R
Arenaria orbiculata Royle ex Edgew.				F
Arenaria oreophila Hk.f. &T.				F
Arenaria polytrichoides Edgew. & Hk.f.				F
Arenaria pulvinata Edgew. & Hk.f. & T.				F
Arenaria stracheyi Edgew.				R
Cerastium fontanum Baumg		Syn C. vulgatum		F
Cerastium glomeratum Thuill.			*	F
Gypsophila cerastioides D. Don			*	C
Holosteum umbellatum L.				F
Lepyrodiclis holosteoides (Meyer) Frenzl				F
Pseudostellaria heterantha (Maxim.) Pax		Syn. Stellaria bulbosa		F
Sagina japonica (Sw.) Ohwi				R
Sagina saginoides (L.) Karsten		S. procumbens		F
Silene amoena L. [S. tenuis Willd.]			*	F
Silene bhutanica (W Sm) Majumdar		S. indica var. bhutanica		R
Silene caespitella Williams				F
Silene gonosperma (Rupr.) Bocquet				F
Silene griffithii Boiss			*	F
Silene indica Otth				C
Silene nigrescens (Edgew.) Majumdar			*	C
Silene songarica (Fisch., Mey & Ave-Lall) Bocq.				F
Silene stracheyi Edgew.				R
Stellaria congestiflora Hara				F
Stellaria decumbens Edgew.			*	F
Stellaria lanata Edgew. & Hk.f.				F
Stellaria monosperma Buch.- Ham. ex D. Don				F
Stellaria palustris Retz. [S. glauca With.]				F
Stellaria patens D. Don				C
Stellaria subumbellata Edgew. ex Hk.f.				F
Thylacospermum caespitosum (Camb.) Schischk.				R
Tamaricaceae				
Myricaria rosea W.W. Sm.			*	C
Hypericaceae				
Hypericum choisianum Robson		Syn H. hookerianum	*	F
Hypericum himalaicum Robson			*	R
Hypericum monanthemum Dyer				F
Hypericum reptans Dyer				F

Coriariaceae			*	F
Coriaria terminalis				
Geraniaceae			*	C
Geranium collinum M. Bieb				F
Geranium donianum	Dhania phool			F
Geranium lambertii Sw.			*	C
Geranium nakaoanum Hara				C
Geranium polyanthes Edgew.				F
Geranium sp.1	Sarma guru			
Oxalidaceae				F
Oxalis leucolepis Diels				
Balsaminaceae				
Imaptiens kingii Hk.f.		Syn I. gamblei	*	C
Impatiens falcifer Hk.f.				F
Impatiens gammiei Hk.f. & T.			*	F
Impatiens laxiflora Edgew.				F
Impatiens occultans Hk.f.				C
Impatiens sulcata			*	C
Impatiens tuberculata		Syn I. agantantha		F
Celastraceae				
Euonymus frigidus Wall.			*	F
Aceraceae				
Acer caudatum		Fuel wood	*	F
Fabaceae				
Astragalus acaulis Baker				F
Astragalus concretus				F
Astragalus kongrensis			*	F
Astragalus lessertoides				R
Astragalus ridigulus				R
Astragalus sikkimensis				F, EN
Astragalus strictus			*	F
Astragalus tongolensis				F
Astragalus zemuensis			*	R, EN
Chesneya nubigena		*purpurea*		F
Gueldenstaedtia himalaica			*	F
Hedysarum sikkimense				F, EN
Oxytropis arenae-ripariae				R
Oxytropis lapponica			*	C
Oxytropis sericopetala			*	F
Parochetus communis				F
Piptanthus nepalensis				F
Stracheya tibetica				R
Thermopsis barbata				F

Rosaceae				
Brachycaulos simplicifolius Dixit & Panig.		Rare/ Endemic		R, EN
Cotoneaster acuminatus			*	F
Cotoneaster microphyllus			*	C
Cotoneaster simonsii Baker				F
Fragaria daltoniana		Fruits edible	*	F
Fragaria nubicola				F
Geum elatum G. Don				C
Geum macrosepalum Ludlow				F
Geum sikkimense Prain				F, EN
Potentilla anserina L.		Syn P. fruticosa	*	C
Potentilla arbuscula			*	F
Potentilla argyrophylla				F
Potentilla biflora Willd. Ex Schlech.			*	C
Potentilla bifurca L.				F
Potentilla calliginosa Sojak	Chang chang guru		*	R, EN
Potentilla coriandrifolia				C
Potentilla cuneata Leh.				C
Potentilla eriocarpa				F
Potentilla eriocarpoides Karuse				R, EN
Potentilla forrestii W.W. Sm.				F
Potentilla fruticosa	Simte phool		*	C
Potentilla latipetiolata				C
Potentilla leuconota				F
Potentilla microphylla			*	F
Potentilla monanthes Lehm.				C
Potentilla peduncularis - 3 vars.	Namle Jhaar			C
Potentilla polyphylla Lehm				F
Potentilla pterocarpa				F
Potentilla saundersiana Royle				F
Potentilla spodiochlora Sojak				F
Prunus comuta	Lekh paiyun	Fuel wood; Fruits edible	*	F
Prunus rufa				C
Rosa sericea	Khorsaney kanra		*	F
Rubus fragaroides Bert.				F
Rubus hypargyrus	Bilbate kanra, Kanre lahara		*	F
Rubus sikkimensis Hk.f.				F, EN
Sanguisorba diandra (Hk.f.) Nordborg		Syn Poterium diandrum	*	F
Sanguisorba filiformis (Hk.f.) Hand.-Mazz.				R, EN
Sibbaldia compacta		Endemic to Sikkim	*	F, EN
Sibbaldia macropetala Murav.			*	F
Sibbaldia micropetala			*	F
Sibbaldia parviflora Willd.		Syn S. cuneata	*	C
Sibbaldia perpusilla			*	F
Sibbaldia perpusilloides				R, EN
Sibbaldia purpurea			*	F
Sibbaldia sikkimensis				R, EN
Sibbaldia trullifolia				F

Sorbus arachnoides Koehn.		Syn - S. foliolosa auct.	*	F
Sorbus microphylla Wenz.	Sano pansi		*	F
Sorbus prattii Koehn				F
Spiraea alpina		Syn - S. ulicina		R, EN
Spiraea arcuata	Shikre phool		*	C
Spiraea bella			*	C
Saxifragaceae				
Bergenia purpurascens (Hk.f. & T.) Engler	Pakhanbhed		*	F
Chrysosplenium camosum Hk.f. & T.			*	F
Chrysosplenium forrestii Diels				R
Chrysosplenium grifithii Hk.f. &T.				F
Chrysosplenium nudicaule				R
Chrysosplenium sigalilense Hara				R, EN
Saxifraga andersonii			*	F
Saxifraga aristulata Hk.f. & T.			*	F
Saxifraga asarifolia Stemb.				C
Saxifraga brachypoda D. Don			*	F
Saxifraga brunonis				C
Saxifraga caveana W.Sm.				F
Saxifraga chumbiensis Engl. & Irm.				F
Saxifraga clivorum H. Sm.				F
Saxifraga coarctata W. Sm.				R
Saxifraga cordigera		Syn S. palpebrata		R
Saxifraga diversifolia			*	C
Saxifraga dungbooii Engl. & Irmsch.				R
Saxifraga elliptica Engl.& Irm.				R
Saxifraga engleriana				F
Saxifraga fastigiata				F
Saxifraga filicaulis Seringe				F
Saxifraga flagellaris			*	C
Saxifraga gageana W.W. Sm.				F
Saxifraga georgei Anth.				R
Saxifraga glabricaulis H. Sm.				F
Saxifraga granulifera H. Sm.				F
Saxifraga hemisphaerica				F
Saxifraga hispidula				F
Saxifraga hookeri Engl. & Irm.				R
Saxifraga inconspicua W. Sm.				R
Saxifraga jacquemontiana Decne				F
Saxifraga kinchingingae Engle.				R, EN
Saxifraga kingiana Engl. & Irm.				F
Saxifraga latiflora Hk.f. & T.				R
Saxifraga llonakhensis W.W. Sm.				ER, EN
Saxifraga lychintis Hk.f. &T.			*	C
Saxifraga microphylla Hk.f. & T.				F
Saxifraga montana H. Sm.				F
Saxifraga moorcroftiana			*	F
Saxifraga mucronulata				F
Saxifraga nigroglandulifera Balak.		Synb S. nutans		R
Saxifraga pallida				C

Saxifraga parnassifolia				F
Saxifraga perpusilla Hk.f.& T.				F
Saxifraga pilifera				R
Saxifraga pluviarum W.W. Sm.				F
Saxifraga pseudopallida				F
Saxifraga pulvinaria				F
Saxifraga punctulata Engler				F
Saxifraga saginoides			*	F
Saxifraga sikkimensis				F, EN
Saxifraga sphaeradena H. Sm.				F
Saxifraga stella-aurea Hk.f. & T.				R
Saxifraga subsessiliflora Engl. & Irm.				F
Saxifraga subspathulata				F
Saxifraga tentaculata Fisch.				F
Saxifraga umbellulata				F
Saxifraga viscidula Hk.f. &T.				F
Parnassiaceae				
Parnassia chinensis				F
Parnassia nubicola		Medicinal	*	C
Parnassia pusilla Arnott.			*	F
Parnassia tenella				F
Parnassia wightiana Wt & Arn.				F
Grossulariaceae				
Ribes acuminatum G. Don		Wild Edible Fruit	*	F
Ribes alpestre Decne		Syn R. grossularia	*	F
Ribes glaciale		Wild Edible Fruit	*	C
Ribes laciniatum Hk.f. &T.				F
Ribes luridum Hk.f. & T.				F
Ribes orientale		Wild Edible Fruit		R
Crassulaceae				
Cotyledon ewersii			*	F
Rhodiola atsaensis (Frod.) Ohba	Chumighata			F
Rhodiola bupleuroides Wall ex Hk. f. & T.	Lekh budho-okhati		*	F
Rhodiola chrysanthemifolia		Syn *Sedum linearifolium Royle*		F
Rhodiola coccinea				R
Rhodiola crenulata (Hk.f.&T.) Ohba				F
Rhodiola fastigiata			*	F
Rhodiola himalense D. Don				F
Rhodiola hobsonii				R
Rhodiola humilis				F
Rhodiola sherriffii				F
Rhodiola smithii				F
Rhodiola stapfii				R
Rhodiola wallichiana (Hk.) Fu				F
Rhodioloa cretinii				F
Sedum gagei Hamet				R
Sedum oreades (Decne) Hamet			*	F
Sedum triactina Berger				F
Sedum trullipetalum Hk.f. & T.				F

Onagraceae			*	F
Circaea alpina				F
Epilobium alpinum L.				R
Epilobium latifolium	Chichu change			R
Epilobium origanifolium Lamk.			*	C
Epilobium reticulatum Cl.				F
Epilobium speciosum			*	F
Epilobium wallichianum	Harsa phool			
Apiaceae				
Angelica officinalis		Medicinal		F
Bupleurum 1	Chattu	Poisonous for yaks		F
Bupleurum 2				F
Bupleurum longicaule			*	C
Cortia hookeri Cl.			*	F
Heracleum 1	Ganer			F
Heracleum nubigenum Cl.			*	F
Heracleum sublineare Cl.				R
Pimpinella hookeri			*	F
Pituranthos acronemaefolia Cl.		Valuable forb		F
Pituranthos bella Cl.		Valuable forb		R
Pituranthos hookeri Cl.	Cheeru	Valuable forb		R
Pleurospermopsis sikkimensis	seto cheeru	Valuable forb		F, EN
Pleurospermu apiolens Cl	Rupouli shyamphool			F
Pleurospermum hookeri			*	F
Selenium tenuifolium	Cheeru	Medicinal	*	C
Selinium wallichii				F
Trachydium 1	Chang chang gı	Valuable forb	*	F
Trachydium dissectum Cl.	Tungu	Valuable forb		F
Trachydium hirsutum Cl.				F
Trachydium novum-jugum Cl.				R
Trachydium obtusiusculum Cl.				F
Vicatia cuneifolia			*	F
Araliaceae				
Panax pseudo-ginseng Wall.		Potential for future medicin	*	F
Aralia cissifolia 3500m				
Caprifoliaceae				
Lonicera acuminata Wall.			*	F
Lonicera angustifolia Wall.		Fuel wood	*	C
Lonicera decipiens Hk.f. &T.				F
Lonicera hispida Pall.			*	F
Lonicera litagensis Batal.				R
Lonicera myrtillus	Langba		*	C
Lonicera obovata			*	C
Lonicera rupicola Hk.f. &T.		Fuel wood	*	F
Lonicera spinosa Jacq.		Fuel wood		F
Lonicera tomentella Hk.f.& T.				F
Triosteum himalayanum		Endemic to Himalaya	*	R
Viburnum erubesces DC.			*	F
Viburnum nervosum	Langba	Fuel wood	*	F

Hydrangeaceae				
Hydrangea aspera				F
Rubiaceae				
Galium aparine L.			*	C
Galium exile Hk.f.			*	F
Galium acutum Edgew.			*	F
Valerianaceae				
Nardostachys grandiflora	Jatamanshi	Used in treating internal bo	*	R
Valeriana hardwickii			*	F
Valeriana wallichii		Incense; Medicinal	*	C
Dipsacaceae				
Dipsacus atratus Hk.f. & T.				F
Dipsacus inermis			*	C
Morina delavayi Franch.				F
M. polyphylla DC.				R
M. longifolia DC.				F
Morina nepalensis	Kanra jhaar		*	C
Scabiosa hookeri Cl.			*	F
Asteraceae				
Anaphalis cuneifolia (DC.) Hk			*	C
Anaphalis deserti Drumon				F
Anaphalis desertii Drumm				F
Anaphalis hookeri Cl.				F
Anaphalis margaritacea (L.) Benth.			*	F
Anaphalis nepalensis (Spreng.) Hand.-Mazz.			*	C
Anaphalis nubigena sensu Hk.f.				F
Anaphalis royleana DC. - **3 vars**			*	F
Anaphalis subumbellata Cl.				R
Anaphalis triplinervis	Ajambari		*	F
Anaphalis xylorhiza Sch.-Bip			*	C
Artemisia biennis Willd.				F
Artemisia campbellii Cl				R
Artemisia desertorum Spreng.			*	F
Artemisia minor Jacq.				F
Artemisia parviflora D.Don			*	F
Artemisia stricta Edgew. non Heyne ex DC.				F
Aster albescens (DC.) Hand.-Mazz.		Syn *Microglossa albescens*	*	F
Aster asteroides (DC.) O. Ktze. ssp. *asteroides*				R
Aster diplostephoides (DC.) Cl.			*	F
Aster flaccidus Bunge ssp. *flaccidus*		Syn A. tibeticus Hk. f. p.p	*	F
Aster heliopsis Griers.				R
Aster himalaicus Cl.				F
Aster polycepsis Chen.				F
Aster stracheyi Hk. f.	Tara phool		*	F
Aster tricephalus Cl.				F
Brachyaactis anomala (DC) Kitam.			*	F
Carpesium cernuum L.				F
Carpesium scapiforma Chen & Hu				F
Cavea tanguensis (Drumm) W.W. Sm.				R
Chrysanthemum atkinsonii Cl				R
Cicerbita lessertiana DC.			*	F

Cicerbita macrantha				F
Cirsium eriophoroides (Hk. F) Petak			*	F
Cirsium falconeri (Hk. f.) Petrak			*	F
Cirsium verutum (D.Don) Spreng.		Cnicus involucratus DC		F
Cremanthodium 1				F
Cremanthodium cremanthodioides	Teen Taare phool		*	F
Cremanthodium decaisnei Cl. - 2 vars.				F
Cremanthodium disoideum Maxim.				R
Cremanthodium ellisii (Hk.f) Kitam.			*	R
Cremanthodium oblongatum Cl.				F
Cremanthodium palmatum - 3 ssp.				R
Cremanthodium pinnatifidum Benth.		Senecio himalayensis		F
Cremanthodium reniforme			*	F
Cremanthodium thomsonii				R
Cremantodium retusum (DC) R. Good				R
Crepis tibetica Babc.				R
Doronicum roylei DC				F
Dubyaea hispida	Dudhe jhaar		*	C
Erigeron acer L. [E. alpinus L]			*	F
Erigeron alpinus var. *multicaulis* Hk. f.				F
Erigeron andryaloides (DC.) Cl.				F
Erigeron bellidioides Cl.				F
Erigeron ellisii Hk f.				R
Erigeron kumaonensis (Vierh.) Wendel				R
Erigeron monticolus DC.				R
Erigeron multiradiatus (DC.) Benth. & Hk.f.			*	F
Erigeron patentisquana Cl.ex. Jeff.		Syn E. alpinus var. patentisquama		R
Gerbera nivea (DC.) Sch.– Bip.			*	F
Heterpappus gouldii (Fisch) Griers.				R
Hypochoeris radiata L.				R
Inula macrosperma Hk.f.				R
Jurinea cooperi Anthony				R
Lactuca bracteata Hk.f. & T.				F
Lactuca cooperi Anth.				F
Leibnitzia nepalensis (Kuntze) Kitam.			*	F
Leibnitzia ruficoma (Franch) Kitam.				R
Leontopodium 1				F
Leontopodium 2	Ajambari			F
Leontopodium alpinum Cass.			*	F
Leontopodium haastioides Hand.-Mazz.				R
Leontopodium himalayanum DC			*	F
Leontopodium jacotianum P. Beauv.			*	F
Leontopodium monocephalum Edgew.			*	C
Leontopodium nanum (Hk. f & T.) Hand.-Mazz.				F
Ligularia 1	Jhumpa phool			F
Ligularia amplexicaulis DC. [Senecio amplexicaulis]				C
Ligularia hookeri		Syn *Doronicum hookeri*		F
Ligularia kingiana (WW Sm) R. Mathur				F
Ligularia mortoni	Barsey	Fodder for wild herbivores		C
Nannoglotis hookeri (Hk.f.) Kitam.				F
Prenanthus scandens Hk.f. & T.				F
Prenanthus sikkimensis Hk. f.				F, EN
Pseudognaphalium affine (D Don) Anders.				F
Saussuera cf. sericea Chen & Liang				F
Saussuera donkiah Sprig				R
Saussurea andersonii Cl.				R

Saussurea auriculata Sch - Bip.		Syn *S. hypoleuca* Spreng		C
Saussurea caespitosa var. depressa				R
Saussurea candolleana Cl.				R
Saussurea gossypiphora D. Don - 3 Vars.	Mykopila	Wool used as cotton substitute		F
Saussurea graminifolia Wall. ex. Hk. f.				R
Saussurea hookeri Cl.				R
Saussurea katochaete Maxim				R
Saussurea laneana WW Sm				R
Saussurea leontodontoides	Kanre lahara		*	F
Saussurea nepalensis Spreng				F
Saussurea nishiokae Kitam				R
Saussurea obscura Lipsc.				R
Saussurea obvallata (DC.) Sch.-Bip.			*	R
Saussurea pachyneura Franch.				R
Saussurea pantlingiana WW Sm				R
Saussurea piptatera Edgew.			*	F
Saussurea polystechoides Hk f.				F
Saussurea simpsoniana Lipsch.				R
Saussurea spicata Kitam.				R
Saussurea stella Maxim				R
Saussurea sughoo Cl.				R
Saussurea taraxacifolia Wall. ex DC.			*	F
Saussurea tridactyla	Mykopila		*	F
Saussurea uniflora (DC.) Wall	Thulo dudhe jhaar			R
Saussurea wernerioides Sch.- Bip. ex Hk. f				F
Saussurea yakla Cl.				R
Senecio acuminatus Wall. Ex DC.				F
Senecio alatus DC.			*	F
Senecio albopurpureus Kitam.				R
Senecio bilugulatus WW Sm				R
Senecio candolleanus Wall. ex DC.				F
Senecio chenopodifolius DC.				F
Senecio chola WWSm				R
Senecio graciliflorus DC.			*	F
Senecio kumaonensis Duthie ex Jef.				R
Senecio laetus Edgew.				F
Senecio raphanifolius Wall ex DC.				R
Senecio royleanus DC				F
Senecio tetrantha DC.				F
Solidago virga-aurea L.				F
Soroseris glomerata			*	F
Soroseris hookeriana (Cl.) Stebb.				F
Soroseris pumila				F
Tanacetum dolichophyllum (Kitam) Kitam			*	F
Tanacetum gossypinum Hk.f. & T.				R
Tanacetum nubigenum Wall.				F
Tanacetum tibeticum Hk. f. & T. ex Cl.				R
Taraxacum officinale Weber				F
Taraxacum sikkimense				F
Waldhemia glabra (Decne.) Regel			*	F
Youngia depressa (Hk.f.&T.) Babc.				F
Youngia gracilipes (Hk. f.) Babc. & Steb			*	F
Youngia racemifera (Hk.f.) Babc.				F
Youngia simulatrix Babc.				R
Youngia stebbiana		Y. gracilis		F

Campanulaceae				
Campanula aristata Wall.				F
Campanula modesta				F
Cdonopsis benthami				F
Codonopsis 1				F
Codonopsis affinis			*	R
Codonopsis foetans				F
Codonopsis subsimplex				R
Codonopsis thalictrifolia	Paduwa jhaar		*	R
Cyananthus incanus			*	F
Cyananthus inflatus				F
Cyananthus microphyllus	Ghanti phool			F
Cyananthus pedunculosus	Ghanti phool			F
Cyannanthus lobatus				C
Lobelia erecta Hk.f. & T				R
Pyrolaceae				
Pyrola sikkimensis Krisa.			*	F, EN
Ericaceae				
Cassiope fastigiata D. Don			*	C
Cassiope selaginoides Hk.f. &T.			*	R
Gaultheria pyroloides Miq.		Syn *G. pyrolifolia Cl*	*	F
Gaultheria trichophylla Royle			*	C
Pieris formosa (Wall.) D.Don		Fuel wood	*	F
Rhododendron aeruginosum Hk.f.				R
Rhododendron anthopogon D. Don	Sunpate	Incense	*	C
Rhododendron argipeplum Balf.				R
Rhododendron baileyi Balf.				R
Rhododendron barbatum G. Don		Fuel wood		F
Rhododendron campanulatum	Chimal		*	C
Rhododendron campylocarpum	Seto chimal		*	F
Rhododendron ciliatum	Junge chimal		*	F
Rhododendron cinnabarinum			*	C
Rhododendron fulgens	Rato chimal		*	C
Rhododendron glaucophyllum Rehder		Syn *R. glaucum* Hk.f.		F
Rhododendron hodgsonii	Kurlingo		*	C
Rhododendron keysii Nutt.				F
Rhododendron lanatum	Chimal			C
Rhododendron lepidotum			*	C
Rhododendron nivale Hk.f.				F
Rhododendron pendulum Hk.f.				R
Rhododendron pumilum Hk.f.				F
Rhododendron setosum	Bhale sunpate		*	F
Rhododendron thomsonii			*	F
Rhododendron triflorum Hk.f.			*	F
Rhododendron wallichii Hk.f.				R
Rhododendron wightii	Sunpate		*	F
Vaccinium sikkimense	Chyasi		*	R, EN
Diapensiaceae				
Diapensia himalaica Hk.f. & T.			*	F
Primulaceae				
Androsace grandifolia				F
Androsace hookeriana Klatt			*	F

Androsace lehmanni Wall.				F
Androsace selago Hk.f. & T				F
Androsace tapete			*	C
Primula bellidifolia King				F
Primula capitata			*	F
Primula caveana			*	F
Primula concinna Watt.				F
Primula denticulata Sm.			*	C
Primula dickieana Watt.				F
Primula elongata Wall.				F
Primula elwesiana King				R
Primula gambeliana Watt				R
Primula glabra Klatt.				F
Primula glomerata				F
Primula hookeri Watt.				F
Primula involucrata Wall.			*	C
Primula kingii Watt.				F
Primula macrophylla				F
Primula muscoides Hk.f.				F
Primula obtusifolia Royle - 2 vars.				F
Primula petiolaris			*	F
Primula primulina				F
Primula pulchra Watt				F
Primula pusilla Wall.				C
Primula reticulata Watt				F
Primula sapphirina Hk.f. & T				F
Primula sikkimensis			*	C
Primula soldanelloides				F
Primula stirtoniana Watt.				F
Primula stuwartii Wall.				F
Primula tenella King				F
Primula tibetica Watt.				R
Primula uniflora Klatt.				F
Primula vaginata Watt.				F
Gentianaceae				
Crawfurdia puberula				F
Crawfurdia speciosa Wall.			*	F
Gentiana amoena Cl.				F
Gentiana elwisii Cl. = L L L C tianschanica)				F — YA
Gentiana infelix Cl.				F
Gentiana micans Cl.				R
Gentiana nubigena Edge.		Medicinal		F
Gentiana ornata Wall.		Medicinal		F
Gentiana phyllocalyx Cl.			*	F
Gentiana recurvata Cl.				F
Gentiana sikkimensis Cl.				R
Gentiana tubiflora Wall.			*	F
Gentiana venusta			*	F
Helinia elliptica D. Don				C
Jaeschkea microsperma Clk.				F
Megacodon stylophorus	Ghanti phool			F
Swertia ciliata Cl.		Medicinal	*	F
Swertia cuneata Wall.			*	F
Swertia hookeri	Lekh chirayto		*	F
Swertia multicaulis Don				F

Swertia rex Cl.				R
Boraginaceae				
Anchusa sikkimensis Cl.				R
Eritrichum munroi Cl.			*	F
Eritrichum pustulatum Cl.			*	R
Eritrichum pygmaeum Cl.				R
Myosotis hookeri Cl.				F
Onosma bicolor Wall.				R
Onosma emodi Wall.		Medicinal		R
Paracaryum glochidiatum			*	F
Trigonotis multicaulis Benth				F
Trigonotis rotundifolius				F
Solanaceae				
Mandragora caulescens Cl. ssp. caulescens				F
Anisodus luridus spreng				R
Scrophulariaceae				
Euphrasia chumbica RR mill				R
Euphrasia melanosticta R.R.mill			*	F
Hemiphragma heterophyllum	Lekh nagbeli			F
Lancea tibetica			*	C
Oreosolen williamsii				F
Pedicularis albiflora (Hk.f.) Prain	Kankola			F
Pedicularis bella Hks				F
Pedicularis bicomuta	Sheto kesari		*	C
Pedicularis chumbica Prain				F
Pedicularis clarkei Hk.f.				F
Pedicularis collata Prain				F
Pedicularis confertiflora Prain				F
Pedicularis cooperi Tsoong			*	F
Pedicularis daltonni PrainYakLa; Chhola:				F
Pedicularis denudata Hk.f.				F
Pedicularis diffusa Prain				F
Pedicularis elwesii Hk.f.			*	F
Pedicularis excelsa Hk.f.				R
Pedicularis flexuosa Hk. f.				F
Pedicularis furfuracea Wall. ex Benth				F
Pedicularis garckeana Maxim,Dzongri				F
Pedicularis gibbera Prain			*	F
Pedicularis globifera Hk.f.				F
Pedicularis gracilis Benth. Lachung			*	R
Pedicularis heydei Prain			*	F
Pedicularis instar Prain & Maixm	Onglakhang			F
Pedicularis integrifolia Hk.f.				F
Pedicularis lachnoglossa Hk.f.			*	R
Pedicularis longiflora ssp tubiformis				F
Pedicularis lyratamaxim				F
Pedicularis megalentha D. Don			*	F
Pedicularis microcalyx Hk.f.			*	F
Pedicularis molllis Benth				R
Pedicularis nana Fischer				F
Pedicularis nepalensis Prain				R
Pedicularis odonophora Prain- Na Tong;				F
Pedicularis oederi Vahl. Ssp branchiophylla			*	F

Pedicularis pantlngii Prain Li				F
Pedicularis paradoxa (Prain) Yamaz			*	F
Pedicularis pauciflora (Prain) Pennell				F
Pedicularis pennelliana Tsoong			*	R
Pedicularis polygaloides Hk.f.-				R
Pedicularis purpurea	Kesari			F
Pedicularis pyramidata	Kesari		*	F
Pedicularis regeliana Prain				F
Pedicularis rhinanthoides Schrenk 2ssp labellata			*	F
Pedicularis robusta Hk.f. Lachung				F
Pedicularis roylei Maxim				R
Pedicularis schizorrhyncha Prain				F
Pedicularis scullyana Prain ex Maxim			*	F
Pedicularis sikkimensis Bonati ex WW Sm				R
Pedicularis siphonantha D. Don			*	F
Pedicularis tantalorhyncha Bonati-Pr				F
Pedicularis tenuicaulis Prain				F
Pedicularis trichoglossa Hk.f.			*	F
Picrorhiza kurrooa	Kurki	Medicinal	*	F
Picrorhiza scrophulariaefolia		Medicinal		R
Scrophularia pauciflora Benth.				F
Veronica caria Benth.				F
Veronica cephaloides			*	F
Veronica deltigera Benth. V. capitat var capitat				F
Veronica himalensis D.Don				F
Veronica lanuginosa				F
Veronica persica poir.				F
Veronica umbelliformis Pennell				R
Acanthaceae				
Strobilanthus lachenensis			*	F
Selaginaceae				
Lagotis cashmeriana	Gidha pankhi			R
Lagotis clarkei Hk.f.				R
Lagotis crasifolia Prain				R
Lagotis kunawarensis			*	F
Lagotis spectabilis Kurz.				R
Orobanchaceae				
Boschniakia himalaica			*	F
Lentibulariaceae				
Utricularia brachiata			*	R
Prezwalskia subbarai (CEC Fischer) Grubov.		Syn. *P. tangutica* sensu Sanjappa		R
Pinguicula alpina L.		Insectivorous; Botanical Interest		R
Lamiaceae				
Dracocephalum hookeri Cl.				R
Dracocephalum speciosum				F
Elsholtzia eristachya Benth.			*	F
Elsholtzia strobilifera Benth.				F
Eriophyton wallichii	Buke phool			R
Galeopsis tetrahit L.				F
Nepeta lamiopsis Benth				F
Nepeta thomsonii Benth				F

Phlomis breviflora				F
Phlomis rotata Benth.			*	C
Phlomis tibetica	Kuro			F
Salvia campanulata Wall.			*	F
Plantaginaceae				
Plantago depressa Willd = p. libetica				F
Chenopodiaceae				
Axyris prostrata L.				F
Microgynoecium tibeticum Hk.f.				F
Polygonaceae				
Aconogonon campanulatum (Hk.f.) Hara				F
Aconogonon molle			*	F
Aconogonon tortuosum		Medicinal	*	C
Aconogonum polystachyum	Phusre thotney		*	C
Bistorta affinis			*	F
Bistorta amplexicaulis			*	C
Bistorta emodi			*	F
Bistorta griffithii				F
Bistorta macrophylla				C
Bistorta milleti Leveille			*	C
Bistorta perpusilla				F
Bistorta vaccinifolia	Brush jhaar		*	C
Bistorta vivipera	Rambu	Medicinal	*	C
Koenigia delicatula			*	F
Koenigia forrestii				F
Koenigia islandica				F
Koenigia nepalensis		Syn P. filicaule		F
Koenigia nummularifolia				C
Oxyria digyna	Mirmire phool		*	C
Persicaria glacialis				F
Persicaria runcinata				F
Persicaria sibirica				F
Rheum acuminatum	Khokim		*	F
Rheum australe		Rare; Medicinal		R
Rheum globulosum Gage				R
Rheum nobile	Kenjo	Eaten as pickle	*	F
Rheum spiciforme Royle				R
Bignoniaceae				
Incarvillea himalayensis Juss.				R
Santalaceae				
Thesium pachyrhizum A. DC.		Botanical Interest	*	F
Euphorbiaceae				
Euphorbia luteo-viridis	Gnatong			F
Euphorbia stracheyi Boiss.			*	F
Urticaceae				
Parietaria micrantha Ledeb.				F
Pilea racemosa			*	F
Urtica hyperborea				F

Betulaceae				
Betula utilis	Bhojpatra	Religious	*	F
Salicaceae				
Salix calyculata Anders.			*	C
Salix daltoniana Anders				F
Salix lindleyana. var. microphylla				R
Salix lindleyana	Langba		*	F
Salix myrtillacea Anders.		Fuel wood		F
Salix oreophila Andrs.				R
Salix pseudocalyculata Kiura				F
Salix serpyllum Anders.				R
Salix sikkimensis	Langba	Fuel wood	*	C
Orchidaceae				
Aphyllorchis parviflora				R
C. himalaicum				R
C. tricarinata				F
Calanthe alpina				F
Cypripedium elegans				R

Epipogium aphyllum				R
Gymnadenia orchidis	Panch Amle	Medicinal	*	F
Habenaria arietina				F
Habenaria clavigera				F
Habenaria ensifolia				F
Habenaria latilabris				F
Herminium josephii			*	R
Herminium laceum			*	F
Herminium monorchis			*	F
Herminium pugioniforme				F
Listera longicaulis				R
Listera pinctorum				F
Listera teunis				F
Neottia listeroides				F
Neottianthae secundiflora				F
Peristylus fallax				F
Platanthera stenantha				R
Poneorchis chusua			*	R
Ponerorchis nana			*	F
Ponerorchis spathulata				F
S. nepalense			*	F
Satyrium ciliatum				F
Zingiberaceae				
Roscoea alpina			*	F
Roscoea auriculata				F
Iridaceae				
Iris goniocarpa Baker				F
Iris kemaonensis D. Don				F
Iris clarkei Hk.f.				R
Smilacaceae				
Smilax rigida		Syn S. myrtillus var. rigida		F
Convallariaceae				
Maianthemum fuscum		Syn. *Smilacina fusca*		F
Maianthemum oleraceum		Syn *Smilacina oleracea*	*	C
Maianthemum purpureum		Syn. *Smilacina purpurea*	*	C
Ophiopogon wallichianus		Syn *O. intermedius var. parviflorus*		F
Paris polyphylla				F
Polygonatum cathcartii	Lekh ghinaula			F
Polygonatum cirrifolium		Medicinal		F
Polygonatum hookeri			*	F
Polygonatum kansuense				F
Polygonatum leptophyllum				F
Polygonatum sibiricum				R
Polygonatum singalilense Hare		Endemic		R, EN
Polygonatum verticillatum				F
Theropogon pallidus				F
Trillidium govanianum			*	F

Liliaceae				
Alertis pauciflora				
Aletris glabra Bureau & Frach.			*	F
Aletris gracilis Rendle			*	C
Allium fasciculatum Rendle				F
Allium macranthum Baker				R
Allium prattii CH Wright				R
Allium sikkimense Baker			*	F
Allium wallichii Kunth				R
Clintonia udensis			*	F
Fritillaria cirrhosa D. Don				F
Gagea lutea (L.) Ker Gaw.		Medicinal	*	F
Lilium nanum Klotz			*	F
Lloydia delicatula				R
Lloydia flavonutans Hara				F
Lloydia longiscapa				F
Lloydia serotina				F
Lloydia yunnanensis				F
Notholirion macrophyllum (D. Don) Boiss.				R
Streptopus simplex				F
Tofieldia himalaica Baker			*	F
				R
Juncaceae				
Juncus allioides Franch.	Suire		*	F
Juncus amplifolius A. Camus				F
Juncus benghalensis Kunth.				F
Juncus brachystigma Samuel.				F
Juncus bryophilus Noltie				R
Juncus bufonius L.			*	F
Juncus cephalostigma Samue.			*	F
Juncus chrysocarpus Buchen.				F
Juncus clarkei Buchen	Sheto suire			F
Juncus concinnus D. Don			*	F
Juncus duthiei (Cl.) Noltiie				F
Juncus glaucoturgidus Noltie	Samiti			F
Juncus gracilicaulis A. Camus				F
Juncus grisepachii Buchen.				F
Juncus himalensis Klotz.			*	F
Juncus kingii Rendle				F
Juncus leucanthus Royle ex D.Don	Sano suire		*	F
Juncus leucomelas Royle ex D. Don			*	F
Juncus minimus Buchen.				F
Juncus nepalicus Miyamoto & Hara				F
Juncus ochraceus Buchen.				F
Juncus perpusillus Samuels	Chaunrikiang			R
Juncus sikkimensis				F, EN
Juncus sphacelatus Decne	Thulo suire			F
Juncus thomsonii Buchen.				F
Juncus trichophyllus WW Sm				F
Juncus triglumis L.			&	F
Juncus uniflorus WW Sm				F
Luzula multiflora			*	F
Araceae				
Arisaema jaquemontii Bl.		Subsidiary food	*	F

Arisaema nepenthoides (Wall.) Marit. & Schott.			*	C
Arisaema propinquum Schott				F
Arisaema utile Hk.f.				F
Juncaginaceae				
Triglochin maritima L.			*	F
Triglochin palustris L.			*	F
Potamogetonaceae				
Potamogeton filiformis Pers.				F
Eriocaulaceae				
Eriocaulon alpestre Hk.f. & T.				F
Cyperaceae				
Blysmus compressus			*	C
Bulbostylis densa (Wall.) Hand.-Mazz.				F
Carex duthiei Cl. (Carex duthiei)		Syn *Carex atrata* L. subsp	*	F
C. fucata Boott ex Cl.				F
C. haematostoma Nees			*	F
C. inanis Kunth			*	F
C. infuscata Nees			*	F
C. lehmannii Drejer				F
C. microglochin Wahlenb.				F
C. moorcroftii Falc. ex Boott.		Syn *C. melanantha* ssp. M	*	F
C. munda Boott				F
C. nigerrima Nelmes		Syn *C. atrata*		F
C. notha Kunth.				F
C. nubigena D. Don				C
C. obscura Nees			*	F
C. orbicularis Boott				F
C. parva Nees				F
C. praeclara Nelmes				F
C. pseudofoetida Kukenth.				F
C. psychrophylla Nees				F
C. setosa Boott	Harkat			F
C. stenophylla Wahlb.	Harkat		*	F
C. stracheyi Boott ex Cl.	Dharkhare			F
C. supina Willd. ex Wahlb.				R
C. teres Boott				R
C. tristis M. Bieb.				F
C. vulpinaris Nees	Ghoda buki			F
Carex atrofusca Schkuhr.				F
Kobresia capillifolia	Sano sunbuki / Gundruke buki		*	C
Kobresia clarkeana Kukenth.			*	F
Kobresia curticeps (Cl.) Kukenth.			*	F
Kobresia duthiei	Bhalu buki	Important winter fodder		F
Kobresia esenbeckii (Kunth) Noltie				F
Kobresia fragilis Cl.				F
Kobresia gammiei Cl.	Buki			F
Kobresia humilis (Mey) Serg.			*	F
Kobresia laxa Nees			*	C
Kobresia nepalensis	Kesari buki		*	C
Kobresia prainii Kukenth.				F
Kobresia pygmaea Cl				C
Kobresia schoenoides (Mey) Steud.				C

Kobresia sikkimensis Kukenth.			*	F
Kobresia sp.			*	F
Kobresia stiebriztiana Hand.-Mazz.				R
Kobresia unicoides (Boott) Cl.				F
Kobresia vaginosa Cl.				F
Kobresia vidua (Boott ex Cl.) Kukenth.				F
Poaceae				
Agrostis hookeriana				F
Agrostis inaqueglumis				F
Agrostis nervosa			*	F
Agrostis pilosula				F
Agrostis triaristata				R
Agrostis ushae Noltie				R
Anthoxanthum flexuosum				R
Anthoxanthum hookeri				F
Briza media				R
Bromus himalaicus				F
Bromus staintonii				F
Bromus sylvaticus				F
Calamogrostis emodensis			*	C
Calamogrostis filiformis	Jau jhar		*	F
Calamogrostis nivicola				F
Calamogrostis scabrescens				F
Calamogrostis tibetica				R
Catabrosa sikkimensis Stapf				R, EN
Colpodium wallichii				F
Danthionia cachemyriana				F
Danthionia cumminsii			*	R
Deschampsia c. ssp. sikkimensis			*	F, EN
Deschampsia caespitosa			*	C
Elumus schrenkianus				F
Elymus himalayanus			*	F
Elymus nutans			*	F
Elymus thoroldianus				F
Festuca bhutanica				R
Festuca boriana				F
Festuca cumminsii				F
Festuca leptopogon				F
Festuca polycolea				F
Festuca stapfii			*	F
Festuca tibetica				R
Festuca undulata Stapf				F
Festuca valesiaca	Rani buki		*	C
Festuca wallichiana				F
Glyceria tonglensis Cl				R
Helictotrichon parviflorum				F
Helictotrichon virescens			*	F
Himalayacalamus falconeri			*	C
Himalayacalamus hookerianus			*	C
Oryzopsis munroii				F
Phleum alpinum			*	C
Poa annua L.			*	C
Poa cf attenuata			*	F
Poa dzongicola Noltie				F
Poa eleanorae Bor				F

				F
Poa gammieana			*	F
Poa hirtiglumis Stapf.				R
Poa lachenensis Noltie				R
Poa longii Noltie				F
Poa ludens				R
Poa mustangensis Rajbh				F
Poa nepalensis				R
Poa nitide-spiculata				F
Poa pagophila				F
Poa polyneuron				F
Poa poophagorum Bor				F
Poa pratensis L				F
Poa pseudotibetica Noltie				R
Poa rahmooniana Noltie				R
Poa rajbhandarii Noltie				R, EN
Poa sikkimensis				?
Poa sp.1	Dubo			F
Poa stapfiana				F
Stipa duthiei Hk.f.				F
Stipa koelzii R.R. Stew.				R
Stipa milleri Noltic				R
Stipa mongholica			*	F
Stipa purpurca Griseb				R
Stipa rahmooiana Noltie				F
Stipa roborowskyi Rosh.				R
Stipa roylei				R
Trikeraia oreophila				F
Trisetum scitulum Bor			*	C
Trisetum spicatum				