(2018) 08 UK CK 0098

In the Uttarakhand High Court

Case No : Writ Petition (PIL) No.123 of 2014

Aali-Bedini-Bagzi Bugyal Sanrakshan Samiti — APPELLANT

Vs

State of Uttarakhand & others — RESPONDENT

Date of Decision : 21-08-2018

Acts Referred:
Forest (Conservation) Act, 1980 — Section 2, 2(i), 3
Wildlife (Protection) Act, 1972 — Section 2(27)

Citation : (2018) 08 UK CK 0098

Hon'ble Judges : Rajiv Sharma, ACJ;Lok Pal Singh, J

Bench : Division Bench

Advocate : J.S. Bisht, Pradeep Joshi

Final Decision : Disposed Of

Judgement

Per: Rajiv Sharma, A.C.J.

Lok Pal Singh, J.

1) This petition, in the nature of public interest litigation, has been instituted on behalf of the petitioner-society which was registered on 6.10.2006 under

the provisions of the Societies Registration Act, 1860. The registered office of the Society is at Lohajung, Post Mundoli, Tehsil Tharali, District

Chamoli. The petition has been filed to conserve and preserve Bugyal (Alpine meadows) situated below the area of Roopkund in District Chamoli.

Petitioner has also sought a direction to the Forest Department to remove the permanent structure/construction of fibre huts constructed in

Bugyalsâ?? area and also to stop the commercial grazing in the area of Bugyals. The population of 60,000/- comes under the Blocks, namely, Tharali,

Dewal and Ghat. The area of Bugyal in these three Blocks covers approximately 4,000 square hectares in the forest area of Badrinath Forest Range.

Petitioner has also placed on record the copy of the objects of the Society.

2) The Bugyals/ meadows are also considered as high-altitude grasslands or meadows situated in the hills, particularly in Garhwal region of District

Chamoli below the peak of â??Jyouragaliâ??. The word â??Bugyalâ?? in Garhwali basically means meadow and pasture land which exists above a

certain altitude in the mountains also known as â??Alpine Meadowsâ??. The Bugyal area is primarily meant for grazing the sheep and goats.

Roopkund is also situate in this area. Bugyal are also known as â??Natureâ??s own gardensâ??. These Bugyals can be flat or sloped and are

carpeted with green grass, various types of seasonal flowers and life saving medicinal plants. The conservation of these Bugyals is of utmost

importance. Petitioner has sought a direction to the Forest Department to take steps and to make a Policy for the protection of Bugyals situate below

the peak of Roopkund Lake particularly known as Aali-Bedini-Bagzi Bugyals. Petitioner has also prayed that the grazing of sheep and goats be

restricted to local shepherds and the commercial grazing should be banned.

3) The Forest Department has constructed fibre huts on these Bugyals. Petitioner has also sought a direction to the respondents to stop the overnight

stay of the tourists in the local surroundings of Himalyan Bugyals and also for stopping the gathering of â??Keera Jariâ?? (Yarsagambu, a medicinal

plant). Lohajung is the base camp of the well-acclaimed trekking for Roopkund. The original track starts from Lohajung and passes through the

Village Didna. There is a small village called â??Kulling. From â??Kullingâ??, steep ascent leads to Raun Bagad. It is densely covered by

Rhododendron, Oak and Pine Forest. The commercial activity in these Bugyals has led to soil erosion and pollution including poaching of animals.

4) The Meeting was convened under the Chairmanship of District Magistrate, Chamoli on 17.3.2008. Various decisions were taken to protect Aali-

Bedini-Gagzi Bugyals. It was also decided to restrict the number of tourists visiting these Bugyals. The District Magistrate, Chamoli sent a

communication to the Principal Secretary, Forest & Village Development Department of Uttarakhand on 28.5.2008 for the protection of Bugyals on

the basis of the project submitted by the petitioner-society. A letter was written by the office of Additional Chief Conservator of Forest (Wildlife),

Uttarakhand to the Principal Secretary, Forest & Village Department regarding

the protection of Bugyals and medicinal herbs. It was admitted by the

Forest Department (Wildlife) that the area of Aali-Bedini-Gagzi Bugyal is spread up to 3000-4000 hectares. The communication was sent by the

Additional Secretary to the Principal Chief Conservator of Forest on 2.2.2012 seeking a report regarding the steps taken pursuant to the directions

given in the meeting held on 15.12.2011. The reminders were also sent. The fibre huts have been constructed with concrete base. The construction of

these permanent fibres construction is adversely affecting the environment and ecology of the area. The Bugyals are maintaining the eco-system. The

damage caused to the eco-system i.e. Bugyals is considered to be the key to global warming and melting of glaciers.

5) The alpine zone in the Himalayas is separated by a distinct tree line (in the western and eastern Himalayas). This is the zone of tree-less vegetation

with highly specialized growth forms. The major vegetation in the alpine zone includes alpine scrub, alpine herbaceous formations locally known as

â??Bugyalsâ?? in Uttarakhand. The tree-line is usually rich of Rhododendron Oak, Fern or brown Oak forests. There is a reference to the Draft

World Charter for Nature (1982), Earth Summit (1992) and National Forest Policy (1988). No Eco-Development Committee has been constituted, as

directed by the State Government. Petitioner has sent various representations mentioned in paragraph no.36 of the petition but the remedial steps have

not been taken.

6) Counter affidavit has been filed by respondent nos.3, 4, 6 and 8 jointly and by respondent nos.5 and 7 separately.

7) The stand of the State Government in the affidavit filed on behalf of respondent nos.3,4,6 and 8 is that the Bugyals named by the petitioner i.e. Aali-

Bedini-Bagzi Bugyals fall under the Badrinath Forest Division, Pinder Part-(iv) and Navaali(i) Blocks, having a total area of 2583.9 hectares, 512.5

hectares and 1407.2 hectares respectively, total area is 4503.6 hectares. These areas are situate at the height of 3,000 meters to 6,000 meters above

sea level. The world-famous Roopkund is situate at a distance of about 15 kilometres towards Nandadevi Peak from Bedini Bugyal and â??Sri Nanda

Devi Raj-Jaat Yatraâ?? is also held here. The Yatra is held after every 12 years. During â??Sri Nanda Devi Raj-Jaat Yatraâ??, 50-100

officers/employees of the Department are deputed. The Department has

constructed several snow huts, fibre huts, rain shelters, potable water

arrangements and pedestrian and bridle paths. The tourist season for Roop-Kund trek is between May and October during which many tourists visit

the area, though, during rainy season (15th June to 15th September), the number of tourists decreases. The State Government vide G.O. dated

2.2.2012 had limited the number of horses/mules in Bugyals and as per the directions of the Central Government, the formation of Eco-Development

Committees is under progress. The fibre huts have been constructed for the convenience of the tourists visiting Roopkund and other higher Himalayan

regions. Fibre huts are constructed in Gairoli Patal, Bedini, Patar Nachaunia, Bagowabasa and Aaul. The permit fee for each horse/mule has been

fixed at Rs.1,000/- (Rs.500/-for the owner and Rs.500/- for the maintenance of pathways). The rates for porters are Rs.25/- per day.

8) Petitioner has filed its rejoinder affidavit to the counter affidavit filed by the respondents. Petitioner has reiterated that the Forest Department has

failed to protect and preserve the Bugyals. There is also encroachment on these Bugyals. The Uttarakhand Government has fixed Rs.1,000/- per

hut/per night for Ranak Dharr, Rs.1,500/- per hut/per night for Gairoli Patal, Rs.2,000/- per hut/per night for Bedeni/Aali Bugyal, Rs.2,500/- per hut/per

night for Paatar Nachaniyal and Rs.3,000/- per hut/per night for Bakhuva Basa. The Government has also fixed the rates for Camping Site Fee which

is Rs.1,000/- per night for more than six nights for small tents, Rs.300/- per night

for 4-6 nights and Rs.200/- per night for 1-3 nights. According to the rejoinder affidavit, the details of the fibre huts constructed in the area are not

correct. According to the petitioner, 02 huts/rain shelters have been constructed in Gairoli Patal, 6 in Bedini, 10 in Paatar Nachaniya, 18 in

Bakhuwabasa and 07 huts have been constructed in Aali Bugyal.

9) Learned Author Mr. Pranay Lal, in his book â??Indica: A Deep Natural History of the Indian Subcontinentâ?, has discussed the making of

Himalaya as under:-

â??Over the past 50 million years, the continuous mountain-building process has made the Himalaya a place of superlatives. Himalayan ranges are

endowed with fourteen of the worldâ??s tallest mountains, and Everest (or Chomolangma as the Tibetans call it) rises above all of them at 8848

metres. The Himalaya is the youngest and fastest-growing mountain range in the

world- rising nearly 10 millimetres a year at Nanga Parbat. It is

estimated that many of its peak will continue to grow for another 10 million years and add 300 metres more to their height despite having the highest

rate of erosion (up to 12 millimetres per year). The slopes of these peaks harbour the largest concentration of glaciers outside of the poles- one reason

why they are called â??Himalayaâ?? (Sanskrit for the â??abode of snowâ??). The Himalaya makes for the biggest climatic barrier and one of the

most influential geographic structures to shape the worldâ??s climate. For its profound influence and role in regulating the regionâ??s water cycle,

scientists have designated the Tibetan plateau and the Himalaya the â??Third Poleâ??.

The Himalaya, Tibet and their rivers have influenced all modern life and the evolution of all modern families of flowering plants and mammals took

place along the Tethys. There is another crucial way in which the Tethys had an important impact although this one is from a more narrow human

angle. While the supercontinents of Pangaes and Gondwana endowed us with the bounty of coal, it was the Tethys that gave us much of the

worldâ??s petroleum reserves. Apart from that, along the shallows of the seas (in Kutch, for example) the Tethys created large, flat salt pans

containing a variety of salts, like saltpetre, which during medieval times was used to make gunpowder and spurred an interest in chemistry.

The modern geological era of India began with Greater India docking with Eurasia and the subsequent rise of the Himalaya. This affected global

climate and transformed the landscape across South East Asia- a change that favoured mammals arrived from Eurasia into India, and India became a

highway for some and a heaver for many. Diminutive mammals gradually became bigger and bolder, and the land once again trembled beneath

massive grass-eaters that evolved along with vicious carnivores. The golden age of mammals had arrived and unlike their predecessors, the dinosaurs,

their ability to adapt and survive ensured that they dominated almost every niche in nature.â??

10) Since we are dealing with meadows in District Chamoli, it would be pertinent to take into consideration the origin of name of district, location,

boundaries, area, as per the details given in the Gazetteer of India, U.P., District Chamoli, published in 1979.

Origin of Name of District

The district of Chamoli, which was formed in 1960, consists of and takes its name from the tahsil and subdivision of Chamoli which, prior to 1960, was

a part of the district of Garhwal and occupied the central part of the Uttarakhand Division till December 20, 1968, when that Division was abolished,

and the district was included in the newly formed Garhwal Division.

Location, Boundaries, Area and Population

Location and Boundaries- Situated in the Himalayas, the district which is nearly half the size of its parent district, Garhwal, is broad in the north and

narrows towards the south and is somewhat cup-shaped, its length from north to south being about 129 km. and its breadth from west to east about

117 km. To its north lies Tibet and to the north from west the district of Uttarkashi. On the east it is bounded by the Pithoragarh, on the south and

south-east by the Almora, on the south-west by the Garhwal and on the west by the Tehri Garhwal districts.

Area- The census records of 1961 give the area of the district as 9,130 sq. km., it being third in area among the districts of the State. According to the

Central Statistical Organisation, however, the area is 9,128 sq. km.

Alpine Pastures- Between the heights of 2,050 m. and 2,975 m. the northern aspect of the hills and between the altitudes of 2,500 m. and 4,425 m. on

the southern aspect of the hills the land is covered with shortgrasses and herbs, which are used as pasture where professional glaziers bring their

cattle.

11) Learned Author Mr. Peter Wohlleben, in his book â??The Hidden Life of Treesâ?, has discussed various aspects of the hidden life of trees as

under:

The Language of Trees

According to the dictionary definition, language is what people use when we talk to each other. Looked at this way, we are the only beings who can

use language, because the concept is limited to our species. But wouldnâ??t it be interesting to know whether trees can also talk to each other? But

how? They definitely donâ??t produce sounds, so thereâ??s nothing we can hear. Branches creak as they rub against one another and leaves

rustle, but these sounds are caused by the wind and the tree has no control over

them. Trees, it turns out, have a completely different way of

communicating: they use scent.

Scent as a means of communication? The concept is not totally unfamiliar to us. Why else would we use deodorants and perfumes ? And even when

weâ??re not using these products, our own smell says something to other people, both consciously and subconsciously. There are some people who

seem to have no smell at all; we are strongly attracted to others because of their aroma. Scientists believe pheromones in sweat are a decisive factor

when we choose our partners- in other words, those with whom we wish to procreate. So it seems fair to say that we posses a secret language of

scent, and trees have demonstrated that they do as well.

For example, four decades ago, scientists noticed something on the African savannah. The giraffes there were feeding on umbrella thorn acacias, and

the trees didnâ??t like this one bit. It took the acacias mere minutes to start pumping toxic substances into their leaves to rid themselves of the large

herbivores. The giraffes got the message and moved on to other trees in the vicinity. But did they move on to trees close by? No, for the time being,

they walked right by a few trees and resumed their meal only when they had moved about 100 yards away.

The reason for this behaviour is astonishing. The acacia trees that were being eaten gave off a warning gas (specially, ethylene) that signalled to

neighboring trees of the same species that a crisis was at hand. Right away, all the forewarned trees also pumped toxins into their leaves to prepare

themselves. The giraffes were wise to this game and therefore moved farther away to a pert of the savannah where they could find trees that were

oblivious to what was going on. Or else they moved upwind. For the scent messages were carried to nearby trees on the breeze, and if the animals

walked upwind, they could find acacias close by that had no idea the giraffes were there.

Similar processes are at work in our forests here at home. Beeches, spruce, and oaks all register pain as soon as some creature starts nibbling on

them. When a caterpillar takes a hearty bite out of a leaf, the tissue around the

site of the damage changes. In addition, the leaf tissue sends out electrical signals, just as human tissue does when it is hurt. However, the signal is not

transmitted in milliseconds, as human signals are; instead, the plant signal

travels at the slow speed of a third of an inch per minute. Accordingly, it

takes an hour or so before defensive compounds reach the leaves to spoil the pestâ??s meal. Trees live their lives in the really slow lance, even

when they are in danger. But this slow tempo doesnâ??t mean that a tree is not on top of what is happening in different parts of its structure. If the

roots find themselves in trouble, this information is broadcast throughout the tree, which can trigger the leaves to release scent compounds. And not

just any old scent compounds, but compounds that are specifically formulated for the task at hand.

This ability to produce different compounds is another feature that helps trees fend off attack for a while. When it comes to some species of insects,

trees can accurately identify which bad guys they are up against. The saliva of each species is different, and the tree can match the saliva to the

insect. Indeed, the match can be so precise that the tree can release pheromones that summon specific beneficial predators. The beneficial predators

held the tree by eagerly devouring the insects that are bothering them. For example, elms and pines call on small parasitic wasps that lay their eggs

inside leaf-eating caterpillars. As the wasp larvae develop, they devour the larger caterpillars bit by bit from the inside out. Not a nice way to die. The

result, however, is that the trees are saved from bothersome pests and can keep growing with no further damage. The fact that trees can recognize

saliva is, incidentally, evidence for yet another skill they must have. For if they can identify saliva, they must also have a sense of taste.

A drawback of scent compounds is that they disperse quickly in the air. Often they can be detected within a range of about 100 yards. Quick

dispersal, however, also has advantages. As the transmission of signals inside the tree is very slow, a tree can cover long distance much more quickly

through the air if it wants to warn distance parts of its own structure that danger lurks. A specialized distress call is not always necessary when a tree

needs to mount a defence against insects. The animal world simply registers the treeâ??s basic chemical alarm call. It then knows some kind of

attack is taking place and predatory species should mobilize. Whoever is hungry for the kinds of critters that attack trees just canâ??t stay away.

Trees can also mount their own defence. Oaks, for example, carry bitter, toxic tannins in their bark and leaves. These either kill chewing insects

outright or at least affect the leaves taste to such an extent that instead of being deliciously crunchy, they become biliously bitter. Willows produce the

defensive compound salicylic acid, which works in much the same way. But not on us. Salicylic acid is a precursor of aspirin, and tea made from

willow bark can relieve headaches and bring down fevers. Such defence mechanisms, of course, take time. Therefore, a combined approach is

crucially important for arboreal early-warning systems.

Trees donâ??t rely exclusively on dispersal in the air, for if they did, some neighbours would not get wind of the danger. Suzanne Simard of the

University of British Columbia in Vancouver has discovered that they also warn each other using chemical signals sent through the fungal networks

around their root tips, which operate no matter what the weather. Surprisingly, news bulletins are sent via the roots not only by means of chemical

compounds but also by means of electrical impulses that travel at the speed of a third of an inch per second. In comparison with our bodies, it is,

admittedly, extremely slow. However, there are species in the animal kingdom, such as jellyfish and worms, whose nervous systems conduct impulses

at a similar speed. Once the latest news has been broadcast, all oaks in the area promptly pump tannins through their veins.

Tree roots extend a long way, more than twice the spread of the crown. So the roots systems of neighbouring trees inevitably intersect and grow into

one another- though there are always some exceptions. Even in a forest, there are loners, would-be hermits who want little to do with others. Can

such antisocial trees block alarm calls simply by not participating? Luckily, they canâ??t. For usually there are fungi present that act as intermediaries

to guarantee quick dissemination of news. These fungi operate like fibre-optic Internet cables. Their thin filaments penetrate the ground, weaving

through it in almost unbelievable density. One teaspoon of forest soil contains many miles of these â??hyphaeâ??. Over centuries, a single fungus can

cover many square miles and network an entire forest. The fungal connections transmit signals from one tree to the next, helping the trees exchange

news about insects, drought, and other dangers. Science has adopted a term first coined by the journal Nature for Simardâ??s discovery of the

â??wood wide webâ?? pervading our forests. What and how much information is exchanged are subjects we have only just begun to research. For

instance, Simard discovered that different tree species are in contact with one another, even when they regard each other as competitors. And the

fungi are pursuing their own agendas and appear to be very much in favour of conciliation and equitable distribution of information and resources.

If trees are weakened, it could be that they lose their conversational skills along with their ability to defend themselves. Otherwise, itâ??s difficult to

explain why insect pests specifically seek out trees whose health is already compromised. Itâ??s conceivable that to do this, insects listen to tress

urgent chemical warnings, and then test trees that donâ??t pass the message on by taking a bite out of their leaves or bark. A treeâ??s silence

could be because of a serious illness or, perhaps, the loss of its fungal network, which would leave the tree completely out off from the latest news.

The tree no longer registers approaching disaster, and the doors are open for the caterpillar and beetle buffet. The loners I just mentioned are similarly

susceptible-they might look healthy, but they have no idea what is going on around them.

12) Learned Author Dr. Rajendra Dobhal in his book â??Grassland Ecosystems of Central India Himalaya: Structure and Functionâ?, has stated as

under:-

Grasslands provide grazing land for both wild and domestic animals thus form an important part of the earthâ??s many ecological communities.

Grasslands cover 40 percent of the earthâ??s land surface. Throughout the world grassland ecosystems are essential to the survival of plant, animal,

and bird species. They composed of grasses, provide grazing for livestock, as well as insect herbivores such as grasshoppers, locusts, etc. and have

been the seedbeds for the ancestors of major cereal crops, including wheat, rice, rye, barley, sorghum, and millet. Besides, they also play a vital role in

sustaining human life. In many countries the grasslands also offer leveled areas that have been ploughed to grow agricultural and horticultural crops.

Thus grassland landscape is a very important topic in the study of the ecosystem because they cover huge land area of earth that also supply three

quarters of the energy that the world needs.

Generally grasslands occur in areas with hot summer temperatures. Areas with low precipitation/rainfall are tend to be deserts while the areas with

more rainfall are likely to be dominated with forests. However, the grasslands are

not restricted to low rainfall areas, several grasslands also form

either through clearings of forests or other vegetation. They are also situated with patches of forests as on hill slopes as well as in depressions as in

the shoal region of South India. Grassland ecosystems are found in form Himalayan pastures, the terai grassland of the foothills, semi-arid grasslands

of Western and Central India, the scrublands of the Deccan Plateau and the Shola forests of the Western Ghats, Nilgiri and Anna-malai ranges.

Depending on the quantity of rain, there are tall, medium and short grasses. Natural grasslands have a variety of grasses, forbs (small plants) and

herbs, which differ according to the different grassland types.

Broadly the grasslands in the world can be divided into two types: Tropical Savannah and Temperate Grassland. The tropical grasslands are found

close to the equator where the general climate is hot throughout the year, whereas the temperate grasslands are farther from the equators that grow

under hot summers and harsh winters. Temperate grasslands cover North America (called as U. S. prairies), and extends to Eurasia and South

America as well. A substantial area of temperate grasslands has also been converted into agricultural purposes because of high productivity of these

areas. In North America the grasslands are known as â??prairiesâ??, in South America they are called â??pampasâ??, in Europe they are known

as â??steppes, whereas in Africa they are popularly called as â??savannaâ??.

Grasslands of India

India comprises 2.5% of the worldâ??s geographical area which is seventh largest size (328.73 million ha). It also comprises 1.8% of the forest area

of the world. It is the largest democratic republic and support second largest human population (>1.10 billion). At present India supports 16% of the

worldâ??s human population and 18% of the domestic cattle population. The country is identified as a mega-biodiversity area because of its ten

major biogeographic zones (viz. trans Himalaya, Himalaya, Desert, Semiarid, Western ghat, Deccan plateau, Gangetic plain, Notheast, Coastal area,

and Islands). Depending upon rainfall, temperature and biotic influences, these biogeographic zones support varied forest types and grasslands. Forests

occupy over 75 million hectares land area (23% of land surace). Major forest types are Tropical forests (comprising moist tropical forests with

Tropical wet evergreen, Tropical moist semi-evergreen, and Tropical moist

deciduous forest types), Tropical dry deciduous forests, Montane

Subtropical forests, Temperate forests, and Alpine forests.

In India grasslands are found in wide-variety of ecosystems and under different climate conditions that that ranged from desert conditions to semiarid

grasslands in western, central India and in Deccan plateau to patches of shoal grasslands with moist evergreen forests on hill-slopes in South India,

and extends to warm and cool temperate climate of Himalayan mountains. In Himalayan region the grasslands at the lower-mid hills are found in

parches with forests and shrubs and popularly called as â??pasturesâ?? that extends with coniferous or broad-leaved forests. These pastures have a

large variety of grasses and herbs. There are also tracts of tall elephant grass in the low-lying terai belt in Himalayan foothills. In alpine areas

grasslands support a large variety of plant species and commonly called as â?? meadowsâ??.

In India the majority of bovine populations depend on grasslands for their forage and herbage needs. These grasslands are traditionally managed by

village communities to support their domestic livestock, thus considered common property resources. In view of different levels of use and

management these grasslands comprise a large variety of plant species and support wide variety of herbivores and carnivores. The grassland

herbivores are mostly fleet footed animals that live in herds. The Himalayan wildlife comprising deer, wild sheep, goat, goral, etc. exclusively depended

on these grasslands for their forage needs. The fastest wild animals of the world live in open grasslands. Grasslands also have an enormous number of

insects, which attract a large number of predatory animals like the lizards and birds. Unfortunately the over exploitation and mismanagement of these

grazing lands in view of ever-increasing bovine population as well as land conversion for agricultural purposes has put tremendous pressure on

grasslands at all locations. It is considered that more that 43% of the grasslands in Indian subcontinent are under the threat to be converted into desert.

Grassland types of India

The distribution of grasses is primarily governed by climatic factors, latitudinal influence, altitude, topography and soil moisture relationship. Natural

grasslands occur in temperate zone with annual rainfall between 280-300 mm, while in tropics they may be formed in areas receiving rainfall up to

1500 cm, Misra (1983) has regarded all tropical grasslands of India is â?? Savannahsâ??, that comprised grassland dominated by grass with scattered

trees or shrubs.

White (1957) described the grasslands of India into eight major typesâ?¦â?¦â?¦â?¦..

Deschampsia- Deyeuxia type:-

These grasslands are mainly found above 3000m in alpine regions of the Himalaya. The growing season is limited to 4-5 months and general climate is

very cold. The common species of such grasslands are Deschampsia, Deyeuxia, Poa, Stipa, Glyceria and Festuca along with large variety of dicots.

Temperate-Alpine grasslands:

These grasslands are found in temperate and alpine region above 2000m elevation in the Himalayan region. Jammu & Kashmir, Himachal Pradesh,

Uttarakhand, West Bengal and the north-eastern states comprised such grasslands. These grasslands are mainly dominated with perennial grasses and

dicots though just few annual grass species are also found. The legume species are also found but less in number. The main species of these

grasslands are Agropyron conaliculatum, Chrysopogon gryllus, Dactylis glomerata, Danthonia cachemyriana, Phleum alpinum, Carex nubigena, Poa

pratensis, etc.

Grasslands in the Himalaya:-

Throughout the world grasslands are an integral part of the human societes, and the Himalaya is not an exception. Grasslands, pastures, alpine valleys,

meadows and steppe vegetation that support native grasses,grass-like plants, forbs or shrubs through manipulation of grazing (Jacoby 1989). The

bioclimatic gradient in the Himalaya yields a unique treeless world in the higher reaches of the mountains, i.e. alpine meadows; however at lower

altitudes the grasslands are a product of exploitation of forests, i.e., by cutting, grazing or fire (Sundriyal 1995a). It is estimated that the Hindu Kush

Himalayan region comprises over 2 million km under grasslands, which is nearly 60% of the total land area of the region (Rechards & Hoffmann

2004). Besides being used as grazing grounds the grasslands provide important ecosystems services such as water towers for major rivers, home for

some of the most endangered animals and plants, habitats for valuable and diverse flora and fauna, and potential tourism destinations. Most of the high

altitude areas support pastoral lifestyle, comprising nomads, transhumance, ranchers and agro- pastoralist types, all of them depend on livestock and

grasslands for their livelihood. These communities posses a huge knowledge about the local environment, natural resources, and plants and animals;

and practice high adaptations to adjust in such areas (Miller 2000). Unfortunately most of the high altitude grasslands and the communities living there

are highly marginalized because of inaccessibility, and complex environmental and socio-economic setups. These grasslands are threatened because of

increased livestock and human population, conversion of lands for agriculture, forestry and non-forest uses, and extension of protected area network in

grassland area (Singh & Sundriyal 2005). The aspiration of the pastoralist communities have also changed over the years ultimately affecting the

pastoralist mode of life (Chaudhry & Sundriyal 2006).

Grasslands from 55% of the total land area in the Himalayan region and comprise diverse vegetation types distributed from the subtropical to the

temperate and to the alpine regions. The high altitude alpine areas exhibit pastoral lifestyle and are visited by the migratory graziers during summer-

rainy season in order to support their animals. These grasslands are important sources of forage and meet over 50-60% of the total requirement of

animal fodder, and their composition and biomass-productivity varies across the Himalaya due to variations in species dominance, topography, rainfall

pattern, biotic pressure, and successional status of plant species (Sundriyal 2011). Free grazing that is often higher than the carrying capacity of the

grasslands is prevalent in most of the areas, which reduced the species diversity and biomass by 30-50%.

Extent of grasslands and bio-climatic setup in the Himalayan region

The Himalayan region extends to about 2500 km in length and 80-300 km in width covering Jammu & Kashmir (J&K) and Himachal Pradesh (HP) in

the north-west, Uttarakhand and Nepal in the central part, and Sikkim, Darjeeling hills, Bhutan and Arunachal Pradesh in the east. Besides, Assam,

Nagaland, Manipur, Mizoram, Tripura and Meghalaya are the north-eastern Indian states that have many similarities in vegetation and grasslands with

the Himalayan region. The grasslands extent over 55% of the total geographical area in the Himalayan region in India, Nepal and Bhutan, of which

14% is under temperate grasslands and pastures, 5% under cultivable

wasteland, and 36% under alpine areas.

The total geographical area of the Indian Himalayan Region (IHR) is 591 thousand sq. km (18% of India) which is inhabited by over 175 communities

with over million people, which forms 6% of Indiaâ??s population. Agriculture is the main occupation for over 70% population of the people in IHR.

Livestock are integral part of the all farming systems in the IHR. Dependence increases on animals with increase in elevation, and at higher reaches

the local economy is totally dependent on animals and its products (Sundriyal 1995a). Above 3000m elevation, a treeless world exists that goes up to

near permanent snowline, and the area support the lush green vegetation comprising herbs and shrubs. These areas are extensively visited by

transhumance and nomadic graziers during summer rainy season. The IHR has over 40 million domestic animals (9% of India) (Anonymous 1992).

Cattle, goat and sheep are important livestock in the western und central Himalaya, while cattle, pig and poultry in low and mid hills and Yak at high

hills are main domestic animals in the eastern Himalaya. These animals are maintained for various purposes, i.e. milk. ploughing, manure, meat and

cash needs.

In the IHR over 50% of the total land areas is under grasslands. At low and mid-hills grasslands, pasture, forest undergrowth and cultivable

wastelands are the major source of forage to livestock. The high altitudes, the major grasslands types are lush alpine meadows, semi-arid steppe and

cold deserts. Such areas form the hardest pastoral areas on the earth that are used extensively by graziers, the most common being nomads

(Bakarwals, Changpas, Gaddis, Jahads, Gujjars), transhumance (Bhutias, Brokpas), agro-pastoralist (Monapas, Nepalis) and ranchers (other

communities). The alpines are the highest elevation grazing lands having the worldâ??s most extreme environment

characterized with progressively semi-attenuate air deficient in oxygen, high atmospheric aridity, low atmospheric pressure and temperature, high

variation between shade and sun temperature, high insulation, radiation, and ultra violet activity. The pastoral communities have the permanent camps

as high as >5100m in Tibet where temperature goes-30ÂºC (Miller 1987). The alpine areas have a limited growing season for plant growth from May

till October, and for the rest of the months the area remains under snow. The

rainfall and temperature condition improves from wet to eastern

Himalayan region. As such the alpine areas are heterogeneous, marginal and fragile areas with rough terrain, high altitudes, poor soils, inaccessibility

to roads, markets and other services (Miller 2000, Singh & Sundriyal 2005). In temperate zone comparatively better growing conditions exist that

extends up to nine months in a year. The length of the drier period is limited to 3-4 month, which is cold and severe. The subtropical zone exhibits the

most favourable conditions for plant growth throughout the year. The temperate and subtropical areas also exhibit higher rainfall and temperature

conditions from west to eastern Himalayan region.

Vegetation dynamics of Himalayan grasslands:-

A number of forest types occur in the Himalaya, which are distributed widely with the gradient of elevation ranging from sub-tropical to temperate and

alpine zones (Champion & Seth 1968, Singh & Singh 1992). These forests also comprise large chunks of grasslands area that support most of the

animals for a considerable period every year (Gupta 1986). Different plant communities occur at different elevations and the palatability level of

forage varies from area to area (Sundriyal 1995b). The species compositions in various grasslands vary with elevation. The higher elevations comprise

Poa, Festuca, Agropyron, Agrostis, Calamagrostis, Carex, and Irish and Yak grasses and the species richness is reported to be 21 to 33 species (Joshi

et al. 1988, Ram et al. 1989, Sundriyal & Joshi 1990, Rikhari & Negi 1993, Kala & Rawat 1999, Singh & Sundriyal 2005, Chaudhary & Sundriyal

2006). The mid and low hills grasslands have developed through replacement of forests and they vary in species composition from place to place due

to varied bio-climate and are Arundinella, Chrysopogon, Themeda, Heteropogon, Brachiaria, Eragrostis, Imperata, Kobresia, etc. In the central

Himalaya the number of species varies from 12-35 at different elevational zones. The dicot forbs and legumes also occur frequently in these

grasslands throughout the Himalaya.

Open grazing is practiced for decades in all parts of the Himalaya particularly at higher elevations, which alters grassland composition. At temperate

and subtropical zones, however, the levels of animal pressure greatly vary from place to place because of the lack of proper grazing strategies and

open access to many areas, thus grasslands exhibited diverse species

composition (Patil & Pathak 1980, Singh & Gupta 1993). Due to high grazing

pressure, the grasslands frequently exhibit degraded state, which calls for immediate mitigation actions to manage such areas up to an optimum level

of forage production (Gupta 1986, Sundriyal 1995a).

Management of Himalayan grasslands:-

Grazing pattern differs at subtropical, temperate and alpine areas (Sundriyal 1995a, Singh and Sundriyal 2005). The local inhabitants enjoy the rights of

fodder and fuel collection from forests or other community land for their domestic needs. In alpines, grazing is highly seasonal (only during the summer

rainy season). Nomadic graziers and local residents from mid-hills move with cattle to high hills during April-May, stay there till October, and

thereafter come back to the lower elevations. At the lower mountain slopes the grazing is done round the year. Sometimes, the cattle are also left in

agricultural fields when the crops are harvested in winter (October-February) (Agrawal & Dhasmana 1989). Due to heavy grazing the animals remain

underfed in certain areas leading to low productivity of livestock (Jackson 1983). Where fodder is available in plenty, the animals are stall fed.

People have indigenous knowledge to manage grassland forage production in the Himalaya. Fodder is readily available during rains, but it is scarce

during winter and summer seasons. At places the grasslands are protected and the forage is collected only once at the end of a growing season during

October-December in order to meet the winter fodder requirement. Agricultural straw, husk and other grasses are stocked for winter and summer

months. Some agroforestry species provide supplementary fodder during winter (Nautiyal et al. 1987).

In the central Himalaya, the mid-hills are subjected to fire during winter months, particularly in Pine forest in ordeer to get forage during the rainy

season. The species composition at the highest stage of progression includes most productive and nutritious species, however it reduces significantly

with increase in grazing (Singh 1993). It is reported that livestock graze selectively on some species and they prefer nutritious forbs (Gupta 1986,

Sundriyal & Joshi 1992). Changes in vegetation composition are also noticeable when non-palatable plant species proliferate due to heavy grazing

pressure (Singh & Gupta 1993).

The forest grazing lands meet up to 45-60% of total fodder need in the central

Himalaya and about 40-45% is procured from agricultural by-products

(Tiwari 1982, Singh & Naik 1987, Pratap & Qureshi 1992). In Nepal hills nearly 50% of the fodder demand is met from forests, 31% by agricultural

residues and rest from other resources (Giri 1989). In the eastern Himalaya (Sikkim) forests meets 50-60% of the total fodder need, while

agroforestry species and agricultural by-products contribute 15-25 and 10-20% of the total fodder requirement (Sundriyal & Sharma 1996). Grassland

productivity though can be increased up to some extent through clipping and other means during rainy season only, when there is no dearth of fodder.

Availability of quality fodder during winter and early summer months shows scarcity and cannot be met from the grasslands at present. Most of the

farmers maintain tree-fodder banks on their farms for winter months, though it is not enough because of small land holding sizes. There is huge scope

to improve fodder resources on the farms and on the bunds of the agricultural fields.

Communities adopt diverse flexible pasture- production strategies that minimize risk and make optimal use of forage. For alpine areas high adaptations

are followed by people for resources available to them due to severencess of the environment. Life of pastoralists and animals are tuned to the growth

of grass and rhythms of the vegetation growth. In Sikkim, the local community imposes certain restriction on animal movement in order to ensure

proper productivity in the high altitude grasslands, which is based on local knowledge about vegetation, climate, and animal preference for species (Rai

& Sundriyal 1995). In the high hillsof Arunachal Pradesh, pastures areas are under private control and the owners charge certain fee to graziers to

permit animals to feed on their land (Chaudhary & Sundriyal. 2006). At certain places, there is a shift in grazing from one place to another to ensure

availability of adequate amount of forage at the locations. There are also examples where over grazed areas are protected by communities that

resulted in better grassland productivity (Sundriyal 1995a). The pastoral communities also maintain social arrangements with other nomad groups in

order to maintain mobility and access to additional resources at the time of stress/calamity (Richard & Hoffman 2004).

Forage availability and productivity of Himalayan grasslands

In alpine grasslands the vegetation growth is extensively governed by the length

of growing season, rainfall and temperature regimes, which results in

short-term resource availability and low productivity (Sundriyal & Joshi 1990, Sundriyal, 1992, Singh & Sindriyal 2005). The growing season for high

altitude (alpine) grasslands extended to May to October and rest of the months were snow covered (Ram et al. 1989, Sundriyal & Joshi 1990, Rikhari

et al. 1992). In temperate and subtropical grasslands, the growing season starts in June with the onset of rains and it goes up to November-December.

The plant phytomass vary from region to region in different grasslands. The mean range of live green shoot biomass varies from 165-1066 g m in

subtropical, 183-658 g m at temperate and 33-409 g m at alpine zones (Bisht & Gupta 1985, Yadav & Kakati 1985, Bawa 1995, Agarwal & Goyal

1987, Ramakrishnan & Ram 1988, Joshi et al. 1988, Ram et al. 1989, Sah & Ram 1989, Sundriyal & Joshi 1990, Rikhari et al. 1992, Uma Shankar et

al. 1993, Singh & Sundriyal 2005). Dead shoots varies from 21-1054 g m and the underground biomass from 255-2026 g m. Generally low elevational

grasslands have more above ground biomass, whereas high altitude grasslands constitute a higher part of below ground biomass.

The phytomass accumulation in grazed, ungrazed and control-grazed sites varied significantly among zones (subtropical, temperate and alpine) and

within a zone. In free grazed grasslands registered a net loss of 35065% I above ground plant phytomass. It is also evident through simulated grazing

(clipping) experiments and may be attributed to continuous loss of growing tissue (Sundriyal et al. 1993, Negi et al. 1993). In contrast, clipping at 15

cm above the ground level and after longer duration increased the biomass by 65%. Applications of fertilizers also increased the herbage production

(Gyamtsho et al. 1996). To compensate the labour for fodder collection, free gazing is adopted as an easiest mean to deed the cattle. Garzing reduced

dominance of palatable species and their yield besides resulting into net loss of biodiversity and low livestock productivity (Sundriyal & Joshi 1990,

Rikhari et al. 1992, Uma Shanker et al. 1993). The impact of grazing is more server during winter, which often leads to the grassland being cleared

from almost all types of vegetation (Sundriyal 1995a). Thus simple protection of grasslands has larger implications for maintaining biomass productivity

up to an optimum level and at certain location such regulations are already in practice. Enclosure of grazing lands has also been helpful in reducing the

number of animals at a few places (Jackson 1983).

Grasslands in Central Himalaya

In Himalayan states the grasslands still support most of the domestic animals as well as entire wild life. This study was conducted in whole of

Uttarakhand state which is located between 28Âº 43'-31Âº 27' N latitudes and 77Âº 34'-81Âº 02' E longitudes. The state borders Uttar Pradesh to the

south, Haryana to the west and Himachal Pradesh in the north â?"west and has international border with the Tibet autonomous region on the north

and Nepal on the east. The total geographical area of Uttarakhand state is 53483 km out of which only 7448 km are the plain the remaining 46035 km

are the hills and mountains. The average annual rainfall of the state is 1606 mm. The mean minimum and maximum temperature are -1.7ÂºC and

42Âº C respectively due to large variation in altitude i.e. 173m to 7280m. Grasslands were mainly found in Rudraprayag, Chamoli, Uttarkashi,

Dehradun, Bageshwar, Tehri, Pithoragarh and Nainital districts. Sampling sites were selected randomly in different districts of Uttarakhand on the

basis of occurrence of grasslands. The availability of extensive grasslands in the from of fodder and feasible climatic conditions manifest a way for

sustainable livestock farming in Uttarakhand. These grasslands are called as bugyals or kharaks. Extensive temperate grasslands are found in the

entire mainland of Uttarakhand, mostly in the high reaches. During the summer, the people migrate to the higher reaches along with their cattle for

four months. Contrary, they move downwards during the winter. In the low-lying areas, fodder is available as a form of crop residue, grassland, and

fodder trees, which the people collect and keep it for the rainy and winter seasons.

The role of grasses in the fodder supply of Central Himalaya is of prime importance, specially in hilly areas. The contribution of grasses in the green

and dry fodder supply is 30.63% and 12.52% respectively. The total production of grasses has been estimated to be 54.10 lakh MT. per annum in the

state, out of which about 32.20 lakh MT. is utilized by animals as green and 4.76 lakh MT. as dry (equivalent to 21.90 lakh MT. green) per annum.

The maximum production of grasses say about 34.45 lakh MT. (63.68%) come from the forest sector. Total area under reserved forest, Van

Panchayats and Civil Soyam is 34.98 lakh hectare, but the actual area under

grass production is 19.91 lakh hectare (56.92%) only (Singh & Singh

2009). The remaining 43.08% area falls under rivers, riverlets, ravines, trees, shrubs, herbs, rocks and settlements. The average production of grasses

from forest area is 1.73 MT. per hectare. There are 350 species of grasses belonging to 116 genera are fully acclimatized in hilly environment. If

proper protection is provided to these grasses, the average production of 5.20 MT. per hectare may be achieved per annum. Van Panchayats are the

appropriate platforms for grass farming where all the measures for higher biomass production can be introduced. In this way about 68.9 lakh MT.

additional green fodder may be procured from forest sector.

The second major source of grass production are lower pastures, agricultural land, fallow, wastelands and orchards having the total area of 15.56 lakh

hectare, out of which about 7.87 lakh hectare (50.58%) is available for grass production which is 14.6 lakh MT. (19.52%) per annum. The average

yield of grasses from these areas is 1.85 MT. per hectare per annum. If proper protection is given to these areas and grazing is prohibited for 3 years

and only cut & carry system is followed, the yield of grasses can be achieved upto 5.5 MT per hectare and 28.7 lakh MT. Additional green fodder

may be produced per annum. The grasses of higher altitudinal zones suffer from severe grazing pressure especially during summer season and

occasional fire.

The alpine grasslands are spread over the northern parts of the region and are mainly used by migratory grazing animals such as sheep, goat, equines,

buffaloes and yak etc. besides wild animals like Bharal, Thars and other high altitude Antilopes. There are 380 important and popular Bugyals with

0.90 lakh hectare in Uttarakhand state which are situated in the disticts of Pithoragarh (Munsyari and Dharchula), Bageshwar (Kapkot), Chamoli

(Joshimath, Ghat and Dewal), Rudraprayag (Ukhimath), Tehri (Ghansali and Pratapnagar), and Uttarkashi (Bhatwari, Barkote, Mori and Purola).

About 1.78 lakh hectare area is covered by Bugyals and about 3.10 lakh hectare is under permanent snow as glaciers, snowclad peaks and their icy

basins. About 1.19 lakh hectare area is under high altitude bushes, rivers, riverlets and ravines etc. (Rawat, 1998). The areas under bugyals are not

fully covered by grasses and grazable herbs. Abut 30% area is blank. The Bugyals are utilized for summer grazing only i.e. from May to October. The

Bugyals used to provide and to a large extent still providing natural and nutritious alpine pastures between 3000 to 4800 m above mean sea level. The

alpine grasslands are having natural grasses of 80 species from 32 genera (family Poaceae), 208 species of grazable hersb from 26 families and non

grazable weeds & herbs of 80 species from 19 families of angiosperms. The quality of herbage of bugyals has, however, deteriorated in terms of

nutrient content and palatability in recent 2-3 decades. Valuable forage from the bugyals is avaibale for 5 to 6 months during summer. During this

period the condition of animals grazed in bugyals substantially improves.

The above discussion clearly revealed that Himalayan grassland are the lifeline of its animals but are under severe anthropogenic pressure. A detail

investigation on grasslands of Central Himalayan Region was made during 1983-1990 comprising structure, composition, phenology, vigour and

dynamics of biomass-productivity, energy and nutrient cycling covering prominent grasslands of sub-tropical, temperate, sub-alpine and alpine region.

Socioeconomic evaluation was also carried out along with it. Though significant time has been elapsed, it is still considered that data generated during

the study has significant importance and need to be complied in the form of a book to provide a comprehensive status report. This compilation may be

of greater use as a reference material to witness the structure and phenomenal changes imparted by climate change in these grasslands. The data has

been thoroughly discussed with existing information on grasslands. It is expected that information given in this book will pave a way to further

research and development in these natural resources, their management and sustainable utilization.

Alpine grassland

In alpine grassland, various species varied considerably with regard to the length of time involved for a given phonologic phase. Most of the species

sprouted from rhizome, rootstock or other perennating organs. Very few species started their germination from seeds. The budding period lasted from

2 to 5 weeks for many species, however, Oxygraphis polypetala took less than one week to develop into a flower from the time of appearance of the

bud. Corydalis cashmeriana, Pedicularis porrecta and Kobresia nitens also flowered in short time after bud enlargement.

Species like Epilobium royleanum, Polygonum sp., Geranium wallicchianum,

Jurinea macrocephala, Saxifraga diversifolia, Danthonia cachymeriana,

Tanacetum longifolium started their vegetative growth after 3-5 weeks of snowmelt. Bupleurum longicaule was late germinating species. It started

germination in late June or early July. In perennial grasses and in majority of forbs, the sprouting started from the rhizome and followed by vigorous

vegetative growth. Very fast sprouting was observed in Danthonia cachymeriana in July-August. The whole area become lush green in the month of

July with new vegetative growth.

The flowering period also varied with species. Maximum number of species opened their flowering buds in late July/early August and took 10-15

week from the time of bud initiation to full expansion. In case of Taraxacum officinale this time scale was more wide. It started flowering in second

week of September. Oxygraphis polypetala, Juncus elegans, Corydalis cashmeriana, Campanula argyrotricha, Geranium wallichianum flowered for a

shorter period while Polygonum species, Tanacetum longifolium, Trachydium roylei, Saxifraga diversifolia, Pedicularis porrecta, Parnassia nubicola

showed longer period of flowering.

Most of the species developed their fruits in 5-6 weeks after flowering. Oxygraphis polypetala, Bupleurum longicaule, Geum elatum, frequently

dispersed their seeds within 1-2 weeks after floral expansion while Trachydium roylei, Paranassia nubicola, Saxifraga diversifolia, Geranium

wallichianum, Danthonia cachymeriana took 4-6 weeks from flowering to seed dispersal. Other species like Tanacetum longifolium, Kobresia nitens

took longer time of 8-12 weeks for seed dispersal after flowering. Almost all the species were found dry at the end of October due to severe climatic

conditions, continuous frost, decline in temperature and occasional snowfall.

It is clear that the time of flowering varies due to photoperiodic response and temperate (Daubenmire 1959, Holwey and Ward 1965). Short and long

vegetative period before blooming were associated with early and late flowering respectively. It is interesting to note that Oxygraphis polypetala

flowered twice in a season, at the beginning when blooming occurs vigorously and in late season when only occasional flowering was observed. The

presence of late season blooming in addition to early blooming may be due to the development of a bud that fails to respond during the normal floral

time. Late flowering may be due to the bolting of floral axes that normally would

have been carried over into the next growing season in the

perennating oragans (Holway and Ward 1965). Maximum species were found reproducing by vegetative means because of low seed production.

13) Learned Author Mr. G.S. Rawat, in his book â??Alpine Meadows of Uttaranchalâ??, has stated as under:-

The alpine zone represents one of the most fascinating biomes in the Himalaya. It forms nearly 33% of the geographical area in the region, of which

about 25.88% area is vegetated and remaining 7.12% area falls under perpetual snow (Anonymous 1989). This proportion is much higher in the states

of Jammu and Kashmir and Himachal Pradesh. In the state of Uttaranchal the alpine zone forms about 24.11% of the geographical area. Limited by a

distinct treeline towards lower elevation which ranges between 3300-3600 m above sea level (asl) in the western and 3700-4000 m m asl in the

easteren Himalaya, the alpine vgetation comprises closely matted dwarf shrubs, herbaceous meadows, bogs, and snow-swept grounds characterized

by cushion shaped plants. The diversity of life forms, structure and composition of alpine vegetation have always attracted a large number of

naturalists, phyto-geographers and ecologists. It is believed that most of the Himalaya forests have actually transformed from the tropical evergreen

forests which were contiguous with other forests of Indo-Malayan region nearly 150 million years ago. However, the alpine vegetation evolved mainly

after the final phase of Himalaya uplift (20-25 million years ago), subsequent increase in the cold-arid climate and migration of flora from the adjoining

regions (Vishnu-Mittre 1984). It is plausible that emergence of Himadri System or Great Himalaya, crustal unrest and receding of Tethys sea provided

corridors and lands bridges for the migration of flora from the north and north-western regions resulting in a common flora between Greater Himalaya

and Tibet and China. It appears that the flora of Greater Himalaya and Tibet partly segregated subsequent to the rise in the Himalaya and Tibet. It is

believed that the Himalaya has risen by about 2000 m since coming of man (Valdiya 2001). A large number of taxa speciated and dispersed within the

Himalayan region and soe of the versatile and cold adapted specie migrated upwards. In due course of time retreating glaciers, truncated spurs and

amphitheatres in the alpine region were colonized by present day flora (Rau 1975). Puri et al., 1989 have opined that while the flora of Himalaya and

Tibet can be said as Sino-Himalayan in origin, the flora of European Alps was derived from the Arctic flora. This explains the marked differences

between the flora of European Alps and Himalayan alpines despite their superficial resemblance. A closer look at the present day alpine vegetation of

the Himalaya reveals interesting facts of ecology, past geo-climatic changes and history of human use.

The alpine regions forms uppermost catchment of the Himalayan rivers which support millions of people in the lower hills as well as plains of north

India. Therefore, health of the alpine ecosystem has direct bearing on the life-support system, environmental stability, biodiversity and human welfare

in the region. In the Greater Himalaya, alpine region is generally separated by a distinct treeline where forests of birch-rhododendron (Betula utilis-

Rhododendron campanulatum), high altitude fir (Abies spectabilis) and brown oak (Quercus semecarpifolia) terminate. The board physiognomic units

of alpine vegetation in the Western Himalaya include the stunted forests or Krummholz, alpine scrub, alpine meadows, and pioneer communities on

scree slopes and moraines (Rawat 1984, Rawat & Rodgers 1988). The vegetation of the cold arid region (trans-Himalaya) is distinguishable from

those of the Great Himalayan ranges by virtual absence of extensive herbaceous meadows and Krummholz formations. The trans Himalayan

vegetation is largely dominated by scrub formations, desert steppe, marsh meadows and pioneer communities. Hence, despite large area under alpine

vegetation in the trans- Himalaya, overall productivity and standing biomass would be relatively low.

The states of Uttaranchal, Himachal Pradesh and Jammu and Kashmir, despite their gradual and inherent eco-climatic differences have been

categorized under a single phytogeographic region i.e., Western Himalaya since the time of early explorers. Thomas Hardwicke was perhaps the first

European to collect plants from this region as early as 1798. Subsequently, a number of European botanists, army officers, administrators, missionaries

and survey officers explored the high altitudes of this region and contributed towards advancement of out knowledge on the floral resources of the

Western Himalaya. Notable among them Richard Blinkworth, who collected plants for N. Wallich during 1815-1820; J.F. Royle who wrote natural

history and botany of Kashmir; Col. Sir R. Strachey and J.E. Winterbottom collected plants from interior areas of Kumaon and Tibet during 1846-49;

Mr. T. Kinney explored the Nilang Valley during 1878-79; and J.F. Duthie who traveled most extensively throughout the Western Himalaya during

1882-1906. Subsequent to Indiaâ??s independence a large number of botanists from the Forest Research Institute, Botanical Survey of India and

regional universities have conducted floristic works in the region.

The Bugyals

Of all the alpine landscapes in the Himalaya, the herbaceous meadows, locally termed as â??Bugyalsâ?? in Uttaranchal, â??Kandaâ?? in Himachal

Pradesh and â??Margâ?? in Kashmir, are of immense ecological and botanical interest. The herbaceous plants in the meadows usually bear

attractive flowers and exhibit a peculiar perennial annual growth habit. The meadows comprise a large number of herbaceous communities with

varying proportions of tussock forming grasses, and sedges. Generally, it is generally seen that grasses are low in abundance in Bugyals and several

herbaceous species belonging to various dicot families predominate these areas. Describing an alpine meadow in Bhyudar Valley, Frank Smythe

(1938) wrote â??I saw ground so closely packed with fritillaries that it seemed impossible that other plants could grow, yet when Fritillarias had down,

they were succeeded by other plants such as Potentilla which grew equally closely. This cycle persisted throughout summer, one plant being replaced

by another with perfect precision. With the melting of snow in May or early June, early summer flowering herbs bloom in profusion which include

Crucifers. Primulas, Anemones and Saxifragas appear in late summer and towards autumn appear Gentians, Swertias with Saussuraes.â? Similarly,

Rau (1975) has described lush carpet of alpine herbs along the right bank of Alaknanda facing Vasudhara waterfall where the main components of

the meadow are grasses and multitude of colourful herbs such as species of Anemone, Gentiana, Potentilla, and Primula.

The term Bugyal has been derived from Bug or Bugia, a clooective term in Uttaranchal for several dwarf forbs and grasses which grow in great

profusion in the meadows. Some of the typical Bug species are (i) Euphorbia stracheyi (Dudh Bug), a nutritious herb yielding milky latex, (ii)

Trachydium roylei and Chamaesciadium garhwalicum (Dhania Bug), dwarf herbs with coriander like leaves, (iii) Saussurea graminifolia (Bus Bug),

dwarf herb with grass like leaves and waxy coat, and (iv) Kobresia species

(Mamla Bug), a dwarf sedge forming pure stands on higher slopes.

Depending upon the prominence of these species and other associated plant communities various Bugyal types can be recognized in the alpine region.

The life of the local inhabitants in high altitude of Uttaranchal is intimately associated with the Bugyals as evident from a large number of folklores.

Several religious sites are located in and around Bugyals where the local people visit for worshipping the deities. The Bugyals are also used as

summer grazing grounds by a large number of migratory and local pastoral communities. Since the lower altitude grazing lands are limited in extent,

summer migration to higher altitudes and alpine meadows has become a practice as a means to sustain the large livestock populations. However,

increase in number of livestock and overuse of certain pastures has led to degradation of high altitude grasslands. A large number of rare and

endangered wild fauna e.g., snow leopard (Uncia uncia), blue sheep (Pseudoisnayaur), Himalayan tahr (Hemitragus jemlahicus) among others inhabit

the Bugyals during one season or the other. Besides, Bugyals are also regarded as repositories of a large number of medicinal and aromatic plants

(MAPs) which are used in local medicine as well as for sale to the herbal industries (Rawat & Pangtey 1987, Pangtey et al. 1989, Samant et al. 1997,

Tolia et al. 1998, Nautiyal et al. 2000). Throughout the Western Himalaya, exploitation pressure is high on several alpine herbs e.g., Salam Panja

(Dactylorhiza hatagirea), Kutki (Picrohiza kurrooa), Dhoop (Jurinea dolomiaea) and Atis (Aconitum heterophyllum) among others. Some other human

activites in the alpine areas include collection of fuel wood, recreation (camping, trekking and skiing) and cultivation on steep slopes. In recent years

there has been a sudden influx of tourism in the Bugyals. Cumulative effect of various anthropogenic activities on these fragile environment can be

irreparable. Several environmentalists and conservationists have raised concern over degradation of alpine habitats, loss of carchment capabilities,

rapid retreat of glaciers and local extinction of endangered species. There is an urgent need to prepare a status paper on this fragile ecosystem and its

major components so that a comprehensive conservation and management plan could be drawn for this area.

Description of the grass communities

1. Byans Valley:

This refers to the upper Kali valley in Dharchula Block of Pithoragarh

District.

The alpine zone of in Byans (en route to Kailash Mansarovar) starts at Chhiyalekh at an altitude of 3300 m above MSL. This being a major campsite

with ITBP and Army camps too, the grasslands are degraded due to overgrazing and have been taken over by Rumex nepalensis at many places. The

moister areas are having gregarious patches of Iris kumaonensis whereas the major conspicuous herb is Anemone rivularis with its white and blue

flowers in spring. The slopes above Chhiyalekh rises up to 4000 m and are dominated by Danthonia cachemyriana, Festuca valesiaca, Agrostis

pilosula, Koeleria argentea, Phleum alpinum, Poa annua, P. ludens, P. nephelophia, P. angustifolia and P. nemoralis were the other grasses in this

meadow. The last altitude at which Cynodon dactylon was found was 3000m, a little before reaching Chhiyalekh. Anropogon tristis was also found at

Chhalekh. The major grassland community was the Danthonia cachemyriana-Koeleria type up to Nabedhang in this valley. Oryzopsis lateralis and O.

humilis were found in the landslip areas and riverbanks. Poa pseudamoena was found closer to the habitations especially at Garbyang and Gunji. From

Gunji, Elymus nutans started to become more dominant along with Festuca ovina. Poa pratensis also formed large patches towards Kalapani and

Nabedhang. Poa tibetica showed its appearance from Nabedhang and became the dominant species in degraded areas. Danthonia cachemyriana and

Deschampsia flexuosa formed the major grassland community towards Lipu. Trisetum spicatum became more aboundant as the altitude increased

above 4200m. Oryzopsis wendelboi was also found at certain places. Poa tibetica was the major species showing maximum affinity with Tibet.

Elymus nutans showed to be an indicator of clod arid conditions.

The valley along Kutti Yangti (river) from its junction at Gunji to its origin at Adi-Kailash and Parvati Tal near Jeolingkong is being referred to here as

the Kuti valley. The southern bank of Kuti and the slopes of the valleys formed by its tributaries from the south were moister and rich in vegetation

than the northern slopes. The Peer Nala of Napalchu had a dense Betula-Rhododendron campanulatum forests and the upper reaches of the nala had

good moist grass cover, consisting mainly of Hierochloe laxa, Poa alpina and Phleum alpinum. Poa nemoralis, P. pseudamoena and Bromus tectorum

was common near the Napalchu village. Calamagrostis epigejos started appearing at Nampha along with Elymus nutans and Poa angustifolia.

Trisetum spicatum also became more common in the Nampha nala. Deschampsia was also fund in the higher reaches. The plains of Kuti were

dominated by Calamagrostis epigejos, Afrostis munroana, Koeleria argentea and Poa angustifolia. The upper slopes of Kuti had Poa tibetica and

Festuca ovina along with large patches of Poa pratensis. Poa alpine and Hierochloe laxa were also found in the valley leading to Sela pass. The major

community was Danthonia cachemyriana. Cassiope fastigata and Rhododendron anthopogon formed the other major group. This bugyal also had an

extensive cover of a single population of Duthiea nepalensis with its persistent glumes and cylindrical spikelets and is the first report of the species in

India. The route to Jolingkong was dominated by Poa tibetica and Elymus nutans. At Jolingkong, Trisetum aeneum and Trisetum spicatum were very

common. The marshes near Parvati Tal had Colpodium himalaicum in plenty. Poa alpine, Hierochloe laxa, Trikereria hookderi were also found. The

new grass community here was Stipa purpurea, which formed extensive ground level vegetation with red glumed spikelets on a short inflorescence.

Poa himalayana were also found at higher altitudes, but the grass found at the highest altitude was Trisetum spicatum at around 5100, on the way to

Shin La at 5448m.

2. Darma valley Across the Sinla (Lebung Pass) is the Darma valley, which is the valley of the Dhauli Ganga. The valley starts from the plains of

Dawe to Tawaghat. The Sipu Gad also comes from Sipu glacier and meets the Dhauli at Tidang. At Dugtu, the tributary from Panchachuli East

Glacier joins the river. Dugtu at an altitude of 3200m can be considered as the start of Alpine meadows. Below Dugtu, sub alpine forests starts. Poa

tibetica, Triticum aeneum, Oryzopsis humilis, Koeleria argentea, Poa alpine, Phleum alpinum, Poa himalayana, etc. formed the grassland community in

the upper reaches of the valley at Bedang. Poa pseudamoena, Oryzopsis munroi, Dactylis glomerata, Pennisetum flaccidum, Calamagrostis gigantean,

Elymus nutans, etc. were the main grasses in the lower reaches at Tedang and Marchcha. Andropogon tristis was also found. The upper reaches of

Sipu had Trisetum aeneum and Oryzopsis aequiglumis in the moist areas. Calamagrostis emodensis formed a large community in the landslide areas

and exposed soil. Agropyron himalayensis also was found at places. The marshy areas of Marchcha had a good path of giant Colpodium nutans along

with Equisetum and Poa pratensis. The bugyals above Dugtu were mainly Danthonia cachemyriana and also had Trisetum spicatum in the upper

reaches.

3. Johar and Ralam valley:

The upper reaches of the Gori Ganga originating at Milam glacier are

referred to as the Johar valley. The valley of Ralam gad meeting Gori Ganga at Lilam and emerging from the Ralam glacier is referred to as the

Ralam valley. The Barjikang pass above Tola connects the two valleys. The alpine meadows start at Nahar Devi above Bagudyar. Calamagrostis

emodensis, Poa pratensis and Dactylis were the main species in the lower reaches whereas Colpodium nutans, Phleum pretense, Trisetum and

Oryzopsis were common in the upper reaches. At Burfu, Martoli, Mapa and Milam, several species of Agropyron, namely A. repens, A. thoroldianum,

A. dentatum and A. himalayanum were adbundant along with Elymus nutans, Oryzopsis grazilis, Festuca alatavica, Trisetum clarkei and Pennusetum

flaccidum were also common. The landraces of wheat and barley, viz., Nappal and Uva were also cultivated in these areas. Colpodium nutans, Poa

trivialis and Bromus tectorum were abundant at Tola. Barjikang had Hierochloe laxa, Festuca valesiaca and Trisetum spicatum. Ralam valley across

Barjikang is a very moist valley and is mostly dominated by Stipa purpurea grassand community in the upper slopes. Trisetum spicatum is also in

abundant. The upper reaches of Martoli were Danthonia cachemyriana, whereas the marshes of Mapa were full of Agrostis giganatea, A.

subverticillata and A. tenuis. One of the interesting grasses was Duthia nepalensis on the way to Burfu glacier. This was the second report of this

grass during the present survey and only consisted of isolated three plants. Defferent species of Poa were also found. Dactylorhiza hatagirie also

formed a major component of the grassland especially in semi marshy areas. The plains of Milam seemed to have a large population of Poa lahulensis

in addition to other grasses.

Beyond Milam, the vegetation started gradually decreasing. The major grasses found were different species of Poa, Elymus nutans and Trisetum.

Agropyron shrenkianum was recorded at Dung. It is quite similar to E. nutans

and can be safely transferred to the genus Elymus. Poa himalayana,

Trisetum and Colpodium himalaicum formed the major species along with Elymus shrenkianus at Bampras. Thylacospermum caespitosum of

Caryophllaceae also was found in abundance. The highest grass found was also Trisetum spicatum on the way to Jim Tal. However, the highest plant

found was Christolea himalayensis at 5100, near Untadhura.

4. Girthi valley:

After crossing Untadhura, one enters into the catchment of the Girthi valley which is a tributary of the western Dhauli Ganga. Along the banks of the

Girthi river is the camp of Topidhunga. The grasslands are mainly of Stipa purpuera. Poa alpine var. vivipara was also observed here. Festuca

kashmiriana showed it s appearance as large populations on the degraded slopes of the riverbanks.

5. Laptel (Lapthal):

From Topidhunga, one has to follow upstream of the Girthi river and then ascend along the steep slopes of Khingru gorge to reach Khingru pass. On

the other side of the pass, one can see the vast plateau of Laptel, which is believed to be the floor of the Thethys Sea that got uplifted during the

formation of Himalayas. The fossils of marine molluscs found abundantly are the major evidence to this theory. From Khingru, one has to descend to

Chhyudhang and then climb another small pass and descend to Kyogad. After crossing the river, one ascends to the vast plateau of Lapthal.

The plateau seems to be barren with Spiti shales forming the fossil beds. The major vegetation is Caragana scrub. The major grassland communities

are of Leymus secalinus, which are tall grasses growing gregariously on the slopes, Festuca kashmiriana on the exposed slopes along the riverbanks

and Stipa on the flat grounds. Catabrosa aquatica is found along the watercourses as long stoloniferous grasses. The average height of Lapthel is

4500m above MSL. Calamagrostis holciformis and Melica persica are also found in the sandy riverbanks. Colpodium himalaicum was common in the

marshy areas. Poa tibetica, Elymus nutans, Oxyzopsis also found the dominate species among the Caragana scrub. Carex and Kobresia formed the

major community in the sedge meadows.

6. Niti valley:

From Lapthal camp, the plateau proceed to the Shalshal gad and across the river to the Nanhoti pass as 5000m. From here, one can descend to Atis

Sem, Takulisain and then follow the nala downstream to Barahoti at 4450m where Hotigad is met with. Hotigad is a major tributary of the Dhauli

River coming from Niti. The ITBP post of Rimkhim is situated between the Hotigad and Rimkhim Gad, which meets further downstream. The

Rimkhim Gad then meets Shalshal Gad furthen down and then Kyo Gad coming from Laptel at Sumna. It is then joined by Girthi River at 16 point and

then by Dhauliganga coming from Niti at Malari at around 3000m altitudes.

Leymus secalinus is seen along the banks of Rimkhim Gad and also at the junction of Shalshal Gad. Melica persica is the common grass which its

plumous silky pink inflorescences on the rocky scree slopes and degraded slopes along the river and is abundant at Malari. Agropyron thoroldanum is

also found up to Sumna. Calamagrotis gigantean is found in the downstream riverbeds. Elymus dahuricus was found in the Langpayar bugyal above

Niti. Chrysopogon echinulatus and Pennisetum flaccidum formed a conspicuous community at Gamsali and Bampa.

7. Saraswati valley:

This valley is behind Badrinath along the tributary of the Alaknanda above Mana village. The vally was surveyed up to Vasudhara falls at 3700m

altitude. The predominant grass community was Agrostis munroana, Festuca ovina, Trisetum and Oryzopsis. Elymus nutans and Agropyron longi-

aristatum was also present.

8. Nelang valley:

The valley of the Jat Ganga from Lanka to Naga is called the Nelong valley. At Naga, the Mana gad joins the Jat Ganga from the northeast and is

white in colour due to glacial origin. The other branch is blue in colour due to non-glacial origin and underlying rocks. The predominant grasses were

Elymus nutans. Pennisetum lanatum and Melica persica.

Based on the ecological expedition the following conclusions can be drawn on the status of Bugyals and medicinal and aromatic plants in Uttanchal:

Bugyals, derived from the local word â??Bug or Bugiâ?? in Uttaranchal, refer to the lush green herbaceous vegetation located between the treeline

and snowline. These are of immense ecological, cultural, aesthetic and economic significance, especially for nutritious forage and high value medicinal

and aromatic plants (MAPs). It is estimated that Bugyals occupy nearly 4250 km2 area in Uttaranchal that forms about 8% of the geographical area

and 50% of the total alpine vegetation in the state.

Based on the altitude, aspect and soil moisture six major categories of Bugyals are clearly recognizable in the state. These are: i. Tall forbs, ii. Mixed

herbaceous formations or short forbs, iii. Matted scrub or dwarf shrubberies, iv. Danthonia grasslands, v. Kobresia sedge meadows, and vi.

Cushionoid vegetation. In addition, several intermediate and edaphic types are interspersed with Bugyals, e.g., alpine moist scrub, alpine dry scrub, and

marsh meadows. Species rich and lush green Bugyals are generally found on stable and open slopes having deeper soil (>5 cm in depth) above 3600m

asl in the Greater Himalaya.

Based on the preliminary survey a total of 82 major Bugyals have been listed for the state of Uttaranchal and their approximate locations have been

shown on a map. Except Bugyals of Nanda Devi, Valley of Flowers and Gangotri National Parks and a parts of some Van Panchayats (e.g., Kwal

Ganga in Milam Van Panchayat and Lung Payar in Niti) most of the meadows are grazed by the domestic livestock during summer and monsoon

period. It is estimated that at least 1.5 lakh sheep and goats and about 8000 cattle, buffaloes, horses and mules graze in the alpine zone of Uttaranchal.

Bugyals with high intensity of livestock grazing especially by heavy animals such as buffaloes, cattle and horses had signs of soil erosion, low

vegetation cover and weed infestation.

Several remote and under-explored alpine areas were surveyed in terms of floristic during this expedition. Critical examination of plant specimens

collected from the survey area is likely to yield some new records for the state and a few species or varieties. It is estimated that the alpine region of

Uttaranchal may have about 1350-1400 species of vascular plants. This forms nearly 80% of total alpine flora reported from the alpine region of

Western Himalaya and 32% of total vascular plants estimated within the state.

Based on the systematic survey of plant species in various types of Bugyals it was found that maximum number of species per unit area (10X1 m2)

were in the mixed herbaceous formations (35-40 species per unit area). This was followed by Danthonia grasslands (25-25 species per unit area),

Marsh meadow (20-23 species per unit area), cushionoid vegetation (18-22

species), Kobresia sedge meadow (16-21 species), alpine dry scrub (7-13

species). 14 Botanical hotspots have been identified across the alpine region of Uttaranchal. Species rich Bugyals include corridors of floral migration,

junctions of major habitats and basins of larger mountains having massive snow banks.

ItÂ was observed thatÂ theÂ local inhabitants inÂ certain valleysÂ follow ecologically sustainable landuse practices such as protecting a part of

Van Panchayat from livestock grazing and commercial exploitation of MAPs, cultivation of valuable MAPs in their agricultural fields for self use and

sale in the local marker, pasture development and hay production. Such practices need to be replicated in other areas. However, in some areas a few

unsustainable land use practices were seen e.g., clearing of treeline and sub-alpine forests for camping, over grazing especially by buffaloes, and over

harvesting of high value medicinal plants. Such practices will have to be gradually curbed by provided better alternatives.

A total of 144 plants species (including one species of terrestrial lichen and one species of fungi) of medicinal use were recorded in the alpine zone of

Uttaranchal. These species along with their local names and uses have been listed. In addition, selected 100 species have been given along

with their status (as per the IUCN criteria) and distribution and pressure ranking. Distribution and pressure ranking for these species are as follows:

Restricted distribution, heavy pressure: Â Â Â Â Â Â Â Â Â 18 species.

Restricted distribution, low pressure:Â Â Â Â Â Â Â Â Â Â Â Â Â Â Â 33 species

Locally common, low pressure:Â 17 species

Locally common, high pressure:Â 8 species

Wide distribution, low pressure:Â 19 species

Wide distribution, high pressure:Â 3 species

Under cultivation, low pressure:Â 2 species

Classification of the species according to above criteria would be useful for developing conservation, development and harvest (CDH) plan and

selection of species under each category.

52 transect were laid for rapid mapping exercise (RME) across various alpine

sites. The location of these transects along with their geographical

coordinates, mean elevation range and characteristic features have been given for further mapping and future monitoring. Status of MAPs in terms of

density and frequency based on these transects and random sampling have been given for 15 major alpine blocks.

General profiles for 100 MAP species found in the alpine region of Uttaranchal have been provided along with their brief description, photographs,

habitat types, local uses and distribution maps. It is hoped that this would form the basis for a computerized Database on MAPs of Uttaranchal state

where more data collected through RME from various ranges would flow in near future and it would be integrated in a Geographical Information

System (GIS) domain.

Based on the direct and indirect evidences along the survey route presence of 25 mammal species were confirmed in the alpine region of Uttaranchal.

Of these, 11 species i.e., Himalayan tahr, Himalayan musk deer, Blue sheep, goral, Himalayan yellow-throated marten, red fox, common langur,

Tibetan woolly hair, pica and vole were sighted. In case of other animals, skin, horns, skull, tracks, dung and other evidences were seen and local

people confirmed their occurrence in the area. Presence of woolly hare (Lepus oistolus), Tibetan argali or nyan (Ovis ammon hodgsoni), and Tibetan

wild ass (Equus kiang) is being reported for the first time in Uttaranchal. There are reports of occurrence of wild yak (Bos grunniens) from Nilang

Valley for which further status surveys are required. General status of wildlife in various valleys has been discussed.

A separate section on the grass cover of alpine region in Uttaranchal has been given along with the ecological observations and suggestions for better

management of alpine grasslands and meadows.

14) In the book â??High Altitudes of the Himalaya (Biogeography, Ecology & Conservation)â? edited by Dr. Y.P.S. Pangtey and Dr. R.S. Rawal, in

article written by learned author Shri D.S. Rawat, Shri L.R. Dangwal and Shri R.D. Gaur under captioned â??High Altitudes Flora of Western

Himalaya : Peculiarities and Conservationâ?? has made following pertinent observations with regard to meadows in Himalayas :-

Alpine zone, restricted in a few elevated localities of the world, represent peculiar and interesting vegetational diversity, Plant Surveys, collections and

investigations in different alpine zones of Garhwal Himalayahave resulted some interesting information on their specific habitat, distribution, community

structure, flowering, mode of perennation and adaptation. Several of the plant species represent their specific locality or distribution range, occasionally

related with slope, exposure, topography, soil, elevation or other ecological factors. They peculiar mode of adaptations to cope with harsh climatic

conditions by these alpine plants, represented by stunted, acaulescent growth habit of spinescent or succulent habit associated with underground

perennation inmost of the cases.

Alpine zone of Western Himalaya have received much attention for floristic investigations, from time to time. In this part of Himalaya Strachey and

Winterbottom made extensive collections of plants from Kumaon and Garhwal during 1846-49, which was published by Duthie (1906), with the

inclusion of plant collections made by Wallich, Royle, Falconer, Blinkworth, Thomson and others. Smythe (1932) published â??Kamet conqueredâ??

in which he listed the plants collected from â??Valley of Flowersâ??. Smythe (1938) again visited â??Valley of Flowersâ?? and reported about 250

species of flowering plants, Ghildyal (1957) recorded 289 species from Valley of Flowers. Rau (1961) made an initial reporting on plants from North

Garhwal during 1957-59. Some more recent contributions include Semwal and Gaur (1981). Negi et al. (1985), Semwal (1984), Polunin and Stainton

(1984), Negi et al. (1987-88) etc.

However, studies on various types of plant communities in context to alpine habitat are lacking, Present paper is based on collection made from

different alpine zones of Garhwal Himalaya to find out their distributional pattern in different topographical situations such as altitude, slope, exposure

and soils and also to denote their phenological system.

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Alpine zones in Garhwal Himalaya are situated in the upper reaches of different river valleys or ranges, fluctuating from 3000 to 5500 m.a.s.i. (snow-

line) and separated from low lying land by a distinct timber-line zone (Troll 1958). Some of the alpine meadows well known for their grandeur are

Tapovan, Khatling, Panwali Kantha, Roopkund, Kedarnath, Madhya Maheshwar, Tugnath, Bedni, Kuari Pass, Bhagwabasa etc.

Beyond timber-line these high altitude zones are not only progressively cold

regions but are primarily regions of gradually semi-attenuated atmosphere

(Mani 1978). Alpine environment is characterized by thin atmosphere, high insolation, precipitation in the form of snow or hail-storms and low

temperature. Situated in the northern part of Chamoli, Tehri and Uttarkashi district, alpine zones are generally difficult to approach. They remain

covered under now during November to April and when snow melt in May, dwarf alpine plants come up with different colour of flowers. After

October snow falls starts at higher elevations which gradually covers lower alpine zone till the end of October-November. In alpine zones temperature

exceeds upto 300 C during hot summer. Relative humidity is high and reach to its maximum reading in July and August. Alpine zones in Garhwal are

usually represented by valleys, meadows, rocky mountain slopes and glacial morains.

During May to October several alpine zones (valley of Flowers, Bedni, Bhagwabasa, Khatling, Dodital, Kedarnath, Tungnath, Kuari Pass, Dalisera,

Badrinath, Alkapuri and Tapovan) were visited for plant collections and field notes related to habit, habitat, flowering time, mode of perennation and

associations etc. were made. Specimens collected from different alpine zones were identified and deposited in the H.N.B. Garhwal University

Herbarium (GUH), Srinagar (Garhwal).

There is scarcely and habitat in the world that is too hostile to support plant life, provided some moisture and light is available (Crawford 1989). In a

total stretch of alpine zones i.e. from 3000 to 5500 m.a.s.i. (approx.), there are several subzones characteristically marked by predominating

vegetation, with their district communities, and adaptive features are described here under.

In Garhwal Himalaya there is no abrupt end of tree cover and the growth of well formed forest trees is followed by a zone of stunted or twisted trees

called â??Krummholz zoneâ??. Timber-line zone is a transition zone between dense and closed forests of oak-rhododendron and dwarf exposed

alpine vegetation. This transition zone is not a sharp and well defined line on mountain slope. It ascends higher on southern slopes and descends down

on northern slopes (Mani 1978). The ultimate boundary of arborescent vegetation is constituted by stunted and twisted woody plants of Acer

acuminatum Wall. Ex G. Don, Betula utilis D. Don, Prunus cornuta (Wall. Ex

Royle) Steud., P. jacquemontii Hook.f., Sorbus aucuparia L., S.

microhylla Wenz., S.ursina (Wertz.) Done, Syringa emodi Wall. Ex Royle etc. This ecotone area represents the elements of alpine vegetation and

forest vegetation together. Species diversity is highest in timber-line ecotone as compared to adjacent parts. Some of the common herbs in timber-line

ecotone as compared to adjacent parts. Some of the common herbs intime-line ecotne are Aconitum heterophyllum Wall. ex Royle, Actaea acuminata

Wall. Ex Royle, Arisaema jacquemontii Bl., Arnebia benthamii (Wall. Ex G. Don) John., Boskniekia himalaica Hook. et Thoms, ex Hook f., Clintonia

udensis Trautv. & Mey var. alpine (Kunth ex Baker) Hara, Corydalis cashmeriana Royle, Chrysosplenium tenelium Hook. f. et Thoms, Cicerbita

cyanea (D.Don) Beauv., C. macrorhiza (Royle) Beauv., Fragaria daltoniana Gay, Geranium wallichianum D. Don ex Sw., G. robertianum L.,G.

polyanthes Edgew., Hypericum hookerianum Wt. et. Arn., Halenia elliptica D. Don, Inula grandiflora Willd., Impatiens glandulifera Royle, I. thomsoni

Hook. f., Galium aparine L., Morina longifolia Wall ex DC., Nomocharis oxypetala (Royle). I. thomsoni Hook.f., Galium aparine L., Morina longifolia

Wall. ex DC., Nomocharis oxypetala (Royle) E.H. Wilson, Pedicularis pectinata Wall. ex Benth., Prunella vulgaris L., Polygonatum multiflorum (L.)

All, Parochetus communis Buch. Ham.

Ex Don, Primula denticulata Sm., P. muneroli, Potentilla arbuscula D. Don, Roscoea alpine Royle, Smilacina purpurea Wall., Salvia hians Royle ex.

Benth., S. nubicola Wall. ex Sm., Stellaria himalayensis Majumdar, Senerio alatus Wall. ex DC., S. rufinervis DC., S. graciliflorus DC., Trillidium

govanianum (D. Don) Kunth, Viola biflora L. etc.

Swan (1967) indentifies two parts of alpine zone above timber-line, namely lower alpine zone ranging from 3000 m (c) to 4000 m (c) a.s.i. and higher

alpine zone (3000-5000 m.a.s.i.) are characteristically marked by plant species. Grasses and sedges are dominating members of alpine vegetation at

lower altitude but they are characteristically replaced by non-grassy dwarf plant species at higher altitudes (near snow-line). The species reaching

maximum altitude in this part of Himalaya is Christolea himalayensis (Singh 1956).

Plant species demarcating higher alpine zones (4000-5000 m.a.s.i.) are Arenaria glanduligera Edgew., Saussurea bracteata Done, S. chthonocephala

Barnm., S. gossypiphora D. Don, S. simpsonia (Field & Gardn.) Lipsch, Saxifraga jacquemontiana Dcne., Sedum imbricatum (Edgew.) Walp.,

Thylacospermum caesitosum (Camb.) Schischt. etc. Most of the plant species growing in higher alpine zone are densely hairy which may be in

response of higher ultraviolet radiation at these altitudes (Mani 1973). In a similar way lower alpine zones (3000-4000 m.a.s.l.) are characteristically

marked by a number of plant species such as Aconitum atrox (Bruhl.) Mukerjee, Megacarpaea polyandra Benth., Meconopsis aculeata Royle,

Pedicularis spp. Potentilla spp., Trollius acaulis Lindl etc. commonly associated with grasses.

In the alpine zones the onset of summer initiates an increase in temperature, high solar radiation and melting of snow cover. During month of May,

some exposed areas of lower alpine zones become free from snow and flowering is initiated. Plants flowering immediately after snow-melt are

Gentiana spp., Oxygraphis polypetala (Royle) Hook. f. et Thoms., Primula spp. and Ranunculus spp. Infact these plants have preformed flower

primordial and even flowers, and when snow melt they immediately bloom and fruiting is preceded soon. Soon after flowering is noticed in Anemone

spp., Bergenia strachey (Hook.f.et. Thoms) Engl., Caltha palustris L., Corydalis spp., Fritilaria spp. Gagea elegans Wall. ex. D Don, Lloydia seritina

(L.) Reich., Rhododendron campanulatum D. Don, R. lepidotum Wall. ex G. Don, Thlaspi cochleariforme DC., T. andersonii (Hook. f. et Thoms)

Schulz, the species growing in shady places show slightly delayed flowering.

During June and early July, flowering in alpine zones is dominated by Arnebia benthamii (Wall ex.G. Don) Johnston, Anaphalis spp. Caltha palustris

L., Cassiope festigiata (Wall.) D. Don Fritilaria spp. iris kumaonensis D. Don ex Royle Lloydia spp. Oxytropis lapponica (Wahb.) Gay, Ponerorchis

chusua (D. Don) Soo, Ptentilla microphylla D. Don, Nomocharis nana (Klotz) Wilson N. oxypetala (Royle) Wilson, Polygonatum sppl, Rhododendraon

campanultum R. hypenanthum Balf. F. etc.

In the month of August maximum species can be perceived flowering. Plants dominating the bloom in alpine meadows are: Acomastylis elata (Wall.

ex. Royle) Bole f., Aconitum atrox (Bruhl) Mukerjee, Anaphalis spp., Aster spp., Angelica glauca Edgew., Cyananathus spp., Campanula spp.,

Corydalis spp., Cremanthodium arnicoides, Cynoglossum spp., Dactyforhiza

hatagirea (D. Don) Soo., Erigeron spp. Epilobium spp., Gentiana spp.,

Geranium spp., Impatiens sp.., Leontopodium spp., Meconopsis aculeate Royle, Parnassia nubicola Wall ex Royle, Pedicularis spp. Potentilla spp.,

Pleurospermum spp., Polygonumspp., Rheumspp., Salvia spp., Swertia spp., Saxifraga spp., Saussurea spp., Sedum spp., Senecio spp., Thymus lineris

Benth etc.

In late September to October temperature decreases rapidly and most of the plant species undergo senescence except Cyananthus spp., Saussurea

spp., etc. Few plants like Oxygraphis Polypetala Potentilla microphylla, Ranunculus spp. reflower at the end of season.

Bright coloured flowers are remarkable features of alpine flora. The most abundant colours are red, blue, white and yellow. Mosaics of different

colours are formed by bright coloured flowers. Anemone spp. are while and impart white colour to the meadows with their splendid bloom, Potentilla

spp. and Acomastylis elata torm yellow patches, while Genetiana spp., Impatiens spp. and Polygonum spp. form blue, pink and red mosaic,

respectively, in alpine meadows. In the short span of favourable climatic conditions an alpine plant has to survive and reproduce successfully and

brightly coloured flowers signify the role of insects to insure successful pollination.

A remarkable feature of alpine plants is their habitat specificity. Utricularia orbiculata Wall. ex DC., U. striatula J.E. Smith, Chrysosplenium tenellum

Hook.f.et. Thom., Ranunculus hyperboreus Hook.f. grow with mosses at moist shady sites. Some plants like Camanula argyrotricha Wall. ex DC.,

Cicerbita cyanea (D.Don) Beauv., Sedum imbricatum. S. quadrifidum Pall, Potentalla eriocarpa Wall. ex Lehman, Bergenia stracheyi (Hook. f.et

Thoms) Engl. can be recorded growing on dry rocks and rock crevices only. Primula reidii Duthie, Chrysosplenium tenelium Hook.f.et Thoms.,

Saxifraga ramulosa Wall., S. cernua L., Circaeaster argestis Maxim. Grow in shady places.

In the alpine zones specially in lower alpine zones (3000-4000m) grasses and sedges grow in the form of grass tussocks. Danthonia cachemyriana

Jaub. & Spach., Danthonia schneidri Pilger., Deyeuxia pulchella (Grieseb.) Hook. f. are common examples. Carex spp. also grow with tussocks of

grasses. This tussock forming feature of alpine grasses and sedges has some adaptive advantages (Hedberg 1973). Kobresia duthieiCI., K. nepalensis

(Nees) Kuk., K. nitens CI. Form dense tussocks at higher elevations in shady and moist places.

A considerable number of alpine plants possess fleshy and succulent habit in alpine environment. Some of the examples are Arisaema intermedium Bl.

Var. intermedium, A. jacquemontii Bl., Caltha palustris L., Cremanthodium arnicoides forma maximowiczii R. Good, Ligularia amplexicaulis DC., L.,

arnicoides DC., L. sibirica, Megacarpaea polyandra Benth., Podophyllum hexandurm Royle, Rheum spp., Saxifraga asarifolia Stemb., S.

jacquemontiana Decne, Sedum Ewersii Ledeb., S. imbricatum (Edgew.) Walpers, S. rosulatum Edgew., S. linearifolium, Hippuris vulgaris L.,

Impatiens glandulifera Royle, Saussurea Obvallata (DC.) Edgew. Etc.

In the alpine habitat time available for a plant to grow and reproduce successfully in quite limited, ranging from 20 weeks (at 3000 m.a.s.l.) to 8 weeks

(5500 m.a.s.l.) only. In such condition an alpine plant must show a high degree of resource exploitation because resources are limiting in both energy

and nutrients. Sexual reproduction via a seed or by the growth of a new tiller is usually several thousands times costlier than vegetative reproduction.

Alpine plants have adjusted to such environmental limitations by evolving herbaceous perennial nature. Majority of the alpine plants perennate by

means of roots, rootstocks, runners, bulbs, bulbils, rhizomes and suckers. A few annual plants like Circaeaster argestis, Polygonum delicatulum, P.

filicaule, Elsholzia strobilifera propagate by means of seeds showing that even this mode of survival is possible in alpine habitat. Some plants like

Polygonum viviparum L., Thalictrum chelidonii Wall., Saxifraga brachypoda D. Don. Saxifraga gragulifera H. Smith., S. stenophylia Royle etc.

reproduce asexually by means of bulbils. Some plants like Saxifraga brunonis Wall. ex Seringe, S. mucronulata Royle, S. stenophylla Royle, Androsace

Sarmentosa Wall., A. primuloides (Hook.f.) Dubby develop runners from lower part of stems bearing bulbils at the tip which develop a new plant at

some distance from parent plant. In viviparous alpine bistort Polygonum alpinum bulbils grow on lower part of flowering stalk while reproductive

flowers are borne on upper part of flowering stalk. On account of its dual mode of reproduction it is highly successful species in arctic (Crawford

1989) and also in alpine zones of Garhwal Himalaya.

15) In article written by learned author Shri B.S. Aswal, under captioned â??High

Altitude Flora of Western Himalaya : Peculiarities and

Conservationâ?? has made following pertinent observations qua meadows in Uttarakhand:-

The â??Himalayaâ?? (certainly not Himalayas as often but quite erroneously spelt) is the name applied in ancient India to the great snowy range of

mountains, visible in fine weather from the plains of North India (Mani 1978). The Himalaya represents the largest mountain chain covering

approximately one millon sq km in surface area and occupying a length of over 2500 km nearly east-west and consisting of complex topographical

features, naturally presents a wide variety of climate, soil and consequently supports a remarkable assemblage of vegetation types.

The Western Himalaya is one of the well-defined and better known phytogeographical regions of the Indian subcontinents. Hooker (1906) recognized

the Western Himalayan botanical province as extending from Kumaon to Chitral. It includes the States of Jammu and Kashmir, Himachal Pradesh

and Garhwal and Kumaon hills of Uttar Pradesh. However, Mani (1978) and Rau (1974) have further subdivided it into North West Himalaya,

comprising States of Jammu and Kashmir and Himachal Pradesh, and Western Himalaya comprising hilly tracts of Uttar Pradesh (Garhwal and

Kumaon).

The lotty snow clad peaks, vast river system, varied topography, climate, soil, different vegetational types. Important religious shrines and beautiful

tourist resorts of West Himalayan mountains have remained the source of allurement and inspiration for people from all walks of life since time

immemorial. In this Himalayan region, there is a zone where vegetation is dominated by herbaceous taxa, is known as high altitude or alpine zone. The

lower limit of high altitude has been arbitrarily taken as 3300 to 3600 m above sea level, because on account of the widely different conditions that

prevail in the different parts of Western Himalaya, it is very difficult to say at what altitude the high altitude flora begins. In Kashmir, where the

glaciers descend to lower levels, alpine flowers may be seen at altitude of 3000 m or less. The upper limit for plant life is seen upto 5500 m, though,

exceptionally, few plants may occur even upto 6000 m or more. The record for Western Himalaya is perhaps held by Christolea himalayensis, a

specimen of which was collected at an altitude of 6300 m by Gurdial Singh during

the Mt. Kamet expedition of 1935, Other angiosperms which are

occasionally met above 6000 m are species of Androsace, Arenaria, Saxifraga, Sedum and Waldheimia glabra.

The fascinating high altitude flora of Western Himalaya has attracted worldwide attention of numerous professional botanists, doctors, surgeons,

engineers, surveyors, foresters, administrators, tradesmen and naturalists to explore its vegetational wealth for more than 150 years ago, resulting the

flora being well known by the end of 19th century. Burkill (1965) and Wadhwa (1978) have given a comprehensive accout of the botanical history of

the West Himalaya. However, a brief account of botanical activity in the high Western Himalaya is presented here.

Thomas Hardwicke was perhaps the first to collect plants in the interior of the Himalaya, in the Alaknanda valley in 1796. He was followed by many

others. In Kashmir, Jacquemont, Baron von Huegel, Vigne, Falconer, Winterbottom and Thomas Thomson collected extensively in the first half of

19th century. Royle also sent his collectors to Kashmir. Royleâ??s Illustrations of the Botany of the Himalayan Mountains and of the Flora of

Cashmereâ?? in 1839 was an outstanding contribution of this period. During the second half of 19th century, significant collections were made by

Clarke, Duthie and his collectors. In Ladakh and adjacent area, the Schlagintweit brothers and Stoliczka made collections. During this period several

collections were made by Officers attached to political missions, boundary commissions and relief expeditions.

The Himachal Pradesh received numerous visitors, among which the names of Gerard brothers, lnglish, Trail, Williram Hay, Edward Madden, Herbert,

Lt. Maxwell, Hoffmeister and William Moorcroft stand prominent in the first half of 19th century. In later years, Clarke, Lace and Gemmie collected

plants in Chamba. Rev. Jaeschke of the Moravina Mission collected extensively in Lahaul, an account of which was published by Aitchison in 1868.

The most attractive, perhaps, of all the sectors of the Western Himalaya from scenic, religious and floristic points of view is the portion between Sutlej

and Kali Valleys, bordering Nepal, had its first collector as Thomas Hardwicke in 1796. He was followed by Moorcroft, Trail, Londsay, Edward

Madden in the earlier years. The most extensive and perhaps the best collection to be made at any time in this sector was that of the two Survey

Officers, Strachey and Winterbottom, a list of which was published in 1882 (revised by Duthie in 1906). George Kind and Duthie also collected

extensively in the second half of the 19th century.

In addition to the collectors named above, specimens were also gathered by native collectors employed by Wallich, Falconer, Royle, Drummond and

Duthie, of which the names of Inayat (in Kashmir and Kumaon), and Harsukh (in Chamba) are the foremost. Hookerâ??s â??Flora of British

Indiaâ?? published during the closing quarter of the 19 century described all the plants known from the area at that time.

At the turn of 19th century, the initiative for plant collection passed on to forest officers, University teachers, botanical gardens and other institutions of

higher learning. Notable collections were made by Keshavanand in Kashmir, Bor in Lahaul, Osmaston in Kumaon and by other forest officers such as

Champion, Laurie and Parkinson. Late Shiv Ram Kashyap also made several visits to the inner Himalayan and adjoining regions in his Presidential

address to the Indian Science Congress Association in 1932. H.A.C. Gill, W. Koelz, R.R. Slewart and M.B. Raizada are other notable collectors of

first half of the present century. The hebarium of the Forest Research Institute, Dehradun (DD), housed all the early plant collections.

The plant exploration activity remained slow in the first half of the present century but it gained momentum with the reorganization of the Botanical

Survey of India and setting up of its Northern Circle at Dehra Dun in 1956. Since then the floristic work is being carried on by Northern Circle,

Botanical Survey of India, Regional Research Laboratory, Jammu, National Botanical Research Institute and Central Drug Research Institute,

Lucknow, regional stations of Central Council for Research in Ayurveda and Siddha, Kashmir, Garhwal and Kumaon Universities. Among the recent

collections, contributions of M.A. Rau, T.A. Rao, N.C. Nair, U.C. Bhattacharyya, B.D. Naithani from Botanical Survey of India, Dehra Dun, Y.K.

Sarin from Regional Research Laboratory , Jammu, A.K. Goel and S.L. Kapoor from National Botanical Research Institute, Lucknow, B.S. Aswal

from Central Drug Research Institute, Lucknow, P. Kachroo and his associates from Kashmir University, R.D. Gaur and his students, Late J.K.

Semwal and G.S. Rajwar from Garhwal Unversity, Y.P.S. Pangtey and G.S. Rawat (Wild Life Institute, Dehra Dun) from Kumaon University and

Prof. Som Deva from Dehra Dun deserve special mention. The significant publications appeared during the last four decades dealing with high altitude

flora and High Altitude Flowering Plants of West Himalaya (Rau 1975), Flora of Bashahr Himalaya (Nair 1977), Flora of Ladakh (Kachroo et al.

1977), Alpine Flora of Kashmir Himalaya (Dhar & Kachroo 1983), Flora of Chamoli District (Naithani 1984), Flowers of the Himalaya (Polunin

1984). Several new taxa, enumeratory lists, new distributional records and articles on medicinal, ethonobotanical, rare and threatened plants have also

been published in various Indian and foreign journals (see references).

The high altitude flora is generally considered to begin where the tree flora ends. This is also called the â??timber lineâ?? (Rau 1975). A fringe of

shrubs may be seen in some places and in others, continuous or scattered dwarf or gnarled trees may be present immediately above the tree line. In

the absence of tree cover, the vegetation is exposed to the fury of cold winds, blizzards and snow storms and as such the stunted trees often show a

characterstic wind-swept or snow-swept appearance. Birches, Rhododendrons and Willows, among others may be seen in such situations. The high

altitude Conifers like species of Abies, Picea, Cedrus, and Pinus reach their highest limit at altitudes around 3500 m.a.s.i. The broad leaved trees like

Quercus semecarpifolia and Betula utilis which are often found in association with conifer forests, also reach this altitude. Above 3500 m., Betula utilis

is found in pure stands or in association with Rhododendron campanulatum in many localities. The prominent shrubs found in high altitude zone are

species of Berberis, Myricaria, Lonicera, Juniperus, Rhododendron, Rosa and Salix. In the drier inner valleys where the vegetation is of a scrub type,

the chief components are species of Artemisia, Astragalus, Caragana and Ephedra. In exteme north-west Garhwal, in Lahaul-Spiti, Ladakh and in the

interior of Sultaj valley, where the rainfall is very scanty, the vegetation closely resembles to that of the Tibetan highlands. Topography and disposition

of the slopes are important factors in determining the composition and extent of distribution of the slopes are important factors in determining the

composition and extent of distribution of the shrubby species. In northen Kumaon, for example, Rhododendron anthopogon, a strongly aromatic shrub,

is particularly common on the northern slopes whereas the vegetation on the southern slopes is more dry in nature, which is evident with the presence

of species of Cotoneaster, Ephedra, Juniperus and others.

The flora above tree line is herbaceous in nature and the high altitude valleys, slopes, marshes, moraines, meadows and pastures present a spectacular

display of multi-coloured flowers during the summer months, the alpine herbs are mostly perennial and show well marked preference for altitudes.

They also exhibit a very interesting cycle of growth. Refering to â??Valley of Flowersâ?? in Garhwal, Smythe (1938) has written â??in the

Bhyunder valley, I saw ground that was so closely packed with fritilarias that it seemed impossible that other plants could grow, yet when the fritilarias

has had died down, they were succeeded by other plants such as Potentilla, which grow equally densely. And this cycle persisted throughout the

summer, one plant being replaced by another with perfect precisionâ?. Smytheâ?? s observations are true for many localities. At high altitude, with

the melting of snow late in May or early in June, a profusion of early summer flowering plants appear, among them, several Crucifers, Primulas,

Anemones and Saxifranges and later in summer and towards autumn appear the Gentians, Swertias and others with SAussureas attaining their best

development late in autumn.

Several plants that grow in high altitude, survive in extreme climatic and ecological conditions by adopting strange appearances, interesting modes of

perennation and special morphological features. The commonest adaptations seen are cushion habit, development of spines, wool and fleshy leaves. In

arid zone of West Himalaya particularly in Ladakh, Lahaul-Spiti, Kinnaur, Gangotri and Niti area of Garhwal, the spinescent cusions are formed by the

species of Arenaria, Astragalus, Caragana and Acantholimon lycopodiodes. Species of Andorsace, Arenaria, Draba, Paraquilegia, Saxifraga and

Sedum form soft cushions with rosette arrangements of leaves. These plants bear attractive flowers in addition to their interesting vegetative habits.

The rigid mat forming plants are also common and are represented by the species of Arenaria, Asstragalus, Cassiope, Cotoneaster, Gautheria,

Oxytropis, Polygonum, Silene and Stellaria.

Â

Thylacospermum caespitosum, a member of Caryophyllaceae and Saussurea sudhanshui, recely described from Nanda Devi (Hazra 1983), from large

hemispheric mcunds or health like clumps on exposed rock faces on alpine

passes. Saxifraga flagellaris (sensu lato) is another significant plant with

numberous thread like surculi radiating from the basal rosette of leaves. At their tips, the surculi bear buds which serve for propagation. Pinguicula

alpine, the insectivorous plant popularly known as butterwort and Balanophora involucrata, a root parasite are of great morphological interest.

The most curious of high altitude plants are species of Saussurea and Soroseris, in which development of profuse wool on the vegtatative and floral

parts is striking. Some species of Anaphalis, Androsace, Arnebia, Gerbera, Leontopodium, Thermopsis, Waldheimia and Tussilago farfara are also

characterized by soft white or brown haris, but do not attain extensive development of wool as in the species of Saussurea and Soroseris (Saussurea

gossypiphora, S. gnaphaloides, S. simpsoniana, Soroseris glomerata).

The famed Himalayan blue poppy (meconopsis aculeate) Braha Kamal (Saussurea obvallata), Phen Kamal (Saussurea simpsoniana), Lady slipper

orchid (Cypripedium himalaicum), large thistles (Cousinia thomsonii, Morina culteriana, M. longifolia), Columbines (Aquilegia fragrans, A pubiflora),

larkspurs (Delphinium cashmirianum), Himalayan edelweiss (Leontopodium himalayanum) and species of Aconitum, Gentiana, Gentianella, Epilobium,

Oxygraphis, Pleurospermum, Primula and several other beautiful alpine gems adorn this sector and attract travelers at a glance.

The west Himalaya mountins have been the source of cultural, spiritual, physical and biological wealth, of which biological wealth is predominant.

These mountains have been a potent source of a variety of medicinal plants since the beginning of human civilization. The efficacy of the medicinal

plants growing here is perhaps as old as these mountains itself. The therapeutic value of some of these plants are mentioned in the oldest Hindu

scriptures i.e. Rigveda, which is said to be the source of ancient medicine, the system of Ayurveda, Charaka also describes the Himalaya as the best

habitats for medicinal herbs. Of about 3000 vegetable drugs incorporated in the Ayurvedic Materia Medica, a large number of which occur in the

Himalaya.

During last four decades, the modern system of medicine has established its lead over the indigenous system, with the result some wonderful allopathic

drugs have been discovered to treat several diseases. But offenly it is observed that some of these drugs used for common ailments leave side effects.

Therefore, keeping in view the various harmful side effects and other metabolic reactions caused by synthetic drugs and antibiotics, the Western

countries are inclined towards the usage of herbal drugs, which are considered safe and without side effects. In recent years, the search for safe and

new therapeutic agents from plant sources, great interest has been aroused in the medicinal value of Himalayan plants, as the crude drugs fetch high

prices, particularly in the foreign markets. This has resulted in plant collectors combing the inner valleys and heights for these plants, and the removal

of such plants in bulk quantity from their natural habitats has caused serious threat to their survival. The â??habitatsâ?? is threatened further by

landslides, erosion, avalanches, road construction, mountaineering, tourism and grazing by sheep, goats, buffaloes and other domestic animals. And it is

an acknowledged fact that is such heavy gathering and destruction of medicinal plants are continued, the time is not far when these plants will become

scarce of disappear from their natural habitats. This will not only a set back to the drug industry, but also result in the non-availability of safe plant

based drugs for humanity. Some of the important medicinal herbs, exploited for sale from high altitudes are â?" Aconitum heterophyllum (Atees). A

ferox (Bish), Angelica glauca (Chora), Arnebia benthami (Balchari), A euchroma (Balchari), Bergenia stracheyi (Pashanbhed), Corydalis govaniana

Kurroo (Karu), Hyoscyamus niger (Khursani) ajwayan), Jurinea macrocephara (Dhoop), Nardostachys jatamasni (jatamasi), Picrorhiza kurrooa

(Kutki), Podophyllum hexandrum (Papra), Rheum emodi (Dolu, Archa), R.webbianum (Dolu, Archa).

In recent years, the biotic pressure on land resources has increased many folds, resulting the destruction of flora and fauna on a large scale. The biotic

pressure, coupled with erosion, landslides, floods and avalanches have caused a considerable damage to the flora and vegetation of high altitudes

during the last four decades.

The impact of man and his domestic animals on the vegetation is seen every where. The opening of the interior high altitude valleys by constructing

roads and bridges for developmental purposes has brought about a significant change in the landscape. The introduction of willows and cultivation of

crops, vegetable and other commercially useful herbs in the high altitude areas have not doubt improved the economy of the local inhabitants but

simultaneously the increasing activity of man and his domestic animals are resulting in the rapid deterioration of high altitude ecosystem.

Overgrazing of high altitude pastures by sheeps, goats and buffaloes is an equally important factor responsible for change in the composition of the

vegetation complex. They cut the palatable species and their movement caused physical injury to young seedings and saplings and in due course of

time, the pastures deteriorate due to replacement of the palatable species by weeds and grasses. The recent example is the introduction of parthenium

hysterophorus, a noxious weed in the high altitude valleys and slopes.

The present awareness about the harmful side effects of modern synthetic drugs and antibiotics to human system, great interest has been aroused in

search of safe and new drugs from plant sources. And the over exploitation of medicinal plants has created their scarcity in the nature.

The vegetation is also affected by mountaineering and tourism. The author observed in holy shrines of Badrinath, Kedarnath and Gangotri, bunches of

Brahmakmal (Saussurea obvallata) are being kept in shops for sale, because they are offered in the temples. Several herbs with beautiful flowere are

plucked by tourists just for fun.

The magnificent flora of high altitude is shrinking day by day due to aforesaid activities. Therefore, the author suggests the following points for the

conservation of high altitude west Himalayan flora.

1. Considering that the high altitude abounds in a wide variety of medicinal, aromatic and botanically interesting plant species, it is suggested that

systematic survey of its flora should be made as early as possible and comprehensive manual should be published for proper exploitation of plant

resources.

2. The grazing by sheep, goats and buffaloes, etc. should be banned or if this not possible, then it should be strictly restricted.

3. Mountaineering and tourism should be restricted and it should be banned in high altitude valleys with rich diversity of medicinal and other economic

plants.

4. The plant resources of the Himalayan region are under the control of State Forest Department, Forest acts are in operation, and permits are issued

for their collection and exports. The author observed during survey work that due to shortage of staff and magnitude of the vast areas involved, the

protection is not much effective. Further, most of the forest staff do not even recognize the flora under their forest division with the result, illegal

collection and exploitation has posed a serious threat to their survival. Therefore, it is suggested that every forest division should have a herbarium of

important medicinal, rare, threatened and botanically interesting plants found in their forest division for reference.

5. The exploitation of medicinal plants should be limited and it should be done only through Government/Public sector.

6. The high altitude housed a large variety of plants whose medicinal value is yet unknown. Therefore, attempts should be made to evaluate their bio-

chemical properties with a view to develop new or better drugs or lead molecules from them.

7. Efforts should be made to develop newer and better varieties of medicinal and economical plants and also better processing technologies to make

the industrial processing and extraction more commercially feasible.

8. Since the individual protection to any plant species is not practicable, therefore, certain import high altitude valleys and meadows with rich plant

heritage should be declared as high altitude National Parks/Sanctuaries. And the important medicinal, rare and threatened plants should be introduced

in these Parks/Sanctuaries for in-situ conservation.

9. The important of medicinal, rare, threatened and other economic plants be made aware to the local people and tourists by popularizing them through

posters, cards and stamps. They can also be grown around religious places, tourist bangalows, forest and PWD rest houses for their familiarisation

and conservation.

10. There is an urgent need of setting a Drug Research Institute cum Factory in the Western Himalaya. The institute will carry out research and

manufacture of drugs based on raw materials available in the Himalaya. This will promote the cultivation and conservation of medicinal plants and will

also boost the economy of the hill people.

16) In article written by learned author Shri G.S. Rawat, under captioned â?? Protected Areas and Conservation of Rare Endemic Plants in the

Himalayaâ?? has made following pertinent observations with regard to Himalayan meadows:-

There are 16 National Parks (NPs), and some 60 Wildlife Sanctuaries (WSs) in

the Himalayan region of India covering about 6 per cent of its

geographic area. Wildlife Institute of India, in its revised Biogeography Report (1991) has suggested a total of 33 NPs and 88 WSs for the Himalaya

region so as to give wider bio-geographic coverage. Though most of these Protected areas (Pas) have broad conservation objectives, only pheasants

and large mammals have drawn the attention of conservationists so far. Endemic plants have not been attended to because of low priority and lack of

interest.

In this paper, I discuss the distribution pattern of some rare endemic plants in various Pas of the Himalaya. Out of about 10,000 taxa (species and

subspecies) of vascular plants reported from the Himalayan region, nearly 3500 are endemic. Of these, some 200 are critically endangered. In

addition, several more species, sub-species and varieties are reported every year adding to the list of neo-endemics. Important sites and critical

habitats in various biogeographic zones of Himalaya are indentified and conservation measures suggested.

The Himalaya, well known for their floral, faunal, cultural and scenic richness, comprise only about seven percent of Indiaâ??s land surface and yet

play a major role in shaping the Indian monsoon bestowing a tremendous life sustaining value to the Indian subcontinent. The growing need for the

conservation of nature and natural resources in these mountains have resulted into a few environmental movements (e.g. Chipko), and scientific

publications e.g. Singh (1985). Pangtey and Joshi (1988), and Guha (1989).

The establishment of several protected area (Pas) in recent years in Himalaya as well as other parts of the country (Rodgers & Panwar 1991) raises

hopes for the conservation of representative natural ecosystems. These Pas initially identified for certain indicator/threatened species of animals are

now getting wider scope for the conservation of overall biodiversity. Several workers have stressed the need for the conservation of overall

biodiversity. Several workers have stressed the need for the conservation of threatened flora in Himalaya e.g. Deva (1968), Sahni (1979), Jain and

Sastry (1980 & 1982), Pangtey and Rawat (1984), Rao and Hajra (1986), Hajra and Rao (1990). In addition, several seminars, symposia and

conferences held from time to time also have been focusing on this subject. But for the declaration of a few wildlife PAs, practically nothing has been

done in terms of plant conservation. The extensive list of threatened plants have been published by Botanical Survey of India (Nayar & Sastry 1987 &

1988) and several other botanists from universities and research institutions. The status reports about the individual species, are, however, lacking.

This means, no comprehensive guideline can be prepared by in-situ and ex-situ conservation of plant species. The protected area managers, therefore,

often face difficulty in making management decisions. This leads to controversy such as problem of Polygonum recurrence in the Valley of Flowers

National Park, Garhwal Himalaya.

In this paper, I intend to review the conservation status of rare endemic plants in Himalaya. The patterns of their rarity and endemism are discussed

along with their conservation status in and around the Pas. The critical habitats for plant conservation are identified in various eco-climatic zones and

conservation measures suggested.

The perusal of literature on Himalayan floristics reveals that nearly 10,000 taxa (including species and sub-species) of vascular plants exist in the

entire belt. Of this, nearly 30% taxa are said to be endemic to the region. The nature of rarity and endemism, however, varies from species to species

and group to group. According to palaeoclimatologist, the post Pleistocene orographic changes and subsequent glaciation in Himalaya created

numberous habitat types and thereby enriched its flora both by speciation as well as migration from adjacent floristic regions viz. Mediterranean, Sino-

Jaanese, Indo-Malayan, and Peninsular region. In this light, a few distinct patterns of rarity and endemism can be visualized in Himalayan region.

Presently there are 16 National Parks and some 60 Sanctuaries in the Himalayan Region covering about 6% of total geographic area. In addition,

some of the reserved forests in less populated areas do represent the natural vegetation and fauna of the region. Rodgers and Panwar (1991) have

suggested several more protected areas (in total 33 NP and 88 Sanctuaries) so as to optimize the biogeographic coverage. But the better protection is

mainly attributed to the control of poaching of wild animals to some extent. The exploitation of minor forest products e.g. subsidiary wild food plants,

bamboo, grass and other activities such a grazing and camping still continues in most of the Pas. These age old practices have been influencing the

distribution of plant species in some way or other, and some of the practices such

as commercial exploitation of rate medicinal herbs and unplanned

developmental activities have caused serious threat to some species.

Himalaya Pas which cover a large altitudinal range and have sizeable areas with limited human pressure harvour a great diversity of flora. The

number of species very depending upon the geographical location of the PA, e.g. Hemis National Park (Trans-Himalaya) with 4000 sq km area may

have 700 species while, Kedarnath Muskdeer Sanctuary (Western Himalaya) with ca 800 sq km. area has 2000 species. Similarly Nanda Devi

Biosphere reserve in Western Himalaya (1200 sq. km.) one of the lease disturbed areas also has about 1500-2000 species of vascular plants. The

degree of rarity and endemism of plants, however, vary considerably. The newly reported taxa from Nanda Devi e.g. Saussurea Sudhansui Hajra and

Carex nandadevica Hajra et Ghildiyal and several other taxa need detailed status survey. The valley of flowers NP (Western Himalaya) which

harvours about 7-800 species of flowering plants is supposed ot have lost the diversity in some parts of the valley because of profused growth of a

native plant Polygonum polystachyum. Casual observations in the Polygonum invaded areas reveal that a few interesting herbs such a Codonopsis

rotundifolia, Cyananthus sp. Angelica archangelica etc. mainly grow in association with it.

Detailed information on the dynamics of such communities and habitat reference of individual species in most of the Pas is lacking. Whereas, this is

time consuming process and more research will be needed to find the answers, identification of critical habitats and sites for plant conservation is a

must for the PA management. A few such areas in various ecological zones are discussed as follows.

The area between the Shivaliks and the great Himalayan range (elevation range c 1200-3500 m asl) represents this zone. This region is quite extensive

and varies in width greatly (more in the west and less in the east). There are basically two types of forest habitats viz. (a) Himalayan Dry Temperate,

and (b) Himalayan Moist Temperate Forests. Numerous stages of secondary succession do exist throughout.

This zone is rich in oaks (Quercus spp.) maples (Acer spp.), rhododendron (Rhododendron spp.), Himalayan bamboos (Chimonobambusa spp.), laurels

(Litsaea, Machilus spp.), conifers (Pinaceae), several epiphytic orchids, ferns, and

mosses (Sahni 1979). Many of these species are of great

conservation significance, some by their interesting pattern of endemism and others by their dwindling conservation status due to over exploitation

despite their importance in the socio-economic lifestyle of the local people.

Habitats that need immediate conservation action in this zone are riverine areas for, temperate oak forests, lime stone rocks, and vicinity of sulphur

springs.

The alpine habitats (alpine, scrub, alpine pastures, and cold deserts) usually start at timberline of the treeline i.e. 3500 m.a.s.l. and are characterized by

the complete absence of trees and lianas. The notable genera in this zone are Allium, Polygonum, Saxifraga, Astragalus, Primula, Gentiana, Carex,

Potentilla, Impatiens, Corydalis, and Saussurea all with more than 20 species each, Rawat and Purohit (1988), Hajra and Rao (1990), discuss more

about the conservation aspects of plant resources in this area. The glaciated valleys and high altitude lakes, and a few relict patches of stunted forest

(krummholz) above timberline are the critical areas for conservation in this zone.

Similarly, the transitional zones between Shivaliks and lesser Himalaya for species diversity and sparsely distributed species such as Pittosporum

eriocarpum, Talauma hodgsonii, steeper slopes for species like Catamixis brachariodes and Olax nana and shady-moist valleys in dunes for Rauvolfia

serpentina, Eremostachys superba, Diospyros embryopteris and several endangered Pteriodophytes.

Whereas, the existing and suggested Pas in all biogeographic provinces of the Himalaya represent the natural habitats for maximum species of flora

and fauna, planning the proper size and shape of Pas suffers due to lack of information on the specific habitats of rare endemic plants and permanent

loss of large areas due to unplanned developmental activities, settled and shifting cultivation, etc. Both in-situ and ex-situ conservation efforts for rate

plants will have to be continued even after the establishment of Pas. Listing of rare species which occur only out side the Pas or which occur in

secondary habitats would be a first step in this regard. In order to maintain habitat mosaic for rare species manâ??s interference may be needed in

some areas. Following are a few points of consideration for rare plant conservation in Himalayan PAs.

Prioritization of species (of national, state, and local importance) to be conserved.

Gene pool conservation for agriculture and horticulture by encouraging local people to protect and cultivate such species including medicinal plants.

Identification of â??Botanical hot spotsâ?? and Natual Diversity score cards of the Pas and threatened localities.

Conservation education to local people.

17) In article written by learned author Shri S.S.Samant, under captioned â??An Assessment on the Diversity and Status of the Alpine Plants of

Indian Himalayaâ?? has made following pertinent observations for meadows in Himalayas/Uttarakhand:-

The alpine plants listed in this paper are based on primary as well as secondary data available to the author on the alpine region of the Himalaya. At

present, a complete checklist of threatened plants for the Himalaya is needed after a through and careful assessment. This will enable to study the

conservation status of each species with reasonable confidence and this will also provide a basis for future management and monitoring by concerned

authorities.

The only way of ensuring the conservation of threatened plants can be made by habitat preservation and their cultivation in botanical gardens and in

other protected areas. Besides, legislation may be framed to allow the collection of these plants in the proper season especially those species which

are economically important. Collections of these plants in proper season will not only give sufficient time to dispersal of their fruits and seeds for

regeneration, but will also improve the quality of drugs which are at present collected at immature stages. The areas rich in rare, endangered,

threatened, vulnerable, endemic, indeterminate and economically important plants including their wild relatives of cultivated plants be declared as

Sanctuaries, Biosphere Reserves and National Palrs, where collections of plans must be strictly prohibited or regulated. Collections of particularly

scace and rare plant material commonly required for the calls room be widely distributed among the Schools, Colleges, Universities and Institutions so

that they may be able to appreciate the danger of over collection and destruction of natural habitats due to indiscriminate collections. Further, to create

awareness among the students of colleges, schools and Universities as well as local people and tourists, the posters cards and stamps of these rare

and endangered plants be widely distributed to make them understand the

importance and significance of these plants.

While making the conservation strategies and developing conservation techniques, detailed information on distribution, size and structure of population,

ecological needs, physiological tolerances, breeding system, pollination and dispersal ecology, germination competitively in the adult and seeding stages

and several other aspects of autecology are essentially required. To obtain an adequate information on these various aspects, both intensive and

extensive collections and surveys of potentially important areas is required and distribution maps of these plants be prepared. Such mapping would be

useful not only in the assessment of floristic wealth but also provide protection to the critical habitat and finally would keep a graphic record for

posterity. Finally the author whishes to say that sufficient skilled and knowledgeable manpower is needed to make the people of all walks of life aware

of the problems of management, monitoring, protection and laying out the policies together with financial and academic support. So that a detailed

checklist of these plants could be prepared.

18) In article written by learned author Shri K.S. Negi & Shri K.C. Pant, under captioned â??Sustenance of Central Himalayan Vegetational Wealth

at the Brink of Depletionâ?? has made following pertinent observations :-

The paper presents the variability /diversity available in crop germplasm and the uses of less-known economically wild plants of Central Himalaya of

Uttar Pradesh. A total number of 25 plant species mainly used as edible and medicine have been described, giving botanical, local names, places of

occurrence, brief description, use and voucher specimen number.

Central Himalyaâ??s importance as a centre of agricultural crop genetic diversity has been recognized only recently by National Bureau of Plant

Genetic Resources, New Delhi and established a regional station- Bhowli, district â?" Nainital, Uttar Pradesh in 1986. Survey of sub-tropical

areas/foot hills, temperate forest, alpine zones/valleys/mountainous parts, cold arid zones were undertaken for the collection in eight hill districts of

Kumaun and Garhwal region of Uttar Pradesh. Systematic collection work started in the region of N.B.P.G.R., by formulating a national plant for

plant germplasm collection for 10 years. Consequently 27 crop specific/area specific/multi-crop explorations both collaborative and individual were

carried out since 1985. A total number of 162 species of agri-horticultural crops

including indigenous cultivated medical plants and approximately 360

wild food plants/wild relatives of crop plants consisting the diversity on genetic wealth of U.P. Himalya and collected 3969 population

samples/primitive cultivars/landraces/wild species of crop plants/less-known and wild economically useful plants.

Numerous indigenous economically useful plant species both domesticated or semi-domesticated contains significant genetic diversity. Rich variability

also exists in conventional crops like Oryza Sativa (paddy), Phaseolus vulgaries (common bean), Vigna unguiculata (cowpea). Macrotyloma uniflorum

(horsegram). An urgent and immediate research attention in order to collect, describe and utilize the total genetic resources of these domesticated and

semi-domesticated species are needed.

Besides the popular apple, preaches, plums and walnuts, central Himalaya has an immense potential for its plants occurring in wild habitat such as

Diplokhema butyracea (Roxb.) Lamk. (cheura)-having multiple uses: fruits exible, flowers for honey and seeds for edible oil; Allium ampeloprasum L.

(Hargand), A. Auriculatum Kunth (Jamboo), A. cernuum Roth (Sidhum, Sikwa), A. Griffithianum Boiss. (Pharan Dunno), A. Wallichii Kunth (Gobka,

Lainka) used for spices and vegetables; Artocarpus lacucha Ham. (Dhau)- fruits edible; Asparagus adscendens Roxb.(Kairua)- young shoots as

vegetables; Bauchinia varegata L. (Kuiral)- buds as vegetable; Berberis sp. (Kingor)-fruits edible; Bombax ceiba L. (semal)- buds as vegetable;

Cleome viscose L. (Jakhya)- seeds as spices; Citrus medica L.(Madkakar)- fruits edible; Colocasia esculent (L.) Schott (Pindalu)-young shoots as

vegetable; Dioscorea belophylla (Prain) Voight ex Hains(Tarur)-roots as vegetable; D. bulbifera L. (Genthi)-bulbils as vegetable; Diplazium

polypodioides blume (Lingura)- unexpanded young fronds as vegetable; Elaeagrun Latifolia L. (Leuchadia)-fruits exible; Lapidium sativam L.

(Chamsoor, Haling)- used as spices and vegetables; Myrica esculenta Buch.-Ham. Ex D. Don (Kaphal)- fruits edible; Phytolacca acinosa Roxb.

(Jarg, Jagroo)-young shoots as vegetable; Rubus elligpticus Sm. (Hissalu)-fruits edible; Rhododendron arboretum Sm. (Burans) used as salad and

colling drink/juice; Schileichera oleosa (Lour.) Oken. (Kusum)- fruits edible ; sSelinum wallichianu, (Dc.) Raizeda et Saxean (Thoyal)-young shoots

as vegetable.

Numerous other cultivated untapped plant species (protected, and naturalized) as well as wild relatives /less known plant species require attention for

both, the improvement and marketability. A few of these already secured a place in the market in recent years.

In the following enumeration, 25 less-known and wild economically useful plants are arranged alphabetically according to their botanical names,

followed by the locality and local names. Brief botanical description, season of flowering and fruiting, use as narrated by local informants and

collector/herbarium specimen number are provided.

19) In an article captioned â??Vegetation Dynamics and Animal Behaviour in an Alpine Pasture of the Garhwal Himalayaâ?, learned author has

stated as under:-

Vegetation dynamics and animalâ??s behaviour was studied in an alpine grazingland at Tungnath in the Garhwal Himalaya. A large number of

species of the area are dwarf-cushion herbs and most of them are distributed in mid-alpine belt. Yellow colour of the flowers is predominant. Hemi-

cryptophytes and chamaephytes are dominant life forms. Steep slopes are covered with tall grass Danthonia Cachymerana, whereas, the plateaus

show a predominance of forb species. Aboveground:belowground biomass ratio varied from 1:2 to 1:5 in different communities. A large proportion of

the net annual production is belowground. All communities are exposed to varying degree of biotic pressure. The plateau site dominated with dwarf

forbs was most heavily disturbed.

Animalâ??s choice for species selection, bite frequency, dry matter intake and movement on the ground vary from month to month and season to

season. About 50% of the herbage is exploited in grazing. Since the current grazing pressure is 3 times higher than the carrying capacity of the

pasture, I suggest deffered grazing as a major cause to manage this grazingland. This may save some palatable species from extinction. As the use of

alpine pastures in being increased day by day for diverse purposes, a more determined effort is needed to protect this ecosystem.

Keywords: Tungnath, Grazingland, Biomass-productivity, Carrying capacity, Management.

Introduction

In India, grasslands are created due to intense biotic interference in the natural

forests with the exception of alpine where environment severity limits

the arboreal growth. In the Himalaya, traditionally, almost every family (in villages) maintains 5-6 animals. For most of the animals, grasslands are the

only source of fodder at all altitudes. With continuous increase in animal population the pressure on the grasslands have increased beyond conceivable

proportion which as endangered their fate of existence. Overgrazing not only reduces grass cover but also deteriorates top soil by trampling which

washes away during rains. Therefore, these grasslands deserve immediate attention.

The grazing pressure is more severe in alpine pastures because of migration of graziers from lower altitudes. Despite an official band during recent

years on the movement of nomadic grazier on alpines, their (Gujjars) huge herd of animals are still reaching the remotest end of the alpine. In the

Himalaya, generally more animals are feeding on these pastures than they can carry. This has caused steady decline in the quality and quantity of

fodder, consequently animals become underfed and less productive. There is a need on the researches on conservation approach benefiting well to

both plants and animals to maintain their productivity with productive capacity of the land. Considering the importance of live-stock industries, which

are mainly based on pasture systems, there is a need of more determined efforts for proper utilization of grasslands so as a balance could be

maintained between herbage production, their exploitation and plant growth. This needs observation on the animalâ??s behaviour on the grazing land,

their forage requirement and availability of forage. Considering these facts a project was undertaken during 1987-88 in the Garhwal Himalaya and the

results are bring presented in the following pages.

Conclusion

Overgrazing of the pasture by huge herd of cattle of local inhabitants and migratory graziers in alpine as well as other areas of hill are main point of

attention. Grazing may increase aboveground productivity (if loss due to grazing is included). However, it decreases belowground productivity

(Sundriyal 1991). Productivity of particular grassland is nearly same from one year to another unless some environmental changes occur. Thus only a

constant number of animals can feed on the low aboveground production of alpines because a major portion of productivity is belowground. As the

grazing pressure increases beyond the carrying capacity, poor and coarser grasses with unpalatable forbs increased in number and dominance.

Besides, the flora and soil of the alpine become increasingly susceptible to injuries and other losses. This may cause major irreversible ecosystemic

changes including species extinction (Billings 1978).

Several approaches have been suggested for proper management of the grasslands in the Himalaya, which include control grazing, receding of

pastures, application of fertilizers and irrigation, introduction of legumes, 2-3 years of grazing rotation and total prohibition of pasture land from grazing.

But some of these recommendations seems to be theoretical rather than to have practical implication for the people of hills due to their specific socio-

economic status and also because grassland management programme will not solve their regulations, villagers interest in such approach is doubtful.

The area under grazing is fixed, so the grazing pattern must reconcile it. In alpines, graziers move from place to place, but this shifting is not fast

enoght to prevent overgrazing in certain places. So if land area could be divided into some parts with one or two years closure for grazing then

consumable energy can be increased upto optimum. As the present economy in high hills is mostly dependent on animals and their products, this can

be attributed to the rearing of a large number of animals by each family. This (rearing of animals) should be discouraged with suitable economic

replacement (what?). Further, number of grazing animals : grazing area ratio should be fixed family-wise and on the basis of grazing animals. This

must be supported by gathering quantitative information on available herbage, stocking rate and herbage intake by cattle. Perhaps more important task

is to educate local folk for careful, thoughtful, conservative and rational use of the grazing lands. Discussion with villagers and to include them in

conservation programmes can yield some fruitful results.

Presently the alpine zones in the Garhwal Himalaya are being used for herbivory, medicinal plant collection, skiing, hiking and to see the sceneric

beauty purposes. In the process plant resources are depleted. Such ativities are likely to increase in years to come. Therefore, a more determined

effort is needed to design the use-plan of the alpine. A good management plan acceptable to locals should be prepared to conserve plant resources in

the high altitude zones of the Himalaya.

20) In an article captioned â??Ecological Study in a Alpine Pasture of Bhagirathi Valley, Garhwal Himalayaâ?, learned author Mr. G.S. Rajwar &

Mr. Manoj Dhaulakhandi have stated as under:-

Abstract

An alpine pasture between Bhojbasa and Gaumukh in Bhagirathi valley of western part of Garhwal Himalaya was studied for phytosociology and

other ecological parameters. Aboveground and belowground biomass and its production were analysed for the months of July and August. The values

of total biomass for the month of July and August were 1776.2 and 1807.7 gm-2 respectively. The belowground biomass was higher than the

aboveground biomass in the present study. On the basis of importance values, the dominant species were Potentilla atrosan-guinea, Artemisia gmelinii,

Nepeta discolor, Stellaria sp. And Anaphalis Triplinervis. This alpine part also showed large populations of Ephedra gerardiana and Juniperus species.

Keywords: Alpine, Vegetation, Pasure, Ecology, Biomass, Himalaya.

Introduction

Garhwal Himlaya has been a centre of floristic as well as ecological studies in last seventy years. Duthie (1906) revised and supplemented the

catalogue of the plants of Kumaun and Garhwal based on the collection made by Strachey and Winterbottom during the years 1846-1849. Other early

contributions made in this part of Himalaya include Osmaston (1927), Dudgeon and Kenoyer (1925), Smythe (1938). Plants of the alpine pastures

were explored by Ghildiyal (1957), Rau (1961 & 1964), Semwal and Gaur (1981), Negi et al. (1985 & 1987-1988). Other floristic and ecological

studies in the high altitude areas of this region were made by Gupta (1964), Rau (1974 &1975), Mani (1978), Singh and Kaur (1980), Rajwar (1992,

1985 & 1987), Gaur (1984), Gupta (1986), Sundriyal et al.

(1987), Srivastava et al. (1988). The floristic patterns of higher altitudes of Garhwal Himlaya have also been described (Purohit 1977, Semwal et al.

1981, Rajwar 1985 & 1987).

The present study was carried out in an alpine pasture in a part of Bhagirathi valley of Garhwal Himalaya to assess its composition and

phytosociology. The biomass determination was, however, done for the months of July and August 1991.

Discussion

In alpine pastures, the emergence of vegetation takes place soon after snow melting in the beginning of May. Most of the alpine plants are perennial.

The perennation occurs through bulbs, rootstocks, rhizomes and suckers. These plants show vegetative growth (after sprouting), flowering, fruiting and

death of the above ground parts during May to October. Some of the species are early flowering, whereas, others late flowering. Early flowering

species flower up to the mid. August. Sprouting followed by fruiting starts from lower to higher elevation in May to June. Species of Ranunculus,

Primula, Gentiana, Stellaria, Polygonum and Anaphalis flower up to the end of July or mid. August.

The climate influences the live standing crop production (Bliss 1963 & 1966, Sims & Singh (1978). The moisture, temperature, radiation, snow cover

and winds are the major environmental factors governing the sprouting, growth and development of the plant populations. The edaphic factors,

however, are of secondary importance in the high altitudes (Mani 1978).

The present study site (Bhagirathi valley) in Western Garhwal Himalaya shows the alpine forests and lower alpine scrubs in the lower adjacent

elevations around 3400 m (timber line). The species of alpine scrub also occur in the alpine pasture. Ephedra gerardiana and juniperus species

exhibited satisfactory density in this area in contrast to their absence or rarity in other alpine zones lying in the Garhwal Himalaya (Rau 1974, Semwal

et al. 1981). The total biomass was higher in the month of August (807.7 gm-2) perhaps due to more vegetative growth and flowering in this month.

Contrary to this, the belowground biomass accumulation decreased in August (-1.7 gm-2 day-1). A similar decreasing trend of belowground biomass

accumulation was also shown by a study carried out at Panwalikantha alpine pasture for these months (Srivatava et al. 1988). The belowground

biomass in this alpine zone is more than the aboveground biomass and thus supports the findings of Gupta (1996), Srivastava et al. (1988).

21) In an article captioned â??Conservation Status of Himalayan Musk Deer and Livestock Impacts in Kedarnath Wildlife Sanctuary, Western

Himalayaâ?? learned authors Mr. S. Sathyakumar, Mr. S.N. Prasad, Mr. G.S. Rawat & Mr. A.J.T. Johnsingh have stated as under:-

Abstract

Conservation status of Himalayan Musk deer (Moschus chrysogaster) and the impact of livestock on its distribution and abundance was studied in

Kedarnath Wildlife Sanctuary (KWLS) by extensive surveys in different locations and an intensive study in the southern region of KWLS. The musk

deer estimates ranged between 1 and 4.1km2 and the mean density of KWLS is 2.81/km2. The mean density is expected to be representative of

KWLS and U.P. Himalaya. The available potential habitat of 293 km2 in KWLS would support 600 to 1000 Musk deer. Similarly, c 3000 km2 of

potential musk deer habitat in U.P. would support 5,200 to 11,700 Musk deer. Habitat destruction and poaching are the two major threats for Musk

deer. Habitat destruction is by removal of understorey vegetation and prevention of regeneration due to livestock (goat and sheep) grazing in â??tree

lineâ?? area and by collection of montane bamboo by the locals. Over 1 lakh goat and sheep use the â??tree lineâ?? areas in and around KWLS

during spring and summer months. Increasing livestock pressures have resulted in decreasing Musk deer densities (p). The livestock impact units

(LIU) calculated using the livestock population and their duration of stay alongwith the Alpine Pasture: Subalpine forested area ration are crucial

determinants of Musk deer abundance. Regulation of livestock use by setting a limit on livestock population, reducing their duration of stay and

rotational grazing are suggested as measures for reducing livestock impact on the vulnerable â??tree lineâ?? of Western Himalaya.

Introduction

The endangered Himalayan Musk deer (Moschus chrysogaster Hodgson) is a small, cryptic, deer like ruminant widely known for its exploitation by

man for â??muskâ??. In general, it inhabits the subalpine and alpine zones between the elevations of 2,500 m to â??tree lineâ??. In Western

Himalaya, Musk deer occur between 2,500 to 3,800 m. Musk deer is crepuscular or nocturnal, resting all day in dense undergrowth of the forests and

alpine scrub. They use the alpine pastures substantially but never venture far away from the â??tree lineâ??. Poaching and habitat destruction has

been largely affecting musk deer. Man, being an integral part of this fragile Himalayan ecosystem, has been exerting considerable influence on musk

deer and its habitat, yet there is virtual lack of information on the present status of Musk deer and how biotic pressures in the â??tree lineâ?? area

affect its abundance and habitat.

This paper presents our results on the conservation status of Musk deer and factors affecting their distribution and abundance in Kedarnath Wildlife

Sanctuary with special reference to livestock impacts. The study was conducted between March 1989 and November 1991.

Recommendations

We suggest the following recommendations for the efficient forest and wildlife management in the Western Himalaya:

Regulating the livestock use by setting a limit on the number of goat and sheep grazing a locality. This has to be done by considering the P:F ratio and

the carrying capacity of that area. Detailed studies on this aspect may be of much value and is of immediate necessity.

Rotational grazing (three year cycle) may be possible in areas where alternate pastures are available.

Duration of stay and use by livestock may be reduced to a maximum of four months particularly in the camps of the southern region.

22) In an article captioned â??High Altitude (above Timber-Line) Bryoflora of Kumaun Himalayaâ?, learned authors S.D. Tewari, Giribala Pant,

Saurav Joshi and Subodh Airi have stated as under:-

Abstract

Knowledge of the high altitude (above timber-line) bryophyte flora of Kumaun Himalaya is very fragmentary and many potentially interesting regions

are totally unexplored or very poorly known. Present paper gives an account of the bryoflora of some selected high altitude areas above timber-line

(3100 m) upto the alpine environs (4000 m), based on the collections made from a variety of substrates during the summers of 1982-90. In general, the

bryoflora above timber-line changes drastically both in species composition and luxuriance. The hepatic population was found comparatively poor than

that of the mosses. In all, 104 species of mosses from 66 genera belonging to 27 families and 42 species of liverworts from 33 genera spread over 21

families have been documented. Out of these, 2 mosses and 1 leafy liverwort are new records for India and 18 mosses and 3 liverworts emerge as

new additions to the Western Himalayan bryoflora. Distribution of each species has been presented. The association of mosses with decaying sheep

carcasses and the expected occurrence of Splachnaceous members have been

observed for the first time in India.

Introduction

â??The Himalayan region is Natureâ??s own botanical garden and primarily the greatest horticultural treasurehouse on earthâ??- Nigel Nicolson.

Apart from the greatest variety of flowers which bloom in an equally wide variety of growing conditions and habitats in various sizes, hues, shapes and

fragrances in the Himalaya, there is yet another realm. This is the world of mosses and liverworts (thalloid and leafy)- the epitome of luxuriance, the

â??standard of greenâ?. These tine, flowerless plants â??adorn, decorate and chequer the rocks without concealing themâ? producing the most

exquisite harmonies of colour-green mixed in hues of gold, white and grey passing into brown and black-all woven together and following the

unimaginable firmness of gentle growth. â??The worm frets them not, and the autumn wastes not. Strong in lowliness, they neither blanch in heat nor

pine in frost. To them, slow-fingered, is entrusted the weaving of the dark eternal tapestries of the hillsâ??.

In the Himalayan forests, the â??knotted limbs are padded and festooned with luscious moss; nothing is ever dry, everything is choked and stifled with

mossâ?. The whole sylvan scenario can be seen through â??waving curtains of mossâ? with â??bannersâ? and â??beardsâ? of mosses and leafy

Jungermanniales hanging from nearly every tree. Down underneath, there is again a â??mossy mattressâ? that retains the moisture and forms a

spongy bed from which â??everything grows and grows and growsâ?. Such is the beauty, luxuriance and significance of bryophytes in the Kumaun

Himalayan landscape. Their diversity and abundance can be observed in every type of habitat the whole year round from the foot hills upto the alpine

regions. Unfortunately the high altitude bryoflora of Kumaun Himalaya is least known. Very few workers have ventured to observe and collect in the

harsh and inhospitable high altitude Himalayan terrain (Duthie 1906, Kashyap 1929, Pande 1931, Chopra 1975, Tewari et al. 1982, Vohra 1983 &

1987, Nath 1985, Tewari, Bisht & Pant 1987, Pant 1989, Pant & Tewari 1989, Bisht 1990, Srivastava & Sharma 1990, Tewari et al. 1990, Tewari &

Pant 1991). To fill this wide gap in the bryofloristic knowledge of our highlands, one of us (S.D.T.) undertook several field survey/collection trips

during the summers of 1982-1990 to some selected high elecation areas in

Kumaun region of North West Himalaya. In the present paper, we have

mainly dealt with the bryoflora of alpine environs from and above timber-line (3100 m) up to the accessible height of 4000 m. This is based on the

collections made by S.D.T. from selected high altitude areas: Phurkia (3300 m), Pindari glacier (4000 m), Kaphani glacier (3300-3800 m), Madhari

(3100-3500 m) in Almora district; Rilkot (3300 m), Burfu (3500 m), Milam glacier (3900 m) and Namik glacier (3300-3800 m) in Pithoragarh district.

Conservation

The high altitude timber-line bryoflora is very interesting but has received least attention from bryologists due to the harshness of the terrain and

relative inaccessibility. It displays a rich bryo-diversity. Many taxa new to India and even to science may be lying hidden-shrouded in the mists of the

remote wilderness. There is an urgent need to explore, collect and study the exuberant, multilayered bryophyte flora of these magnificent Himalayan

heights before these large yet fragile â??blocks of diversity are lost without being studied scientificallyâ?? by man-made disturbances of their habitats.

23) In an article captioned â??High Altitude Forests with Special Reference to Timber Line in Kumaun, Central Himalayaâ?, learned authors Mr.

R.S. Rawal & Mr. Y.P.S. Pangtey have stated as under:-

Abstract

Studies conducted by our team and few others in the high altitude zones of Kumaun in Central Himalaya have been reviewed here. Study was mainly

conducted on the north-western sector of Kumaun lying with the source region of three rivers viz. Pindar, Sarju and East Ramganga. The forest

vegetation was analysed on 95 stands lying between 1500-3300 m altitude. In addition, the vegetation at timber line zone was surveyed extensively.

A total of sixty three species were identified from these forests and the patterns of community distribution were recognised with the help of gradient

analysis method. Along the altitudinal sequence, the high altitude forest vegetation could arbitrarily be differentiated into three distinct belts as-low

altitude belt (2600 m). Considerable variation in total tree basal area is characteristic

feature. In general, high basal area value (>40 m2 ha-1) in more than 50% forest stands indicates the high altitude forests have a potentiality to

support large forest biomass. The seedling/sapling density remained low

throughout the altitudinal range suggesting poor regeneration in these forests.

Preponderance of megaphanerophyte, vernal flowering, microphyll leaves, biotic seed dispersal and prevalence of deciduous tree species is

characteristic of these forests. An attempt has also been made to give preliminary account of the structure and composition of timber line vegetation in

this region of the Himalaya.

Introduction

The descriptive account of Himalayan vegetation is available (Champion & Seth 1968, Stainton 1972, Singh & Singh 1987 & 1992, Ohsawa 1986 &

1991 etc.). Among various classical works, Singh and Singh (1987 & 1992) particularly, provided a detailed description of Central Himalayan forest

vegetation. However, in most of cases much weight was given to the structure and function of forests in comparatively low altitudes (300-2500 m),

located at southernmost fringe (far from the main Himalayan ranges) of Kumaun Himalaya. The forest vegetation near to the main Himalayan ranges

and comparatively on higher elevations (1500-3300 m) remained less explored. A few studies were, however, conducted recently in these ranges

(Rawal 1991, Rawal et al. 1991, Adhikari et al. 1991, Bankoti et al. 1992) and some information has been generated.

The aim of this paper is to compile the existing information coupled with our own findings from different high altitude forests of Kumaun Himalaya.

The study also highlights the compositional and structural peculiarities of timber line vegetation.

In fact, the term timber line still needs an exact and precise definition. We used this term in a broader sense to represent the upper elevational zone of

forest growth. The term, in general, corresponds to â??Forest limitâ?? (Ohsawa 1990). Several studies have appeared on identification and

explanation of various ecological factors limiting tree growth at alpine or arctic timber lines (Shaw 1909, Griggs 1938, Daubenmire 1954, Klikoff 1965,

Bliss 1969, Wardle 1971, Troll 1973, Tranquillini 1979). Whereas, the vegetation patterns at timber line in different climatic regions of the world have

been reviewed (Wardle 1971 & 1974, Troll 1973, Ohsawa 1990).

Although, the major plant associating terminating at timber line zone in the Himalaya are known (Smith 1913, Schweinfurth 1957, Champion & Seth

1968, Stainton 1972, Shreshtha 1982, Puri et al. 1989, Singh & Singh 1992,

Ohsawa 1987 & 1990). Even then, the information is quite meagre and do

not exactly explain the patterns of vegetation at Himalayan timber line. Thus, we have attempted here to provide a basic information about the

vegetation composition and structure at timber line zone in Kumaun, Central Himalaya.

Conservation Problems in High Altitude Forests

As stated by Wilcove et al. (1986), that most of the worldâ??s temperate forests were cleared by man long before people noticed or cared. The

Himalayan temperate forests are no exception as bulk of human population inhabit in temperate zone. Excessive tree felling for timber and fuel wood,

establishment of cattle camps (creating artificial pastures), unplanned tourism and pilgrimage etc. have caused a tremendous pressure on high altitude

forests.

In general, the potential area of sub-alpine forests in the Himalaya is about 50760 sq. km, of which only 0.2-13% is forested (Gadgil & Meher-Homji

1986). During 1952-1976, a total of 1960050 ha forests has been lost from Indian Himalaya (Kawasa 1988) and the stipulated fuel wood consumption

rate from various sources is to be 549.4 kg Capita-1 year-1 against a sustainable forest biomass yield of 77.9 kg capita-1 year-1 (lves & Messerli

1989). This indicates that there has been a tremendous pressure on the remaining forests of temperate and sub-alpine regions throughout the

Himalaya.

Though, the precise data on the rate of lowering of natural timber line are not available, however, the expansion of artificial meadows in sub-alpine

forest zone due to deforestation and over grazing have affected the timber line adversely. It could be predicted, with the increasing human and cattle

pressure, the natural timber line in the Himalaya will further lower in subsequent decades and sub-alpine forests will be fragmented like the Shola

forests of Western ghats. In many areas of Central Himalaya, some sheltered oak-conifer and a few birch patches protected on account of religious

significance give such appearance. The main environmental problems directly related to the conservation of Himalayan timber line are as follows

(G.S. Rawat, WII, Dehrad Dun pers. Comm..).

- habitat degradation e.g. invasion of weeds.

- habitat fragmentation i.e. destruction of habitat and resultant isolation of remaining habitat patches e.g. creation of small forest islands in sub-alpine

zone.

- possible loss of species diversity and extinction of the regional rare flora and fauna e.g. removal of species like Aconitum heterophyllum, Juniperus

indica, Taxus wallichiana etc. from over exploited areas.

- failure of timber line tree species regeneration.

- transformation to alpine deserts.

Concluding Remarks

Forest vegetation of high altitude zones in Kumaun Himalaya could be divided into three arbitrary belts on elevational sequence viz. low elevation belt

(2600 m). Each belt has its own dominant types and consequently exhibiting the

peculiar composition. In general, most of the forests showed a close similarity with temperate forests of Kumaun in their qualitative and quantitative

characters. However, in certain cases they differed considerably. The forests of much higher elevations particularly showed characteristic differences

from the low elevation forests. The high tree basal area in most cases, suggested that the high altitude forests have a potentiality to support large

forest biomass. But on the other hand, the poor regeneration of seedling and sapling individuals throughout the zone indicated possible changes in

forest composition in future. The timber line in this region is unique in its position and structure. The floristic diversity at timber line zone is variable

according to the habitat conditions. Dominance of three distinct physiognomic types and higher percentage of deciduous tree species at timber line are

the interesting features. However, detailed analysis of forests and regeneration studies are needed and both extensive and intensive field studies at

timber line zone would be the major research areas in the Himalaya.

24) What emerges from the facts, enumerated hereinabove, is that there are world famous Bugyals/meadows in District Chamoli. The State

Government has not taken effective steps to conserve and preserve them. Construction of Fibre Huts in Bugyals is causing irreparable damage to the

environment and ecology of the area. The meadows are godâ??s grass-lands. No camping activity should be permitted on these grasslands. The

number of tourists visiting these Bugyals should also be restricted. The

commercial grazing should not be permitted. The State Government has

permitted the tourists to stay overnight in these huts. The Bugyals are the eco-systems in themselves. The damage caused to these Bugyals has led to

global warming resulting in melting of glaciers at an alarming rate. The State Government, till date, has not constituted any Eco Development

Committees to save the Bugyals. The Bugyals are the important feature of eco-system. Every effort should be made to save them from disaster. The

correspondence(s) have been exchanged between the functionaries of the State but on the ground, nothing concrete has been done to salvage the

situation.

25) In AIR 1997 Page 259 in the matter of â??Om Prakash Bhatt v. State of U.P.â??, the Division Bench of the Allahabad High Court has issued

the directions to the State Government to remove the Camp Tourist Resorts by State agency. Their Lordships have held that the Bugiyal belongs to

the people. It is an ecosystem in itself. Nature has tailored it. It is not for man to erode the sanctity of this area. It must be resumed to nature to

provide for whom it was meant; the sheep, the shepherd, the wild flowers, the micro-orgams and the plant and insect life below the turf and in the

shrubs at that altitude. The Division Bench has also highlighted the damage caused by use of plastic and non-biodegradable material which has been

brought into the hills. Further held that the High Courts would be in a better position to ascertain facts and to ensure and examine the implementation

of the anti-pollution laws where the allegations relate to the spreading of pollution or non-compliance of other legal provisions leading to the

infringement of the anti-pollution laws. Their Lordships have held as under: -

â??2. This petition by Om Prakash Bhatt and others was basically brought to Court as the residents of the hills, particularly of Garhwal, and more

particularly of the district of Chamoli, fell threatened by the invasion by State organisations and the erosion of the sanctity and the peace and

tranquillity of the bugiyal. Bugiyal, in Garhwal basically means meadows and pasture land which exists above a certain altitude in the mountains no

different than the alpine meadows of Switzerland and Austria. Closer to home the meadows at Khilanmarg above Gulmarg in Kashmirare called

marg"". The complaint to the Court was that these areas are pastura lands to the sheep and the shepherd. The submission was that the bugiyal is

basically an ecosystem in itself and this delicate balance between ecology and environment has to be understood and respected. It cannot be defiled

and the intricate balance of nature docs not suffer the presence of aliens on these pasture lands as it keeps away the sheep and shepher, thus,

disturbing the ecology. This living phenomenon may be watched but cannot be tread upon.

3. The complaint is that the Garhwal Mandal Vikas Nigam (hereinafter, in short, the Nigam) had put up pre-fabricated lodging houses as a hotel for

tourist on the slopes of a bugiyal which is below the peak of the temple of Tungnath. This has happened at Chopla. Tungnath incidentally, is accepted

and reported even by the State administration as one of the highest temples in India.

4. The next issue presented was that indiscriminate import of plastic and nonbio-degrad-able material is playing havoc with the environment of the hills

as each seasons plastic collects on the slopes of the hills to be covered by autumn leaves of one season and this exercise is repeated year by year with

plastic being sandwiched be-tween leaves preventing rain water from seeping and per polating into the hill slopes and causing another ecological

disbalance; the disappearance of little streams and water resources on which the hill people rely upon. This deposit of plastic materials also kills the

green life on the siopcs of the mountains.

5. The third aspect is about the tourist and trekking pilgrimage routes, where the tourist, the pilgrim and the trekker devoid of all civic sense with no

respect of the environment throw nonbio-degradable material on the slopes of the hills and the mountain routes are being littered with indiscriminate

evidence of deliberately created garbage. Besides on these mountain routes commercial activity, like kiosks and tea shops at places where they ought

not to be, lias been encouraged by the State ad ministration. Court's attention was drawn to the garbage strewn on the slopes of the hills right up to the

glacier of Gomukh and of man made deposits of synthetic and non-bio-degrad-able materials at the source of the river Ganga at above 14,000 feet.

Environmentalists have voiced concern on the receding glacier at Gomufch, the source of the river Ganga. A leading news agency reported that the

glacier at Gomukh was drying up. Discussion on this dangerous retardation of the glacier at Gomukh has even been broadcast on the British

Broadcasting Corporation. Today, as this matter is being considered by the Court, a national daily reports, summarised in effect, that the glacier at

Gomukh is receiving the harmful impact of spreading deforestation and urbanisation and ill mannered anti-environment recreational visits of city

dwellers to these regions. This newspaper highlights the worry of scientists of the glacier at Gomukh receding, reducing and shrinking. The 'warming

up' phenomenon is one factor, but this itself is related to many others.

16. The directions given to the Nigam, to withdraw occupation of its camp side on the slope of the bugiyal below the temple of Tungnath and above

Chopta are to be carried by this public sector state organisation running a hotel at this place. The Chairman and Managing Director of the

Organisation will ensure that the direction is followed and implemented by 31 March, 1997. Hereinafter hotels and tourist lodges will ensure following

the precautionary principle. There are several open patches made available by nature where barren terrain exists to take in tourist lodges provided

they are spread out widely. The Chief Conservator of Forests (Hills) for Kumaun and Garhwal can indicate the specific sites in consultation with the

village Panchayats.â??

26) In 1996 (1) SCC 774, in the case of â??Union of India & others vs. Kamath Holiday Resorts Pvt. Ltd.â?, their Lordships of the Honâ??ble

Supreme Court have held that Collector of Union Territory was obliged to obtain approval of Central Govt. before issuing order granting lease of site

in reserved forest area to respondent for putting up snack bar and restaurant to cater needs of tourists visiting the forest. That having not been done,

Collector was directed to send the proposal as approved by him, together with the objecftion of Conservator of Forests, to Central Govt. under Section

2 of the Forest (Conservation) Act, 1980 read with the Rules. Their Lordships have held as under:-

â??5. This assertion and interpretation as accepted by the High Court, in our view, was in the teeth of the clear applicability of the Act extending to

the whole of India except the State of Jammu and Kashmir. The Act was obviously meant to apply to Union Territories as well and not to the States

alone. And in the context, the expression â??other authorityâ?, as is evident from the above reproduction of the provision, is all-comprehensive and

far wide so as to include any authority concerned with the matter. Such authority

instantly being the Collector was thus required to seek approval of

the Central Government before passing orders under Section 2, consonant with the orders of the Central Government. Nothing of the kind was done

here. The High Court on that basis, erroneously though, approved the action of the Collector who had acted solely, without seeking the prior approval

of the Central Government.

6. We cannot agree with such view of the High Court and therefore have felt the need to substitute its order with the present one for it appears to us

that it is essential to marshal the priorities; instantly on one side those of the tourist department and on the other of the forest department. For this

purpose, Section 3 of the Forest (Conservation) Act, 1980 has envisaged the constitution of an Advisory Committee to advise the Government in the

matter of grant of approval under Section 2 and on any other matter connected with the conservation of forest which may be referred to it by the

Central Government. We assume that a Committee of the kind has been constituted. All current streams of thought lead towards protection of

environment and preservation of forest wealth. On the other hand there are demands in justification of other use telling on the forests. A balance

would have to be struck, in a cool and dispassionate manner.

7. As a way out, therefore, we direct that the proposal as mooted by the Collector and approved by his action, together with the objection of the

Conservator of Forests be sent by the former to the Central Government under Section 2 of the Forest (Conservation) Act, 1980 read with the rules

framed thereunder. The Central Government may on receipt of such proposal by the Collector act in accordance with the provisions of the aforesaid

Act and the rules and after obtaining advice from the Advisory Committee pass such orders thereon, which may be warranted in the facts and

circumstances, informing the Collector accordingly. The Collector shall thereafter abide by the orders of the Central Government. Let the entire

exercise be over within a period of three months from today. The appeal would stand disposed of with these directions. No costs.â??

27.) In 1997 (2) SCC 267, in the case of â??T.N. Godavarman Thirumulkpad vs. Union of India & othersâ?, their Lordships of the Honâ??ble

Supreme Court have held tha all on-going activity within any forest in any State throughout the country, without prior permission of Central Govt., must

stop forthwith. Their Lordships have also explained the term â??forestâ??. Their Lordships have held as under:-

â??4. The Forest Conservation Act, 1980 was enacted with a view to check further deforestation which ultimately results in ecological imbalance;

and therefore, the provisions made therein for the conservation of forests and for matters connected therewith, must apply to all forests irrespective of

the nature of ownership or classification thereof. The word â??forestâ? must be understood according to its dictionary meaning. This description

covers all statutorily recognised forests, whether designated as reserved, protected or otherwise for the purpose of Section 2(i) of the Forest

Conservation Act. The term â??forest landâ?, occurring in Section 2, will not only include â??forestâ? as understood in the dictionary sense, but also

any area recorded as forest in the Government record irrespective of the ownership. This is how it has to be understood for the purpose of Section 2

of the Act. The provisions enacted in the Forest Conservation Act, 1980 for the conservation of forests and the matters connected therewith must

apply clearly to all forests so understood irrespective of the ownership or classification thereof. This aspect has been made abundantly clear in the

decisions of this Court in Ambica Quarry Works v. State of Gujarat1, Rural Litigation and Entitlement Kendra v. State of U.P.2 and recently in the

order dated 29-11-1996 (Supreme Court Monitoring Committee v. Mussoorie Dehradun Development Authority3). The earlier decision of this Court in

State of Bihar v. Banshi Ram Modi4 has, therefore, to be understood in the light of these subsequent decisions. We consider it necessary to reiterate

this settled position emerging from the decisions of this Court to dispel the doubt, if any, in the perception of any State Government or authority. This

has become necessary also because of the stand taken on behalf of the State of Rajasthan, even at this late stage, relating to permissions granted for

mining in such area which is clearly contrary to the decisions of this Court. It is reasonable to assume that any State Government which has failed to

appreciate the correct position in law so far, will forthwith correct its stance and take the necessary remedial measures without any further delay.â??

28) In 2002 (10) SCC 606, in the case of â??T.N. Godavarman Thirumalpad vs. Union of India & othersâ?, their Lordships have held that tide of

judicial considerations in environmental litigation in India symbolizes the anxiety of courts in finding out appropriate remedies for enviromental

maladies. To protect and improve the enviroment is a constitutional mandate. It is a commitment for a country wedded to the ideas of a welfare State.

The trees, water, land and animals had gained important positions in the ancient times. Progress and polllution go together. Their Lordships have held

as under:-

â??23. Apart from the direct cost to business of complying with stricter regulatory controls, the potential liabilities for non-compliance are also

increasing. These liabilities fall into five general categories:

(a) Criminal liabilities

The number of criminal offences for non-compliance with environmental legislation is immense, and in recent years the regulation agencies have

shown an increased willingness to resort to prosecution. Private prosecution is also a possibility. Fines will be the normal penalty, though in a number

of cases sentences of imprisonment have been imposed (there is normally a potential personal liability for directors and senior managers). Maximum

fine levels have risen in recent years, as have actual levels of fines imposed.

(b) Administrative sanctions

In most regulatory systems there is a range of options available to the regulator, including variation, suspension or revocation of a licence. Since these

steps may lead to the closure of a plant, they are obviously of great importance.

(c) Clean-up costs

In most environmental legislation there is a power to clean up after a pollution incident and receive the cost from the polluter or (in some cases) the

occupier.

(d) Civil liability

There is growing interest in the toxic torts, although many of the actions have in fact been around for a long time. Many environmental actions rest

upon strict liability. Although liability may often be difficult to establish, the size of claims may be very high indeed.

(e) Adverse publicity

In practice the publicity attracted as a result of infringements of the law may be as costly as any direct costs.

24. The tide of judicial considerations in environmental litigation in India symbolizes the anxiety of courts in finding out appropriate remedies for

environmental maladies. At global level, the right to live is now recognized as a fundamental right to an environment adequate for health and well-

being of human beings. [See World Commission on Environment and Development â?" Our Common Future (1987).] To commemorate the tenth

anniversary of the Stockholm Conference, the world community of States assembled in Nairobi (May 10-18, 1982) to review the action taken on to

implement the Stockholm Declaration. It expressed serious concern about the state of environment worldwide and recognized the urgent need of

intensifying the effort at the global, regional and national levels to protect and improve it.

25. Progress and pollution go together. As this Court observed in M.C. Mehta v. Union of India9 when science and technology are increasingly

employed in producing goods and services calculated to improve the quality of life, there is a certain element of hazard or risk inherent in the very use

of science and technology and it is not possible to totally eliminate such hazard or risk altogether. We can only hope to reduce the element of hazard or

risk to the community by taking all necessary steps for locating such industries in a manner which would pose least risk of danger to the community

and maximizing safety requirements. As observed in the United Nations Conference held at Stockholm in June 1972, economic and social

development was essential for ensuring a favourable living and working environment for man and for creating conditions on earth that were necessary

for the improvement of the quality of life.

26. The tragedy of the predicament of the civilized man is that â??Every source from which man has increased his power on earth has been used to

diminish the prospects of his successors. All his progress is being made at the expense of damage to the environment which he cannot repair and

cannot foresee.â??

There is increase in awareness of the compelling need to restore the serious ecological imbalances introduced by the depredations inflicted on nature

by man. The state to which the ecological imbalance and the consequent environmental damage have reached is so alarming that unless immediate,

determined and effective steps were taken, the damage might become irreversible. In his foreword to International Wildlife Law, M.R.M. Prince

Philip, the Duke of Edinburgh said:

â??Many people seem to think that the conservation of nature is simply a matter of being kind to animals and enjoying walks in the countryside. Sadly,

perhaps, it is a great deal more complicated than thatâ?¦. As usual with all legal systems, the crucial requirement is for the terms of the conversions to

be widely accepted and rapidly implementedâ?¦. Regretfully progress in this direction is proving disastrously slow.â? (See International Wildlife Law

by Simon Lyster, Cambridge, Grotius Publications Ltd., 1985 Edn.)

29. To protect and improve the environment is a constitutional mandate. It is a commitment for a country wedded to the ideas of a welfare State. The

world is under an impenetrable cloud. In view of enormous challenges thrown by the industrial revolution, the legislatures throughout the world are

busy in their exercise to find out means to protect the world. Every individual in the society has a duty to protect nature. People worship the objects of

nature. The trees, water, land and animals had gained important positions in the ancient times. As Manu VIII, p. 282 says, different punishments were

prescribed for causing injuries to plants. Kautilya went a step further and fixed the punishment on the basis of importance of the part of the tree. (See

Kautilya III, XIX,

197.)

30. As observed by this Court in Rural Litigation and Entitlement Kendra v. State of U.P.10 natural resources have got to be tapped for the purpose

of social development but one cannot forget at the same time that tapping of resources has to be done with requisite attention and care so that ecology

and environment may not be affected in any serious way; there may not be any depletion of water resources and long-term planning must be

undertaken to keep up the national wealth. It has always to be remembered that these are permanent assets of mankind and are not intended to be

exhausted in one generation.

31. Academy Law Review, at pp. 137-38 says that a recent survey reveals that every day millions of gallons of trade wastes and effluents are

discharged into the rivers, streams, lakes and sea etc. Indiscriminate water pollution is a problem all over the world but is now acute in densely

populated industrial cities. Our country is no exception to this. Air pollution has further added to the intensity and extent of the problem. Every year

millions of tons of gaseous and particulate pollutants are injected into the

atmosphere, both through natural processes and as a direct result of human

activity. Scientists have pointed out that earthâ??s atmosphere cannot absorb such unlimited amount of pollutant materials without undergoing

changes which may be of an adverse nature with respect to human welfare. Man in order to survive in his planetary home will have to strike a

harmonious balance with nature. There may be boundless progress scientifically which may ultimately lead to destruction of manâ??s valued position

in life. The Constitution has laid the foundation of Articles 48-A and 51-A for a jurisprudence of environmental protection. Today, the State and the

citizen are under a fundamental obligation to protect and improve the environment, including forests, lakes, rivers, wildlife and to have compassion for

living creatures.

32. A learned jurist has said, the Rig Veda praises the beauty of the dawn (usha) and worships nature in all its glory. And yet today a bath in the

Yamuna and Ganga is a sin against bodily health, not a salvation for the soul â?" so polluted and noxious are these â??holyâ?? waters now.

â??One hospital bed out of four in the world is occupied by a patient who is ill because of polluted waterâ?¦. Provision of a safe and

convenient water supply is the most important activity that could be undertaken to improve the health of people living in rural areas of the developing

world.â?? (WHO)

â??Nature never did betray, the heart that loved her.â? (Wordsworth) The anxiety to save the environment manifested in the Constitution (Forty-

second Amendment) Act, 1976 by the introduction of a specific provision for the first time to â??protect and improveâ? the environment. Man is

natureâ??s best promise and worst enemy. If industry is necessity, pollution inevitable. Since progress and pollution go together, there can be no end

of progress, and consequently, no escape from pollution. If industry is a necessary evil, pollution surest sufferance. Several enactments have been

made to combat pollution. â??Pollutionâ? is a noun derived from the transitive verb â??polluteâ? which means to make foul or unclean, dirty, to make

impure or morally unclean. In Halsburyâ??s Laws of England (4th Edn., Vol. 38, para 66) â??pollutionâ? means the direct or indirect discharge by

man of substances or energy into the aquatic environment resulting in hazard to human health, harm to living resources and aquatic ecosystems,

damage to amenities on interference with other legitimate uses of water.

34. The aesthetic use and the pristine glory cannot be permitted to be eroded for private, commercial or any other use unless the courts find it

necessary, in good faith, for public good and in public interest to encroach upon the said resources.

35. It cannot be disputed that no development is possible without some adverse effect on the ecology and environment, and the projects of public utility

cannot be abandoned and it is necessary to adjust the interest of the people as well as the necessity to maintain the environment. A balance has to be

struck between the two interests. Where the commercial venture or enterprise would bring in results which are far more useful for the people,

difficulty of a small number of people has to be bypassed. The comparative hardships have to be balanced and the convenience and benefit to a larger

section of the people has to get primacy over comparatively lesser hardship.

40. Sustainable development is essentially a policy and strategy for continued economic and social development without detriment to the environment

and natural resources on the quality of which continued activity and further development depend. Therefore, while thinking of the developmental

measures the needs of the present and the ability of the future to meet its own needs and requirements have to be kept in view. While thinking of the

present, the future should not be forgotten. We owe a duty to future generations and for a bright today, a bleak tomorrow cannot be countenanced.

We must learn from our experiences of the past to make both the present and the future brighter. We learn from our experiences, mistakes from the

past, so that they can be rectified for a better present and the future. It cannot be lost sight of that while today is yesterdayâ??s tomorrow, it is

tomorrowâ??s yesterday.

42. The Union Government framed the National Forest Policy in 1988. Though the basic objectives are very laudable, it is sad to note that it has

virtually been confined to the papers containing it, and not much has been done to translate them into reality. Nevertheless, it reflects the anxiety of the

Union Government to protect and preserve natural forests with a vast variety of flora and fauna, representing biological diversity and genetic

resources of the country.

29) In 2008 (12) SCC 646, in the case of â??A. Chowgule and Company Ltd. vs.

Goa Foundation & othersâ?, their Lordships of the Honâ??ble

Supreme Court have held that composite reading of Rules 4, 6, 2-A and 5 reveals that the prior approval under Section 2 of the Forest (Conservation)

Act, 1980 cannot be granted before procedure prescribed in the said Rules has been complied with. Prior approval under Section 2 of the Act, 1980 is

sine qua non for the State Government and other authorities before taking any other steps in respect of the forest land. Their Lordships have held as

under:-

â??18. Section 2 of the Act and the relevant Rules are reproduced below:

â??2. Restriction on the dereservation of forests or use of forest land for non-forest purpose.â?"Notwithstanding anything contained in any other law

for the time being in force in a State, no State Government or other authority shall make, except with the prior approval of the Central Government,

any order directingâ?

(i)Â Â that any reserved forest (within the meaning of the expression â?? reserved forestâ?? in any law for the time being in force in that State) or

any portion thereof, shall cease to be reserved;

(ii)Â that any forest land or any portion thereof may be used for any non-forest purpose;

(iii) that any forest land or any portion thereof may be assigned by way of lease or otherwise to any private person or to any authority, corporation,

agency or any other organisation not owned, managed or controlled by Government;

(iv) that any forest land or any portion thereof may be cleared of trees which have grown naturally in that land or portion, for the purpose of using it

for reafforestation.â??

Rules

â??2. (b) â??Committeeâ?? means the Committee constituted under Section 3;

*Â Â Â Â Â Â Â Â Â *Â Â Â Â Â Â Â Â Â *

2-A. Composition of the Committee.â?" (1) The Committee shall be composed of the following Members:

(i) Inspector General of Forests, Ministry of Environment and Forests â?" Chairman.

(ii) Additional Inspector General of Forests, Ministry of Environment and Forests

â?" Member.

(iii) Joint Commissioner (Soil Conservation), Ministry of Agriculture â?" Member.

(iv) Three eminent environmentalists (non-officials) â?" Member.

(v) Deputy Inspector General of Forests (Forest Conservation), Ministry of Environment and Forests â?" Member-Secretary.

*Â Â Â Â Â Â Â Â Â *Â Â Â Â Â Â Â Â Â *

4. Procedure to make proposal by a State Government or other authority.â?"(1) Every State Government or other authority seeking the prior approval

under Section 2 shall send its proposal to the Central Government in the form appended to these Rules:

Provided that all proposals involving clearing naturally grown trees in forest land or portion thereof for the purpose of using it for reafforestation shall

be sent in the form of working plan/management plan.

(2) Every proposal referred to in sub-rule (1) shall be sent to the following address, namely:

Secretary to the Government of India

Ministry of Environment and Forests

Paryavaran Bhavan, CGO Complex

Lodi Road, New Delhi 110 003:

Provided that all proposals involving forest land up to twenty hectares and proposals involving clearing of naturally grown trees in forest land or portion

thereof for the purpose of using it for reafforestation shall be sent to the Chief Conservator of Forests/Conservator of Forests of the regional office

concerned of the Ministry of Environment and Forests.

5. Committee to advise on proposals received by the Central Government.â?"(1) The Central Government shall refer every proposal received by it

under sub-rule (1) of Rule 4 to the Committee for its advice thereon if the area of forest land involved is more than twenty hectares:

Provided that proposals involving clearing of naturally grown trees in forest land or portion thereof for the purpose of using it for reafforestation shall

not be referred to the Committee for its advice.

(2) The Committee shall have due regard to all or any of the following matters while tendering its advice on the proposals referred to it under sub-rule

(1), namely:

(a) whether the forests land proposed to be used for non-forest purpose forms part of a nature reserve, national park wildlife sanctuary, biosphere

reserve or forms part of the habitat of any endangered or threatened species of flora and fauna or of an area lying in severely eroded catchment;

(b) whether the use of any forest land is for agricultural purpose or for the rehabilitation or persons displaced from their residences by reason of any

river valley or hydro-electric project;

(c) whether the State Government or the other authority has certified that it has considered all other alternatives and that no other alternatives in the

circumstances are feasible and that the required area is the minimum needed for the purpose; and

(d) whether the State Government or the other authority undertakes to provide at its cost for the acquisition of land of an equivalent area and

afforestation thereof.

(3) While tendering the advice, the Committee may also suggest any conditions or restrictions on the use of any forest land for any non-forest purpose

which, in its opinion, would minimise adverse environmental impact.

6. Action of the Central Government on the advice of the Committee.â?" The Central Government shall, after considering the advice of the

Committee tendered under Rule 5 and after such further enquiry as it may consider necessary, grant approval to the proposal with or without

conditions or reject the same.â??

A bare perusal of the aforesaid provisions would show that prior approval is required for the diversion of any forest land and its use for some other

purpose. This is further fortified by a look at Rule 4 which provides that every State Government or other authority seeking prior approval under

Section 2 of the Act shall submit a proposal to the Central Government in the prescribed form and Rule 6 stipulates that the proposals would be

examined by a committee appointed under Rule 2-A within the parameters and guidelines postulated in Rule 5. There is nothing on record to suggest

that this procedure had been adopted. Admittedly, also the approval for 4.44 ha had been obtained long after the lease deed had been executed on 1-

11-1989 and there is no suggestion that even for this limited area the procedure envisaged under Rules 4, 5 and 6 had been followed. We are,

therefore, of the opinion, even assuming that some approval was granted with respect to 4.44 ha of land in the year 1997, it would not amount to prior

approval in terms of the Act and the Rules aforequoted.â??

30) In 2012 (4) SCC 362, in the case of â??T.N. Godhavarman Thirumulpad vs. Union of India & othersâ?, their Lordships of the Honâ??ble

Supreme Court have explained the terms â??Critically endangeredâ?, â?? endangeredâ?, â??vulnerableâ? and â??threatenedâ? species. Their

Lordships of the Honâ??ble Supreme Court while dealing with issue whether sandalwood (Santalum album linn) and red sanders (Pterocarpus

santalinus) being endangered species, should be declared as a â??specified plantâ? within the meaning of Section 2(27), and be included in Scheduled

VI to the Wildlife (Protection) Act, 1972, have held as under:-

â??42. A taxon is critically endangered when the available evidence indicates that it meets with the criterion of extremely high risk of extinction. It is

endangered when it meets with the criterion of facing a very high risk of extinction. A taxon is vulnerable when it is considered to be facing a high risk

of extinction. Near threatened means a taxon is likely to qualify for a threatened category in the near future.

46. Sandalwood as such we have already indicated finds no place in CITES but it is included in the Red List of IUCN as â??vulnerableâ? and hence

calls for serious attention by the Central Government, considering the fact that all the sandalwood growing States have stated that it faces extinction.

Section 61 of the Act empowers the Central Government to add or delete any entry to or from any schedule if it is known that it is expedient so to do.

Section 5 deals with the constitution of National Board for Wildlife (NBWL) which is headed by the Prime Minister as Chairman. Section 5-C deals

with the functions of NBWL which states that it shall be the duty of the National Board to promote the conservation and development of wildlife and

forests by such measures as it thinks fit. Section 5-C(ii)(a) states that the measures may provide for promoting policies and advising the Central

Government and the State Governments on the ways and means of promoting wildlife conservation and effectively controlling poaching and illegal

trade of wildlife and its products and also for reviving from time to time the progress in the field of wildlife conservation in the country and suggesting

measures for improvement thereto. Various other powers have also been

conferred on the National Board which consists of experts in the field of

environment. In such circumstances, rather than giving a positive direction to include sandalwood in Schedule VI, we are inclined to give a direction to

the Central Government to examine the issue at length in consultation with NBWL and take a decision within a period of six months from today as to

whether it is to be notified as a specific plant and be included in Schedule VI of the Act.

47. We are also inclined to give a direction to the Central Government to formulate a policy for conservation of sandalwood including provision for

financial reserves for such conservation and scientific research for sustainable use of biological diversity in sandalwood. The Central Government

would also formulate rules and regulations under Sections 3 and 5 of the Environment (Protection) Act, 1986 for effective monitoring, control and

regulation of sandalwood industries and factories and it should also formulate rules to ensure that no imported sandalwood is sold under the name of

Indian sandalwood and adequate labelling to this effect be mandated for products manufactured from or of import of sandalwood. The States are

directed to immediately close down all unlicensed sandalwood oil factories, if functioning and take effective measures for proper supervision and

control of the existing licensed sandalwood oil factories in the States.â??

31) Learned Authors, as discussed hereinabove, have highlighted that the vegetation is also affected by mountaineering and tourism. Excessive tree

felling for timber and fuel wood, establishment of cattle camps (creating artificial pastures), unplanned tourism and pilgrimage etc. have caused a

tremendous pressue on high altitude forests. In general, the potential area of sub-alpine forests in the Himalaya is about 50760 sq. km, of which only

0.2-13% is forested. During 1952-1976, a total of 1960050 ha forests has been lost from Indian Himalaya. This indicates that there has been a

tremendous pressure on the remaining forests of temperate and sub-alpine regions throughout the Himalaya. In recent years, the biotic pressure on

land resources has increased many folds, resulting in the destruction of flora and fauna on a large scale. The biotic pressure, coupled with erosion,

landslides, floods and avalanches have caused a considerable damage to the flora and vegetation of high altitudes during the last four decades. The

impact of man and his domestic animals on the vegetation is seen every where.

The opening of the interior high altitude valleys by constructing roads

and bridges for developmental purposes has brought about a significant change in the landscape. Overgrazing of high altitude pastures by sheeps,

goats and buffaloes is an equally important factor responsible for change in the composition of the vegetation complex. They cut the palatable species

and in due course of time, the pastures deteriorate due to replacement of the palatable species by weeds and grasses. The high tree basal area in most

cases, suggested that the high altitude forests have a potentiality to support large forest biomass. But on the other hand, the poor regeneration of

seedling and sapling individuals throughout the zone indicated possible changes in forest composition in future. The timber line in this region is unique in

its position and structure. There are 16 National Parks and 60 Wildlife Sanctuaries in the Himalayan region of India covering about 6% of its

geographical area. There is an urgent need to explore, collect and study the exuberant, multilayered bryophyte flora of these magnificent Himalayan

heights before these large yet fragile â??blocks of diversity are lost without being studied scientificallyâ?? by man-made disturbances of their habitats.

32) Alpine meadows/ sub-alpine meadows/ Bugyals are also littered with plastic bags, cans thrown indiscriminately by the tourists. It is the duty cast

upon the State Government to protect and improve the environment and to safeguard the forests and wild life of the country as per Article 48A of the

Constitution of India. Under Article 58A(g), it the duty of every citizen of India to protect and improve the natural environment including forests, lakes,

rivers and wild life, and to have compassion for living creatures.

33) Accordingly, the present petition is disposed of by issuing the following mandatory directions: -

A. The State Government is directed to remove all the permanent structures from the alpine meadows/ sub-alpine meadows/ Bugyals in the State of

Uttarakhand including Aali-Bedini-Bagzi Bugyals within a period of three months.

B. The State Government is directed to constitute the Eco-Development Committees within six weeks in eco-sensitive zones throughout the State of

Uttarkahand to protect and preserve the nature, environment and ecology.

C. The State Government is directed to restrict the number of tourists (not more than 200) visiting the alpine meadows/ sub-alpine meadows/ Bugyals.

D. No person including the State Public Undertakings/ Private Entrepreneurs shall

construct any permanent structure on the alpine meadows/ sub-

alpine meadows/ Bugyals throughout the State of Uttarakhand.

E. The overnight stay in the Alpine meadows/ Sub-alpine meadows/ Bugyals is banned.

F. The commercial grazing of cattle is banned on alpine meadows/ sub-alpine meadows/ Bugyals forthwith. The local shepherds alone will be

permitted to graze their cattle on the alpine meadows/ sub-alpine meadows/ Bugyals by imposing reasonable restriction on the number of cattle.

G. All the District Magistrates throughout the State of Uttarakhand are directed to ensure removal of plastic water bottles, cans etc. from the alpine

meadows/ sub-alpine meadows/ Bugyals within six weeks from today.

H. The State Government is also directed to ensure that no encroachment is made in these alpine meadows/Bugyals in any form, even in the name of

religion. The encroachments already made are ordered to be removed within three months from today by issuing notices.

I. The State Government is directed to conduct systematic survey of its flora at the earliest to prepare comprehensive manual, as recommended by the

experts within six months from today.

J. Every forest division should have a herbarium of important medicinal, rare, threatened and botanically interesting plants for reference. The

exploitation of medicinal plants should be limited and it should be done only through Government/Public sector, as recommended by the experts.

K. The State Government is also directed to introduce rotational grazing of cattle in alpine meadows/ sub-alpine meadows/ Bugyals, as recommended

by experts, where alternative sites are available. The stay of livestock is ordered to be reduced, as recommended by the experts.

L. The State Government is directed to consider declaring all import high altitude valleys and alpine meadows/ sub-alpine meadows/ Bugyals with rich

plant as high altitude National Parks/Sanctuaries, within a period of six months from today.

34) In Guru Granth Sahebji, it is written that â??Pavan paani dharati aakas ghar mandar har baniâ?, (Air, water, earth and sky are Godâ??s home

and temple).

35) All pending applications stand disposed of accordingly.

