COMPARATIVE STUDY OF THE VEGETATTION OF GANGA CHOTTI AND BEDORI HILLS, DISTRICT BAGH, AZAD JAMMU AND KASHMIR WITH SPECIAL REFERENCE TO RANGE CONDITIONS

BY

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DEPARTMENT OF BOTANY,

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DEDICATION

Sincerely dedicated to my parents
And Malik family

University of Peshawar

Peshawar

COMPARATIVE STUDY OF THE VEGETATION OF GANGA CHOTTI AND BEDORI HILLS, DISTRICT BAGH,AZAD JAMMU AND KASHMIR WITH SPECIAL

REFERENCE TO RANGE CONDITIONS

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ABSTRACT

Comparative study of the vegetation of Ganga Chotti and Bedori Hills, District Bagh, Azad Jammu and Kashmir with special reference to range conditions

By

MALIK ZAHID HUSSAIN QADRI

The floristic, vegetation structure, productivity and range conditions of Ganga Chotti and Bedori hills were analyzed in two consecutive years i.e. 1999 and 2000. There were 206 species of 47 families. Based on the number of species Asteraceae, Rosaceae, Poaceae, Pinaceae, were the important families in spring. While in monsoon Poaceae, Rosaceae, Ranunculaceae, Lamiaceae, Leguminosae, Caryophyllaceae were the most prevalent families. However, quantitatively based on family importance value (FIV) the status of families drastically changed. Pinaceae, Ranunculaceae, Asteraceae, Polygonaceae, and Rosaceae emerged as the important families during spring. While in monsoon Poaceae was the leading family. It was followed by Pinaceae, Asteraceae, Rosaceae, Leguminosae, Ranunculaceae, Caprifoliaceae, Rubiaceae, Salicaceae and Lamiaceae. Biological spectrum showed that hemicryptophytic and therophytic were the life form classes while microphylls, nanophylls were the most prevalent leaf sizes. Status on the aggregation indicated that most of the species exhibited aggregation.

The growing season commences at the beginning of May and last up to November. There are two flowering seasons. Some 53.88% plants flowered

during the first spell while 46.11% plants had flowering during the second spell that lasted from September to November. Few species exhibited flowering throughout the growing season.

The studies indicated that plants are mostly used fodder (46.20%), medicinal (28.62%), vegetable/ edible fruits (6.89%), fuel weed (5.17%), poisonous (4.13%) tanning/ dying species (2.41%) and herbal tea species (2.41%), resin yielding (2.06%), timber wood species (1.37%), roof thatching (0.34%) and evil repellant (0.34%).

There were 30 plant communities during spring and monsoon. However on the basis of cluster analysis and Detrended Correspondence Analysis, the plants communities were grouped in to four major association:

Woodland temperate association, Woodland alpine association, Shrubland alpine association and alpine grassland association.

The soil texture was mostly fine to medium fine in various associations with acidic to basic pH. The organic matter varied from 1 to 5.3%, in these associations. The EC was in between 0.07 to 0.60 (low), $NO_3 - N$ laid between 0.43 to 72.10, P for less then 1 to 179 ppm and K contents varied from 50 to 230 ppm.

The availability of fodder species differed from May to November. There were 115 palatable species. Among them, 9.2% (19 spp) were highly palatable, 16.01% (33 spp), mostly palatable, 15.5% (32 spp) less palatable and 15.05% (31 spp) rarely palatable.

Considering the grazeable parts, it was seen that in 49 species (23.7%) shoot/ whole plants were used, in 64 species (31.06%) foliage and leaves were used, while in 33 species (16.02%) floral parts were consumed.

Climatic fluctuations especially rainfall strongly influenced plant productivity in both the years (1999, 2000). The total average biomass for both the years was 7610 kg/h. The month of July and August yielded the maximum productivity of 1357 and 1536 kg/h, in Ganga and Bedori Hills respectively. The herbage production gradually increased from May to August (4970 kg/h) that progressively declined till November (2640 kg/h).

The available amount of forage decreased after plants had reached maturity. The amount was generally high in spring as compared to monsoon.

The investigated rangelands are less productive and need rehabilitation through ecological management. This would be possible with the participation of local communities and government to make the resourced sustainable. It is recommended that government of Azad Jammu and Kashmir should give complete protection to range land for atleast 10 years for the improvement of vegetation and range conditions. There is need to provide alternate sources of energy so as to lessen the burden on the rangeland resources. The severely degraded sites be subjected to reforestation with suitable woody and herbaceous species.

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INTRODUCTION

Introduction

Location

The Ganga Choti and Bedori Hills are situated in district Bagh, Azad Jammu and Kashmir. The District Bagh is bounded on north by District Muzaffarabad, on south by District Poonch, on west by Murree (District Rawalpindi) and Hazara (District Abbottabad) and on the east by occupied Kashmir. District Bagh stretches over an area of 3,34,269 hectares. The area is primarily a mountainous terrain. The population of the Districts is 4,70,000 including 2,45,000 male (GOP,1996). The District is administratively divided in to three tehsils: Dhirkot, Bagh and Haveli.

Of the total area of 13297 sq. Km of Azad Jammu and Kashmir, 1.2 million (55%) hectare area is classified as rangeland. The livestock of the area include cattle, buffalo, goat, sheep and horses.

The highest peak in the District Bagh is Bedori Hills, which is 3578m. The Ganga Choti hills lie within 34°3' 50" to 34° 4' 50" north and 73° 44' 50" to 73° 47' 3" east (Toposheet number 43 F/16) whereas Bedori hills lie in between 33° 36' to 34° 0' north and 73° 23' to 74° 9' east (Toposheet number 43K/1).

Climate

Rainfall

The area is characterized by subtropical climate in the lower reaches which changes to moist temperate, sub alpine to alpine type in the upper reaches. The summers are hot in the lower altitude and pleasant in upper reaches. The winters are cold. There is no meteorological observatory in District Bagh, therefore data was obtained from the nearest observatory Rawalakot located 30 Km away from research area.

The data shows that the total annual rainfall is 705.12 mm. The maximum rainfall occurs during the month of June to August having 76 to 167 mm, respectively. November (17.04 mm), October (36.24 mm), November and May generally receive the least rainfall which amounts to 17.04 and 25.20 mm, respectively (Table 1).Winter precipitation is gentle, steady and regular. It mostly gets absorbed in the soil. The summer rains, on the other hand, are heavily torrential and irregular and cause heavy soil erosion. The area above 2000-3700m receive snowfall from November to April which starts melting at the end of April and is a source of melt-water.

Temperature

The maximum temperature from January to March ranges in between 11-16 C^0 while the minimum temperature -1.54 to 3C^o during winter. From May to August, the temperature ranges in between 25 –29C^o, while the minimum temperature lies in between 10-17C^o. It decreases and remains between 14-24C^o during September. At the same time the minimum temperature also drops from 12 C^o to less than 1C^o (Table 1).

Relative humidity

The relative humidity fluctuates in between 55-84 % at 3 GMT. The most humid months, August and September have the highest relative humidity of 80-83%. During July, January and February the humidity remains 71-75%. In the remaining months the relative humidity records low. Similarly, at 12 GMT the highest relative humidity was reported for the month of August, which is followed by 63 –66% humidity in the months of June and September. The relative humidity remains above 50% during January to March (Table 1).

Hail and sleet

Hail and sleet are frequent during the month of January to March and then a second spell occurs from August to September. A considerable damage is caused to vegetation and crops by hail storms.

Snow fall

Snow falls frequently at altitude above 2000 m during November-January in the investigated area which melts during the month of May. However there is no permanent snow cover.

Hydrography

A big perennial Nala called as Nala Mahal oozes from Lasdana and Ganga Choti which is the main source of water. It ultimately joins River Jhelum at Tien area. There are a number of small springs scattered in the wood lands.

Edaphology

The soils of the investigated area vary from clay loam to sandy loam, sandy clay loam type.

Geomorphology

Geologically, the area is characterized by Dogra slates and Murree formation. The Dogra slates (Panjal slates) are unfossiliaferous black and green cleaved slates. They are light gray to black in color in upper Haveli (Bedori) (Wadia, 1928; Farooq, 1988). At some localities quartz and feldspar content gradually increase from top to bottom while at other places slates contain rounded particles of quartz mixed with particles of lime stone along cleavage planes. The upper contact of Dogra slates is with gneissic schists and Gondwana formation. According to Wadia (1928), the age of Dogra slate is Precambrain.

Murree formation is composed of a sequence of dark, red, purple clay and sand stone of purple, gray, and greenish gray color with subordinate intra formation conglomerate. Sedimentary structures cross beding and ripple marks are common in Murree sand stone. In Haveli area, the cross beding and ripple marks in sand stone are present.

Natural vegetation

The vegetation of the investigated area could be generally classified into following main types.

1. Siwalik moists Chir pine forest

This type lies a sub-zone above the tropical dry deciduous forest zone and below the Kail zone. Champion *et al.* (1965) recognized it as a degraded stage. *Pinus roxburghii*, *Zanthoxylum alatum*,*Quercus dilatata* , *Pyrus pashia*, *Ficus palmata*, *Berberis lycium*, *Rubus fruticosus* and *Clematis grata* are characteristics species in the lower hills below 2000 m; While in moist Chir pine forest *Pinus roxburghii*, *Quercus incanas*, *Punica granatum*, *Ficus palmata*, *Berberis lycium*, *Rosa macrophylla* and *Indigofera heterantha* (Alt.1000-2000 m) are present. Champion *et al.* 1965 considered it as siwalik moist Chir pine forest.

2. Low level blue pine forest

This forest is characterized by *Pinus wallichiana*, *Quercus dilatata*, *Quercus incanas*, *Populus ciliata*, *Pyrus pashia*, *Machilus odoratisima*, *Viburnum grandiflorum*, *Sarcococca saligna*, *Berberis lycium*, *Jasminum officinale*, *Viola odorata*, *Pteris cretica*, *Fragaria nubicola*, *Galium boreale*, *Hedera nepalensis* and *Nepeta erecta* .

3. Moist temperate forest

This forest occurs between 2000-3000 m in moist depression and on the gentler slopes with deep, especially wet soil. *Pinus wallichiana, Abies pindrow* and *Picea smithiana* are the characteristics plants. *Viburnum grandiflorum, Sarcococca saligna* and *Berberis lycium* are shrubby components.

4. Sub alpine forests

They lie between 3000 and 3300 m depending upon the aspect. The trees are of moderate size with branching canopy. The forest consists of *Pinus wallichiana* singly or in groups with other trees and shrubs like *Salix grandiflorum*, *Viburnum grandiflorum*, *Juniperus communis, Rosa macrophylla* and other species including herbaceous vegetation.

5. Alpine scrub and pasture

The alpine vegetation consists of shrub formation often forming quite as dense cover which is composed of limited number of herbaceous species, mostly deciduous and with small leaves but including dwarf *Salix*.

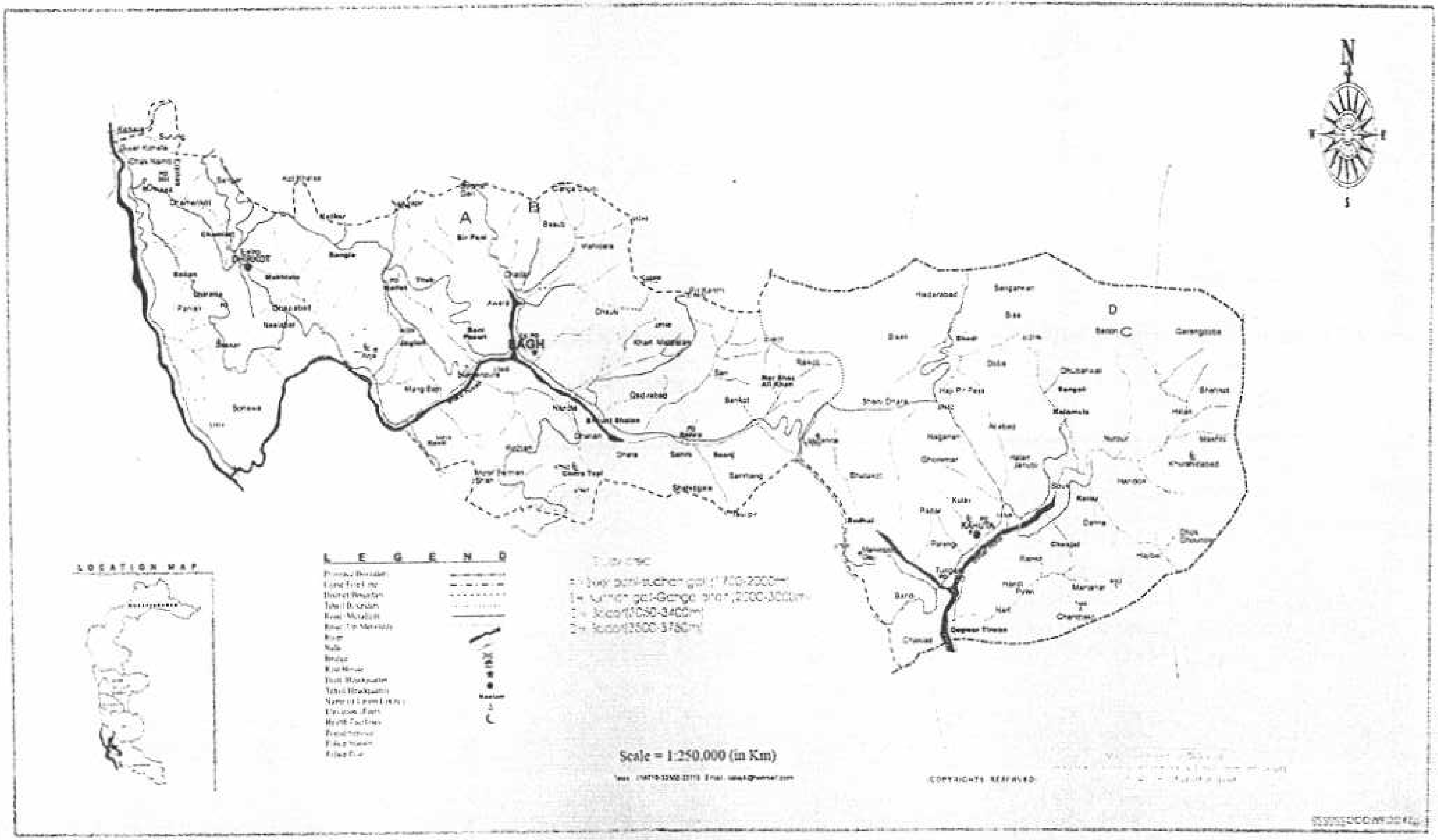

Fig. 1. Showing Location of study Area

Table 1. Meterological Data of Rawalakot, Azad Jammu and Kashmir (1993-2002)

Months	Temperature (C°)		Rainfall (mm)	Humidity (%)	
	Maximum	Minimum	Mean total	3 hours GMT	12 hours GMT
January	11.22	-1.54	49.68	75.64	55.83
February	13.22	-0.51	86.64	71.11	54.16
March	16.63	3.28	73.44	69.74	52.11
April	24.22	7.67	42.84	62.61	47.89
May	27.05	10.64	25.20	54.90	43.14
June	29.10	13.65	75.96	65.41	48.67
July	27.12	17.16	166.80	75.70	66.58
August	25.82	16.12	75.36	83.73	77.26
September	24.87	12.97	33.16	80.39	63.43
October	22.67	6.63	36.24	69.93	48.38
November	18.30	2.59	17.04	61.75	44.00
December	14.63	0.15	20.76	66.38	41.36
Annual Value	254.85	92.91	705.12	837.29	642.81
Mean Monthly Value	21.24	7.74	58.76	69.77	53.57

Courtesy: Pakistan Metrological Department, Lahore.

REVIEW OF LITERATURE

Review of Literature

Vegetation / Phytosociology

Saxena *et al.* (1987) worked on altitudinal variation in the vegetation of Kumaun Himalayas. Their finding showed that subtropical zone was dominated by phanerophytes, while hemicryptophytes dominated the temperate and alpine zones. The dominant species of different forests showed overlapping and formed a loose continuum. The diversity of tree layer was higher, which decreased both at lower and upper altitude. Similarly, with increasing altitude, the average tree height also decreased.

Ram and Arya (1991) stated that there were 36 % short forbs, 27 % cushion and spreading forbs, 17 % each were tall forbs and shrubs and under shrubs in the alpine vegetation at Rudranth. The flora as a whole was dominated by chamaephytes and geophytes.

Collin (1992) worked on the effect of disturbance on spatial and temporal heterogeneity in tall grasses. Spatial heterogeneity is the dissimilarity in the species community where as temporal heterogeneity is compositional change with in a site over time. His findings showed that heterogeneity was lowest on sites and positively correlated with species richness and diversity.

Hajar (1993) reported 72 species of 32 families from Hemasabihah Saudi Arabia. There was great species diversity with the presence of more palatable plants. Greater species diversity plays a major role in soil conservation. In grazed area less plant cover was observed as compared to protected area and less plant cover resulted in severe soil erosion.

Tsuyuzaki (1993) stated that in northern Japan *Petasites Japonicus var. giganteus* was dominant in all the three ski grounds. He noted three phases of vegetation establishment. There was invasion by woody plants consisting of *Betula* spp. and *Salix* spp.

Running *et al.* (1994) proposed a simple new classification for global vegetation based on simple, observable, unambiguous characteristic of vegetation structure that are important to ecosystem biogeochemistry. Vegetation index database currently recognized global biome classes can easily be derived from this classification by adding climatic description and defining mixtures of these fundamental six vegetation classes of United States.

Aslan *et al.* (1994) reported a good correlation between normalized difference vegetation index (NDVI) and rainfall rate, NDVI, and relation humidity; NDVI, sensible heat flux and relative humidity; NDVI momentum flux and emissivity; NDVI sensible heat flux and emissivity. Their study suggests that the momentum flux has only one marginal impact on NDVI. Further, thermodynamic discontinuities considerable influence the vegetation pattern.

Coetzee *et al.* (1995) described 14 plant communities of grassland with classification and ecological interpretation in South Africa. They stressed the need for the preservation of biotic diversity.

Loftin *et al.* (1996) assessed relationship between total soil organic carbon (T0C), total Kjeldahl nitrogen (TKN), total phosphorus (TP) and plant community structure. It was seen that plant community structure changed across the ecotone from grassland with > 44 % grass cover and >2 % shrub cover to a shrub land with 8% shrub cover and >8 % grass cover. Soil TOC, TKN, TP, in the upper 20 cm, were not significantly different between plant communities.

Leonard (1997) worked on the flora and vegetation of Jebel uweinat (Libyan desert; Libya, Egypt and Sudan) and recorded 23 species of grasses with details of taxanomy, frequency, distribution, palatability and adaptation to drought. Feeding habits of the herbivores present were discussed.

Al-Farraj *et al.* (1997) stated that the vegetation of protected site was usually rich in composition as compared to surrounding area in Saudi Arabia. Their study showed that the silt basin was dominated by ephemerals and that the distribution and intensity depended on the amount of rainfall. The perennial vegetation was represented by few stands and constituted less than 10 % of the total vegetation cover. The species diversity and vegetation density might vary seasonally due to the amount of rainfall. The diversity was higher during spring as compared to other season due to ephemeral species.

Raizada *et al.* (1998) observed that diversity and species richness was highest in moderate grazed and least in intensively grazed area of alpine grassland.

Watson *et al.* (1999) suggested that the most important factor influencing vegetation was soil depth. It is much greater in bush clumps and less in succulent patches.

Gokbulak (1999) compared vegetation diversity of grazed rangeland with exclosed rangeland in Turkey. The exclosure had greater species diversity and plant growth than heavily grazed rangeland. The latter retained only resistant species to grazing due to their morphological structure such as sod - forming graminaceous species.

Dickore and Nusser (2000) reported the flora of Nanga Parbat which was predominantly west Himalayan (26.8%) with Sino Himalayan elements comprising further 12.5%. This flora is characterised by high proportions of Central Asian (8.6%), Irano-Turanian (8.8%) and Pamirean (7.9%) elements, whereas Tibetan elements (1.9%) are poorly represented. A marked irregularity of diversity at about 2300m seems to be related to relief features and climatic factors. No clear signs of change in species diversity due to recent human interference. The annotated enumeration of vascular plants may serve as basis for subsequent investigation in to the dynamics of the flora. Repeat phytogeography revealed environmental changes during the past 60 years.

Papanastasis e*t al.* (2000) stated that woody species and cacti are common character of vegetation. They constitute an indispensable drought fodder by drawing moisture and mineral from deep soil. Productivity and palatability, provenances varies among the species. During critical dry period, they can mitigate the problem of climatic uncertainty and ensure sustainable production system.

Miller *et al.* (2000) reported that with the increase of Juniper / dominance the population of aspen declined. Herbaceous cover and species diversity also declined. With increased Juniper canopy to 50% sagebrush declined to 80% of maximum potential. There were 19% cover and 64 trees / ha $^{-1}$ in a low sagebrush community.

Spehn *et al.* (2000) investigated that plant species and functional group richness improved establishment of grassland assemblage and increased mean vegetation cover. With increasing diversity a positive effect was recorded.

Kikim and Yadava (2001) reported phenological characteristics of 32 dominant tree species in forest ecosystem. The number of evergreen tree species were greater than that of deciduous tree species. Majority of the species exhibited peak of leaf drop in cool dry period (January- February) and leaf flushing in the beginning of warm dry period (March - April) and another in rainy season (August) of the year. Both over and under-storey species showed a sharp flowering peak in April. The peak period of fruit maturation occurred during September - October. Leaf flush and flowering were simultaneous in over and under-storey tree species, while the fruiting of under-story tree species was one month earlier than that of over-story tree species.

Asada (2002) reported vegetation gradients in relation to temporal fluctuation of environmental factors in Bekanbeuslu peatland, Hokkaido, Japan. His finding suggests that parameters that are obtained from the consecutive measurement of environmental factors may have differing significance in explaining vegetation gradients in these pleatlands, and values from a single sampling may miss important ecological informations.

XI-an and Ping (2003) reviewed ecological function of herbaceous layer in forest ecosystem in the last two decade Herbaceous layer has been reported to have a lot of ecological functions, such an increasing ecosystem diversity, preventing water and soil loss, enhancing soil nutrition, amending soil structure, improving seedling growth, improving microclimate, and accelerating ecological restoration. However, there are several aspects that should be paid more attention in the study on herb layer in the low sub tropical forest ecosystem eg. ecological functions and benefits of herbaceous layer or litter; 2) The colonization and succession of herbaceous layer in understory of artificial forests, 3) mechanism of seedling renovation in the forest, 4) The eco-functions and mechanisms of herbaceous layer in agro-forestry ecosystem; 5) screening for more excellent herbaceous species.

Heinrich and Hurka (2004) recorded species richness and composition during sylvigenesis in a tropical dry forest in northwestern Costa Rica and described nine pairs of spatially separated plots representing each of different ages of secondary regeneration ranging from recently cleared and burned to more than 50years of re-growth. Their results document great changes in species diversity and composition of plant form categories during sylvigenesis. Species richness was greatest after 15years and decreased significantly in older plots. The number of non-weedy species was highest after three years of succession. Minimum of woody plant species was after one year and increased significantly after 5 years. Maximum was in the 15years plots with a slight decrease in older forests.

Rangeland Productivity

Hidalgo and Cauhepe (1991) evaluated the effect of seasonal rest in above ground biomass for native grassland of the flood Pampa Argentina.The total above ground biomass averaged 4600+445 and 3750+120 Kg/h^{-1} for spring and summer. Due to an increase in *Paspalum dilatatum* and *Bothriochloa laguroides*, warm season species increased. Above ground biomass yield was 2000$\pm$170 kg/ ha^{-1}. *Poa* and *Stipa* species increased in cool season. *Sporobolus indicus* increased under continuous grazing.

Ralph and Pfizer (1992) observed that cattle selected forbs in proportion to their availability (46-83 %) of their diets in forbs dominated plant communities while in grass dominated communities, forbs comprised only 11-32 % of their diets. On a landscape scale cattle preferred and spent proportionally more time in grazing in a forbs dominated communities. Both, these studies indicated that cattle have a wide acceptability for forage and can effectively utilize forbs dominated high mountain rangelands.

Pandey and Singh (1992) reported that rainfall and grazing affect the net primary productivity in a tropical Savanna, India. The above ground net primary production in protected savanna ranged from 329-741 gm/yr and was positively related to annual rainfall. The maximum production occurred due to moderate grazing. The net primary production of rangeland averaged from 11.9 to 19. 1Mg/ha.Rainfall variability and grazing intensity control the net primary productivity.

Michael *et al.* (1993) stated that location, date, past grazing history (vigor) and phenological development were significant in shaping the vegetation. The record of phenological development was more useful for estimating utilization than height. This factor was best expressed in 3 phenological classes. Height-weight relationship can be improved as biomass predicator when using these 3 phenological classes.

Zhang and Romo (1994) worked on *Agropyron dasytachyum* grass community at south Seskatchewan. Their finding showed that defoliation reduced all yield components.

Residual and live grass were reduced to 37, 57 and 46 % in 3 years. They recommended that deferred grazing will allow maximum forage production.

Austin *et al.* (1994) determined forage preference for 16 grasses in rangeland. *Bromus tectorum* was the most preferred species in the spring and fall. *Dactylis glomerata* and *Agropyron cristatum* was also preferred species while three wild rye, vinall and magnar basin wild rye (*Elymus cincerus)* were least preferred. The results showed a wide range of preference for grasses by mule deer.

Beeskow *et al.* (1995) reported ecosystem changes associated with grazing intensity on the Punta Ninfas rangeland of Patagonia, Argentina. There were significant negative relation between grass and shrub cover which suggested that grasses decreased as of crusted and desert pavement areas and mound increased with shrub cover. Three stages of range degradation were identified along the gradient of grazing intensity.

Bruce and Cade (1995) reported that biomass estimates of beaver food and total live biomass had smaller standard error than sample mean for all the stem diameter investigated. Percentage of stem weight that was beaver food varied from 93.6-12.2% for the smallest stem to the largest stem. They concluded that the logistic model provided reliable estimates of beaver food biomass.

Willma *et al.* (1996) reported seasonal changes of the herbage biomass on the fescue prairie at Aberta and recorded 3 communities. Standing production varied from 398, 305 and 226 gm m^{-2}, respectively. For spring standing production as a percent was 73, 50 and the percent of total herbage form fall to spring 24, 43 and 56 % respectively. Dry matter possesses over winter averaged 27 and 58% for grasses and forbs. As a whole production on the rough fescue community was greatest and it had the greatest forage values. This community is least dependent on precipitation and least susceptible to weathering losses.

Sadki and West (1996) worked on the phytosociological studies of the Blidean Atlas grasslands. They emphasized on the *Poa bulbosa* association and the *P. bulbosa* and *Plantago coronopus* facies (which constitute good pasture). The in vitro digestibility of *P. bulbosa* was 87 %; mean dry production was 140 kg/h.

Kaiser and Fischer (1997) studied suitability of sheep for landscape conservation on extensive peat grassland in Germany. Here animal live weight was 500 kg. The vegetation change its structure due to partial irregular grazing caused by extensive use. They recommended mowing of thistles in July and concluded that the Skudde is more suitable for the use in extensive paddocks than merino sheep.

Pitt *et al.* (1998) envisaged that browsing increased with increasing grazing pressure. It provided a useful index for predicting the potential for trampling damage of pine seedling by cattle. The value of grazing pressure and associated basal scarring are influenced by pasture size, kind of grazing animal, forage species, tree height, topography and weather patterns during grazing period

Orodho *et al.* (1998) observed that there was no significant differences in seed production between grazed and ungrazed collection of a 50 year old heavy grazing with protection from livestock grazing in the semi arid area of Chaco canyon in the south western United States.

Sundarapandian *et al.* (1999) recorded that fine root biomasses and net primary productivity was insignificantly greater under natural ecosystem as compared to monoculture plantation.

Lambardi *et al.* (1999) stated that grazing animal reduce wood plant cover and halted scrub encroachment, though the impact varied with animal and wood species. Among wood species, only *Vaccimium myrtillus* was markedly browsed and damaged. *Arctostaphylos, Rhododendron* and *Juniperus* were seldom affected.

Perez and Frangi (2000) reported grassland biomass dynamics, along an altitudinal gradient in the Pampa at an altitude of 550, 850 and 1025m. elevation in Argentina. Biomass was 1184$\pm$ 41, 1208$\pm$ 70 and 150$\pm$ 63gdm-2yr^{-1} respectively for the grassland sites. Below ground allocation of net productivity increased with altitude. The above and below ground turn over rates decreased with altitude but rates were faster for above ground tissues. They found different temporal pattern in productivity, water holding capacity of soil and temperature which was important factor related to several of the observed trends in structure and function.

Hierro *et al.* (2000) showed that productivity might decrease with shrub age. The mathematical equation developed allowed a rapid and accurate estimation of shrub biomass in the area. For shrub biomass, they consider diameter of the longest stem.

Ueckert (2001) reported that herbage production on untreated rangeland was predicted to decline slowly (2.4 to 5.0 Kgha^{-1} year^{-1}) as Juniper cover increased from 6-14% and rapidly (>8Kg ha^{-1} year^{-1})cover increased from 30-38%. Herbage production was predicted to decline at a constantly increasing rate following mechanical control of juniper, from <2Kg ha^{-1} year^{-1} in year 1 to 23Kg ha^{-1} year^{-1} in year 29. Potential additional livestock carrying capacity due to Juniper control would be under estimated by more than 40%, assuming forage production without treatment remained constant during the entire planning horizon of an economic analysis. To avoid significant reduction in livestock carrying capacity, redberry Juniper control should be implemented before its canopy cover exceeds above 20%.

Desta and Coppock (2002) stated that cattle number followed a boom and bust cycle. Neither rainfall nor stocking rate were significantly associated with cattle mortality. They concluded that the strongest information was the aggregated pattern of herd dynamics. Further the Boran live in a dynamic and productive equilibrial system where land-use change has intersected with rainfall variation to create a vicious cycle of massive cattle losses every 5 to 6 years.

Tate *et al.* (2003) reported that cattle feces distribution patterns were significantly associated with location of livestock attractants, slope percentage, slope aspects, hydrologic position and season. Daily fecal load was significantly lower during the wet season compared to dry season. Daily fecal loading rates across hydrologic position were dependent upon season.

Lucas *et al.* (2004) stated that increased grazing pressure did not have significant impacts on *Populus angustifolia* populations. Effects of season of use were significant on both herbaceous species richness and diversity. They concluded that no single riparian area management approach is best in all situation, but the grazing treatment use appear to have been successful at maintaining riparian communities.

Palatability

Vallentine (1990) envisaged that Spanish goat consumed grasses, forbs and browse. Their percentages varied 25%, 50% and 70%, respectively. Similarly Angora goat consumed 53%, 61% and 41% grass, forbs and browse during various seasons. In winter, Spanish goat consumed 28% browse in their diet. Whereas Angora goat consumed 19%, sheep selected 2 to 3 browse, 3 to 62% forbs, 36-70 grasses.

Kababia *et al.* (1992) reported that in Judean mountains goat grazed six hours daily on natural mediterranean rangeland and consumed 87, 79 and 86 % dry matter of bushes in winter, spring and summer respectively and corresponding value for grasses were 13, 21 and 14%, respectively.

Grunzoaldt *et al.* (1994) observed that in most cases goats preferred dicotyledonous herbs and shrubs. They concluded that goats were not primarily browser and showed the ability to maintain the quality of their diet even in declined range condition.

Nyamangara and Ndlovu (1995) reported that feed selection of animals differed with season. During wet season 55-70% grasses were consumed while in dry period browse, herbs and fruit formed 77-91% of the diet.

Hunt (1996) observed that grazing of sheep together with poor seasonal conditions result in expansion of the area surrounding water points in Australia. He recommended that the area need to minimize the death of mature plants by preventing heavy grazing during dry period.

Ralphs (2002) stated that poisonous and less palatable plants increased with declining range condition and livestock. Some poisonous species are major components of pristine, pre- European plant communities such as *Delphenium, Cicada, Presidium, Prunus, Pinus* and *Quercus*. When livestock consume these plants poisoning occur.

In Pakistan following studies have been done on different aspects of vegetation and phytosociology.

Tareen *et al.* (1987) established nine plant communities showing good correlation with edaphic factors in Spin Karez area, Baluchistan.

Marwat *et al. (1990)* reported 63 plant species in five plant communities from Zangilora. The physical condition of habitat was similar in all the communities. It appeared that chemical contents played a significant role in shaping the communities.

Tareen and Qadir (1991) observed 57 plant communities in Quetta District and grouped 45 communities in to 8 steppe types which were *Artemesia, Nepeta, Salvia,* *Cymbopogon, Chrysopogon, Sophora, Astragalus* and *Prunus*. Species diversity ranged from 0.16 to 2.33.

Marwat *et al.* (1992) recognized *Artemesia herba- alba, Artemesia- Poa-Taeniatherum, Bromus- Prunus* and *Artemesia - Sophora* communities in Chilton National Park, Quetta. They further reported that vegetation of Hazargangi was remnant of original *Juniperus macropoda* forest in the past.

Khan *et al.* (1993) reported 6 communities with low species diversity at Karachi. Perennial shrubs viz;*Suaeda fruticosa, Haloxylon recurvum, Cressa critica* and *Salsola baryosma* dominated. There were poor relationship between seed bank and vegetation. Halophytic species showed a transient nature of seed bank.

Tareen and Qadir (1993) observed that in Quetta phanerophytes decreased gradually from lower elevation to higher elevation while chamaephytes were slightly lower than the normal spectrum. However, hemicryptophytes were more or less constant in all zones and therophytes showed no consistency. The area was characterized by microphyllous and nanophyllous species.

Dasti and Agnew (1994) observed the vegetation of Cholistan and Thal deserts. They suggested that the human population create problem in topography, disturbance and utilization. The major axes brought out by ordination were related to disturbance and seasonality.

Shah *et al.* (1994) while working on the phytosociology of Ambela Pass, Buner stated that the area as a whole was under a very high biotic pressure. Overgrazing, trampling, lumbering, cutting, fodder and fuelwood extraction were very common.

Hussain *et al.* (1994) reported that in District Swabi, the overall vegetation was dominated by *Acacia modesta* followed by *Zizyphus mauritiana*.

Dastagir *et al.* (1995) worked on the phytosociology of Mai Dhani Hills and established *Celtis - Dichanthium -Themeda, Ficus - Dichanthium- Themeda, Ficus - Dodonaea - Themeda, Celtis - Dichanthium- Themeda, Dodonaea -Pinus - Themeda, Celtis - Pinus -Dodonaea* and *Micromeria -Themeda - Dodonaea* communities. It was concluded that diversity decreased from low altitude to high altitude. With increasing altitude nanophanerophytes and hemicryptophytes increased while megaphanerophytes decreased accordingly.

Mahmood and Mirza (1995) recognized 9 plant communities from Valika Chemical industries, Karachi and reported that it was a disturbed area. Their were sandy loam soil with slight variation in water holding capacity, little organic matter and exchangeable sodium was high.

Badshah *et al.* (1996) stated the flora of Pirghar hills; South Waziristan was dominated by Asteraceae and Lamiaceae. Microphyllous species were the dominating group in the area. The area is under heavy deforestation and over grazing pressure.

Mirza and Bashir (1996) recorded vegetation description of Sargodha with soil characteristic and seral relationships of 14 associations based on over 300 releves. The association was classified into their respective class, order and alliance. They described five associations from saline and low sodium concentration soil.

Hussain *et al.* (1997a) reported 6 plant communities of Girbanr Hills, District Swat. They observed that the original Chir Pine (*Pinus roxburghii)* forest had been replaced with open scrub or grassland through deforestation, terrace cultivation and overgrazing.

Ahmed *et al.* (1998) reported 4 ecological units, vegetation and land use map of southern Attock. They listed plant community characteristics and species list for protected and unprotected area. Overall, they reported widespread invader plant species and removed with desirable forage trees and grass species in protected area.

Dasti and Malik (2000) stated that there were significant association between landscape and patterns of environmental heterogeneous and distribution patterns of plant communities and species across an arid landscape. They suggested that altitude and substrate were ecological factors. The highest diversity in summer was due to precipitation and lowest diversity due to rainless spring.

Malik *et al.* (2000) stated that *Acacia nilotica- Haloxylon recurvum* and *Acacia nilotica- Calotropis procera* communities occurred on moderately alkaline and non saline and non sodic areas of Multan. All the soils were Sandy clay with poor organic matter content.

Awan *et al.* (2001) recorded 267 species making 21 plant communities from Swat District. Six stands were closely related, 5 slightly different and one stand showed greatest diversity.

Some work has been done on the vegetation of Azad Jammu and Kashmir and Kashmir valley which is summarized as below.

The finding of Malik and Hussain (1988) showed a high state of degradation in Badana and Palalan hills near Kotli. There were *Acacia-Olea-Dactyloctenium, Cyperus Acacia-Themeda* and *Themeda-Cissus-Olea* communities.

Malik (1989) recommended the establishment of a network of protected areas for the degraded vegetation in different vegetation zones of Kotli Azad Jammu and Kashmir, which is one of the examples of human interference.

Malik and Hussain (1990 a) observed high state of degradation from woody to scrub vegetation due to heavy deforestation and over grazing in Sundgalli and Kotli hills.

Malik *et al.*(1990 b) studied the vegetation and species composition of Sundgalli near Muzffarabad and observed high degree of degradation due to extensive deforestation. At present the area was occupied by *Malvastrum - Cymbopogon-Adiantum, Medicago - Cynodon - Euphorbia* and *Cynodon - Reinwardtia - Micromeria* communities.

The vegetation of Bhimber Hills was worked out by Ahmed (1991), who stated that high frequency and low canopy coverage of plants within the communities indicated severe biotic pressure. *Pinus roxburghii, Dodonaea viscosa, Butea monosperma, Acacia modesta* and *Carissa opaca* were seen only in the protected places.

Malik *et al.* (1993) reported that deforestation and heavy grazing has degraded the vegetation of Bhimber Hills. It was also noted that the diversity of plant species decreased from low altitude to high altitude.

Hussain *et al.* (1994) concluded that deforestation due to nomades and over extraction of medicinal plant caused degradation of vegetation in Kel (Neelum Valley).

Malik *et al.* (1994 a) while working on the vegetation of Samani and Dhirkot Hills stated that heavy deforestation, erosion and over grazing has led to degradation of forests in to scrubs. Some of the most common communities in this area were *Dicliptera - Pinus - Arthraxon, Themeda - Pinus -Cheilanthes, Themeda -Dodonaea - Pinus* and *Rosa - Berberis - Melia, Pinus -Quercus - Punica, Myrsine - Pinus -Themeda, Pinus - Berberis -Viburnum, Abies - Rosa - Quercus and Myrsine - Berberis - Themeda.* The vegetation of Pir Chinassi hills was characterized by ten communities (Ashraf, 1995). The dominant woody species included *Pinus wallichiana* and *Abies pindrow* while understorey consisted of *Viburnum grandiflorum, Indigofera, Elsholtzia, Sorbaria* and *Sibbaldia. Pinus wallichiana* appeared to be the only regenerating species while *Abies, Picea* and *Juglans* did not regenerate.

Biotic influences such as trampling, overgrazing over extraction, of medicinal plants and deforestation were the main factors for the destruction of the vegetation of Machyara National Park (Bokhari, 1995).

Malik and Zandyal (1996) reported ten plant communities in Machyara Hills, which were dominated by *Pinus wallichiana* in the tree layer. The communities included *Cedrus - Pinus, Pinus - Abies, Pinus – Bistorta* and *Pinus - Abies.*

Malik *et al*. (2001) stated that at Dao Khun *Pinus wallichiana* was the most common component of the vegetation. The vegetation as a whole was hemicryptophytic and microphyllous. *Abies pindrow* and *Picea smithiana* lack regeneration due to adverse habitat conditions.

Aims and objectives of the study

The two area chosen for study lie side by side and one of the area namely Bedori has maximum height in the area. Both were investigated to make a clear profile from subtropical to alpine vegetation. Similarly, since there are seasonal changes, therefore the study was conducted in both the season to get a complete picture of the resources and vegetation.

1. Prepare an inventory of plant i.e. floristic composition of the area and the ecological characteristics.
2. To classify plants into the economic uses/importance.
3. To see the present status of vegetation and its structure.
4. To correlate vegetation with its edaphic, climate etc.
5. To assess rangeland productivity.
6. To classify plants into various palatability classes.
7. To suggest the possible ecological approaches for the awareness and improvement of plant resources for the uplift of the socio-economic status of the area.
8. To see the effects of deforest and overgrazing in the investigated areas.
9. To generate data on seasonal variations regarding availability of forage plants.
10. To study the foraging strategy of livestock
11. To see vegetation patchiness and patch utilization by livestock.

MATERIALS AND METHODS

Materials and Methods

Locations

Two hills viz, Ganga Choti and Bedori were selected for detailed floristic and phytosociological study. Both these hills are located in Bagh district. Ganga Choti is located within latitude $34^0\ 3'\ 50''$ to $34^0\ 4'\ 50''$ north and between longitudes $73^0\ 44'\ 50''$ to $73^0\ 47'\ 3''$ east (Toposheet number 43F/16) while Bedori hills are located between $33^0\ 36'$ to $34^0\ 0'$ north and $73^0\ 23'$ to $74^0\ 9'$ east (Toposheet number 43K/1). The altitudinal variation of Ganga Choti Hills ranged between 1600 to 3000m, where as Bedori Hill ranged between 3000m to 3758m.

General survey

After going through the topographic map of area followed by frequent survey visits, which were made during the initial stages of study, the entire area was divided into different stands. The stand identification was based on the altitude, physiognomy, aspect, degradation stage and floristic composition of the area. This resulted in the identification of 15 stands. Each stand was approximately located at distance of 100m.

I. Floristic composition

Collection of plants

Frequent surveys and visits were made in different seasons for two consecutive years: 1999 and 2000 to collect the flora of the area, as it is the reflection of the climate of an area. Complete specimen of each of the species were collected in triplicate, dried, preserved and mounted on standard herbarium sheet. The plants were identified with the help of available literature (Nasir and Ali, 1971-1994; Ali and Qaisar 1995-2002) and confirmed at National Herbarium NARC, Islamabad, Pakistan Muesum of Natural History, Islamabad and Herbarium Department of Botany University of Karachi. A complete floristic list along with families was complied. Observation on the life form and phenological behaviour were recorded on spot. The voucher specimens were deposited in the Herbarium University of Azad Jammu and Kashmir, Muzaffarabad.

Phenology

The phenological observations were recorded every month for two consecutive years from May to November, 1999 and then again from May to November, 2000. The data was averaged.

The plants were classified into the following three stages.

1. Seedling (vegetatively young and pre- flowering)
2. Flowering (only flowers seen)
3. Fruiting (mature where both flowering and fruiting can be seen)
4. Dormant. (life cycle completed or fruiting completed)

Economic use classification

Plants were classified on the basis of local economic uses such as fodder species, medicinal vegetables/edible fruit, fuel wood, poisonous and roof thatching etc. The information was gathered through elders, nomads and local inhabitants of District Bagh.

II. Ecological characteristics

Life form

Life form reflects the adaptation of plants to climate. The relative proportion of different life form for a given region or area is called its biological spectrum or biospectrum. The plants were classified into different life form classes as follows after Raunkiaer (1934).

1. Phanerophytes

Species with perennating buds emerging at least 25 cm above from aerial parts of the plants. They were further subdivided in to following sub-classes.

A. Evergreen phanerophytes without bud scales

B. Evergreen phanerophytes with bud scales

C. Deciduous phanerophytes with bud scales

Each of these types may be classified according to height:

Megaphanerophytes (>30m).
Mesophanerophytes (8-30m)
Microphanerophytes (2-8m)
Nanophanerophytes (>2m)

2. Chamaephytes

The perennial shoots or buds on the surface of the ground up to 25cm. The buds receive protection by falling leaves from snow cover.

3. Hemicryptophytes

The perennial buds are located from a surface of the ground, where soil and leaves protect them. The perennial buds lie at ground level and dying back at the on set of unfavourable conditions. Stolon may or may not be present.

4. Geophytes

The perennial buds lie below the ground level or submerged in water. Rhizome, bulb or tuber geophytes, over-wintering by food stores under ground from which arise the buds to produce the next seasons aerial shoots.

5. Therophytes

Annual species, which complete the life history from seed to seed during the favorable season of the year. Their life span can be as short as few weeks. They are characteristics of desert grassland region and cultivated soil where the interference of man protect them from their (lower ground) natural competitors.

Leaf size spectra

The leaf size knowledge helps in understanding physiological process of plants and plant communities and is useful in classifying the association. The plants were divided into the following leaf size classes as described by Raunkiaer (1934).

1. Leptophyll (L): The leaf size is 25 sq. mm or 0.000025sq.m.

2. Nanophyll (N): The leaf size is 225sq. mm or 0.00025sq.m.

3. Microphyll (Mi): The leaf size is 2025sq.mm or 0.0025025 sq.m

4. Mesophyll (Me): The leaf size is 18225sq .mm or 0.018225sq .m

5. Megaphyll (Ma): The leaf size is 164025sq.mm or 64025sq.mm

However, for a rapid estimation of the leaves in the field Raunkiaer, (1934) diagram was used (Fig 2).

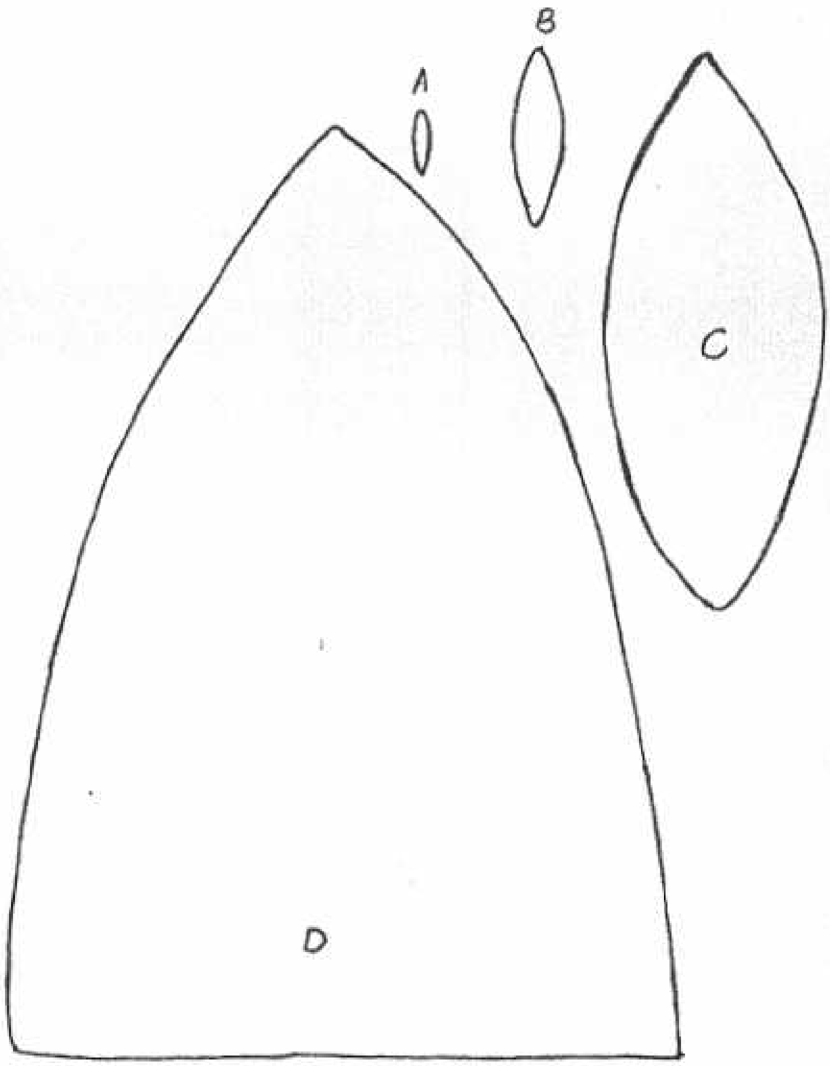

Fig2. Leaf Size Classes

1. Less than A Leptophyll(L)
2. Between A and B Nanophyll(N)
3. Between B and C Microphyll (Mi)
4. Between C and 2 time D Mesophyll (Me)
5. Between 2 time D and 8 times the size of the diagram as bouneded by the black line Megaphyll (Mg)

Reference: (Curtis and Cottam, 1950).
Scale given on page 23.

Phytosociology

Community structure

Determination of suitable size and number of quadrat

Based on species area curve, the suitable size of the quadrat for tree, shrub and herb were determined which were respectively, 10 X 2m, 5 X 2m and 0.5m. Similarly the suitable number of quadrats in each stands was 5, 10 and 15.

Distribution of quadrats

A combination of systematic and random quadrats was used as it gives better results. Thus, at Beerpani and Sudhan Galli quadrats were laid systematically while in hilly sites they were laid randomly . The distances between the two adjacent stands was approximately 100 meters.

The following phytosociological attributes were measured in each case.

Frequency

It is a percentage of sampling plots in which a given species occurs. It is concerned with the degree of uniformity of occurrence of individuals of a species within an area. Frequency gives distribution.

$$\text{Frequency} = \frac{\text{Number of times in which a species occur}}{\text{Total number of quadrats}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Total of all species}} \times 100$$

Density

It shows the numerical strength of the species.

$$\text{Density} = \frac{\text{Number of individuals}}{\text{Total number of quadrats}}$$

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Total of all species}} \times 100$$

Cover

Cover is defined as the proportion of the ground occupied by the perpendicular projection on to it of the aerial parts of individuals of the species under consideration. (Greig Smith,1983) It is infact an estimation of the area covered by given species, usually expressed as percentage of the total area and estimated form a number of sample points. The cover of herbs and shrubs was calculated using cover scale of Daubenmire (1959).

Class	*Range of mid cover (%)*	*Point coverage class(%)*
1	0-------5	2.5
2	5------25	15.0
3	25-----50	37.50
4	50-----75	62.50
5	75------95	85.00
6	95-----100	97.50

For trees, dbh at 1.5m was recorded and changed in to

Circumference =π D

D= C/π

Area=π d^2

Or

Area = CXC or

Area = $C^2/12.56$

$$\text{Basal area} = \frac{\text{Basal area of a species}}{\text{Total basal area of all species}} \times 100$$

The importance value of each species was calculated following the method of Curtis and Mcintosh (1951).

Importance value = relative density + relative frequency + relative basal area.

The species within a stand were arranged on the basis of importance values and named after the leading species with the highest importance values. The closely approaching species were considered as Co. or sub-dominants of the community.

Detrended Correspondence Analysis (DCA)

Most ordination methods, including CA, are affected by the 'arch or horse shoe effect' in which the points along a gradient form a curved pattern on the scatterplots rather than a straight line. This is a result of a mathematical distortion as the data are reduced in dimension. This arch can be removed using the detrending option. This splits the axis into segments and adjusts the scores so each segment has same mean value. It also rescales the axis so that points at the end are not closer together than in center. Detrending can make the results more interpretable, but may also averaging.

Reciprocal

Correspondence analysis can be calculated in two different ways. It can be done using a cyclic jacobi algorithm, similar to PCA, or it may be done in a reciprocal averaging manner. The jacobi method gives the complete solution (on axis for every variable) but also detrending can not be performed. The reciprocal averaging techniques allows for detrending and is faster, but will only gives the four axis. It is also more liable to inaccuracies if two or more axis have very similar eigen values.

Weighting strategy

We have to choose the scores weighted in a variety of ways, based on formulae of Orloci (1978). Rare or common species may be upweighted by multiplying the original scores by either the ratio of the total abundance for each species or vice versa. Alternatively, the scores may be adjusted to percent scales, so that the values for each axis range from 0 to 100 if the reciprocal averaging algorithm is being used then weighting is done in different ways. We may choose to have rare species downweighted before the analysis to remove the problem of unusual taxa dominating the analysis.

The data obtained was subjected to ordination analyze to detect relation between environmental factors, structure and composition of vegetation. For ordination and classification, qualitative data (presence/absence) was used as it gives clearer picture than quantitative data. For classification and ordination, Multivariate Statistical Package was used. The floristic data was subjected to normal (stands) and inverse (species) cluster analysis. For soil, altitude, pH, Ec, NO3, P, K, organic matter and total soluble salts was used. The plant associations were established by specifying the three levels of division on hierarchical diagram obtained by cluster analysis. The data was obtained both for stands (normal) and species (inverse) by using Detrended Correspondence Analysis (DCA). In this method, the final out put matrix places samples with similar composition and species with similar distribution in the sample adjacent to each other.

Family importance value (FIV)

It was calculated qualitatively as well as quantitatively (Table11). Qualitatively, 206 plants of two years (1999-2000) were divided into their respective families and collected their number, while quantitatively the importance value (IV) of each species was added and their values was putt in to their respective families.

Degree of Aggregation

The degree of aggregation of plant individual was determined through the use of an index (Curtis and Cottam (1950). This method makes use of the mathematical relationship between frequency and density as follows:

Degree of aggregation = D/d

Where D = observed density, d = expected density from the frequency of that species.

If the value is greater than 2, it indicates that the species is aggregated, while a value less than 1 indicates that the species is regular. If observed and expected densities are equal then it is randomly or unity.

Regeneration Capacity

The distribution of plants in different age classes indicates age and population status of a community i.e. weather regenerating, declining or standstill. The self-regeneration capacity of forest was determined by classifying woody plants into different diameter classes. The class interval was kept 30cm. (Table. 3)

Degree of homogeneity

The degree of homogeneity in vegetation was determined by classifying plants in various frequency classes and applying Raunkiaerian (1934) law of frequency as follows (Table.4).

The normal distribution of the frequency percentage derived from such classification is expressed as

$$A>B>C<=> D<E$$

and this has been termed as Raunkiaer's law of frequency.

Index of diversity

The index of diversity is used for the comparison of the diversity of plant communities in various altitudes. It was calculated after Shanon and Wiener (1949) as follow:

The average degree of uncertainty in predicting what species an individual chosen at random from a sample will belong to ith species

$$H= \ [(ni/n)x(ni/n)]$$

$$i=1$$

where ni= Actual number of individual of the one species in a stand.

n= Total number of individual of all the species present in that stand.

Species richness

It is the richness of flora of an area. It is an expression of simple ratios between number of species and the square root of the total number of individuals of all the species. The species richness was determined by Margalef (1958)

$$R =S -1/\ln (n)$$

Where S= total number of species in a community

ln = natural log

n= total number of individual of all species in a community.

Table 2. Age classes of woody species as defined on the basis of available data.

Class	Range of diameter
1	01-30
2	31-60
3	61-90
4	91-120
5	121-150
6	151-180
7	181-210
8	211-240
9	241-270
10	271-300
11	301-330
12	331-360
13	361-390
14	391-420
15	421-450
16	451-480
17	481-510

Table 3. Frequency classes according to Raunkiaer's classification for determining degree of homogeneity.

Frequency class	**Range (%)**
1	1-20
2	21-40
3	41-60
4	61-80
5	81-100

Equitability or Evenness

It is a component of diversity and presents the ratio of the observed diversity to the maximum diversity possible for the same number of species. The equitability components are related to the evenness of allotment of individuals among the species (Peet, 1974). The equitability was determined after Pielou (1975).

$$\text{Equitability} = \frac{\text{Natural log of expected value from Shanon -Wiener index}}{\text{Natural log of total species in a community}}$$

Maturity index

Maturity index is an indicator of maturity of stand or community. A value more than 60% indicates maturity of the stand. It was measured by Pichi – Sermolli's (1948) method as follows:

$$\textbf{Degree of maturity} = \frac{\text{Frequency values of all species in a stand}}{\text{Total number of species in a stand}}$$

Community similarity

It is used for the comparison of all communities within an area. It is defined as the number of species common to the two communities and is expressed as % of the total number for both the communities. This index was calculated after Sorenson (1948) as follows by using importance values:

$$Is = \frac{2C}{A+B} \times 100$$

Where C =Number of species common to two communities and have least Importance value.

A= Total number of importance value in community A

B = Total number of importance value in community B

Is = Index of similarity

S = Sorenson Index

Index of dissimilarity = 100-Is.

Edaphology

Soil collection

Two Kg soil samples were collected from each stand up to depth of 15 cm. and mixed to make a composite sample. It was stored in a polythene bag and labeled. These were analyzed for physical and chemical characteristics.

Soil texture

It was determined by Hydrometer method (Boyoucous, 1936). The texture class was determined with the help of textural triangle (Brady, 1990).

pH

pH of the soil sample was determined by pH meter using 1: 5 soil saturation extract (Jackson, 1962).

Electrical Conductivity

It was measured by electrical conductivity meter by using 1:5 soil saturation paste (Jackson, 1962).

Organic matter

Organic matter was determined by Walkley and Black's titration method (Jackson, 1962, Hussain, 1989).

Calcium carbonate

The amount of CaCo3 was determined by the acid neutralization method (Hussain, 1989).

Potassium

It was determined by atomic absorption spectrophotometer in the flame emission mode after diluting the sample with 250 ml of 1 % lithium sulphate solution. A standard solution was prepared to plot the standard curve and potassium of each sample was calculated from the respected curve. The method of Jackson (1962) was followed.

Calcium and Magnesium

The amount of Ca + Mg was determined by Versenate method (Jackson, 1962)

Phosphorus

Soluble P was extracted with hydrochloric-ammonium fluoride solution, and determined colourimetrically (Kitayama et al; 2000).

Sodium

The amount of sodium was determined by flame photometer (Jackson, 1962).

Total soluble salts (TSS)

Total soluble salts were determined after Hussain (1989).

$NO_3 - N$

It was determined following methods described after Hussain (1989).

Chloride

Chloride was determined by titration method following Jackson (1962).

Measurement of forage productivity

It is the standing amount of above ground plant material present in a unit area at a given time.

Herbaceous biomass

It was determined by harvest method by using 1X1 m quadrat. Four quadrats were selected from each community permanently. They were put into two different polythene bags and were averaged and weighed. Clipping was done in every month from May to November 1999 and then from May to November 2000 (2 years). The result was expressed in gm/unit area and then changed it into per hectare.

Shrub biomass

It was estimated by reference unit technique (Kirnse and Noston, 1985). A small representative part of a plant like shoot was designated as reference unit. The size of the reference unit was 10—20% of the foliage weight of average plant. The number of reference unit of plants were counted and multiplied by average weight of clipped reference unit to estimate shrub biomass production.

Degree of Palatability

Following palatability classes were used for classification of plants.

I. Non palatable

The plants not grazed by animals.

II. Palatable

All those plants which were partially or wholly grazed by animals. They were further separated on the basis of preference of animals, parts grazed, freshness / dryness of plants and availability in various seasons. The palatable species were classified into the following categories.

1. Highly palatable

Those species, which were highly preferred by animals over other plants throughout the growing season.

2. Mostly palatable

Species with intermediate or average likeness by the livestock animals.

3. Less palatable

All those species, which were less preferred by animals.

4. Rarely palatable

Species grazed rarely under compulsion when no other choice / option was available for feed.

B. Palatability parts used / by animals

The palatable species were classified on the basis of parts grazed by the livestock in the following categories.

1. Whole plants grazed.
2. Leaves, grass grazed.
3. Flowers and Fruits grazed.

C. Palatability by freshness / dryness of forage

Plants were classified whether grazed in fresh condition, dry condition or both.

D. Palatability animal preferences

The grazing animals differ in their choice of selection of food in the same rangeland. In the present case the plants were classified whether grazed by goats, sheep, cattle or by both.

RESULTS

Results

Floristic Composition

There were 206 species of 47 families (Table 5). Poaceae and Asteraceae were the dominant with 30 and 22 species, respectively. They were followed by Rosaceae (17 spp.), Pteridaceae and Fabaceae (10 spp.each), Ranunculaceae (8 spp.), Polygonaceae (7 spp.) and Lamiaceae (6 spp.). Caryophyllaceae, Pinaceae and Apiaceae had 5 species each. Gentianaceae and Onagraceae had 4 spp. each. Plantaginaceae, Salicaceae, Malvaceae, Euphorbiaceae and Boraginacea had 3 species.

Violaceae, Rubiaceae, Araceae, Liliaceae, Primulaceae, Saxifragaceae, Triliaceae, Scrophulariaceae, Lauraceae, Brassicaceae, Geraniaceae, Balsaminaceae, Cyperaceae and Convolvulaceae were represented by 2 spp. each. The remaining 24 families had one species each.

In spring at Ganga Choti and Bedori hills there were 120 and 39 species, respectively while in monsoon 119 and 81 species were reported from Ganga and Bedori hills.

In spring 45 and 20 families were reported from Ganga and Bedori hills respectively. While in monsoon there were 49 and 35 families (Table 4).

Phenological Behaviour

There were two flowering seasons in the investigated area. One from May to August followed by the second from September to November. From December to April the entire area is covered by snowfall.

In the first spell, 111 species (53.88%) flowered, which included 6.89% trees, 10.34% shrubs, 62.06% herbs and 13.79% grasses. There were 6.89% ferns in reproductive phase (i.e. sori were prominent) (Table 6)

During the second flowering spell, 95 species (46.11%) were blooming. of them. 1.12% were trees, 2.25% were shrubs, 74.15% herbs, 16.85% grasses and 5.61% ferns (in reproductive phase). There were 1 % shrubs, 15% herbs and 2% grasses, which exhibited continuous flowering during growing season.

The months of May and June and then July and August appeared to be the peak flowering seasons as 36 (18%), 53(26%), 81(39%) and 28(14%) species were in the flowering stage. The flowering percentage declined to 6 (3%) 1).5% 1(.5%) from September to November.

Majority of species viz., 55% became dormant during September while the remaining 45% also become dormant in November.

Trees such as *Abies pindrow, Quercus dilatata, Picea smithiana, Pinus wallichiana* and *Ficus palmata* flowered in April and May and thereafter cones of conifers started maturing within the next 2-3 years. During this time cones remaining intact on parent trees. Shrubby species had maximum flowering around May and June, which decreased to 20% towards the end of September. Thus, during September 80% species became dormant. From here onward with the onset of winter most (80%) species remain dormant till next April.

There were 38 herbaceous species in flowering stage in May 46 in June and 83 in July, which decline to 27 in August. There was a tendency of declining flowering from September to October. Of the total 127 recorded herbaceous species, only 33% completed their life cycle at the end of June.

Maximum flowering of grass species (46.63%) was observed in May, followed by 28.5% in July. In the remaining months grasses flowered less than 10%.

Economic use of classification

The total useable species were 198 (Table 5_b). While for the remaining 8 species no current use was discovered.

There were 29% (83 spp.) of medicinal plants, 46 % (134 spp.) fodder / forage species, 5% (15 spp.) fuel wood species, 1 % (4 spp.) timber woood species, 7 % (20 spp.) vegetable / edible fruit species, 4 % (12 spp.) poisonous species, .4 % (1 spp) roof thatching species, 2.5 % (7 spp.) tannin / dying species, 2 % (6 spp.) resin yielding species, 2 % (7 spp.) herbal tea species and 0.3 % (1 spp.) evil repellant species. The data shows that the area is suitable for rangeland and medicinal plants.

Life form spectra

The life form spectra are depicted in Table 7.

In spring there were 45 % hemicryptophytes (54 spp.), 23% therophytes (28 spp.), 9 % geophytes (11 spp), 8 % megaphanerophytes (9 spp.) 10 %

nanophanerophytes (12 spp.), 2 % chamaephytes (3 spp.) and lianas 0.83 % (1 sp.) in Ganga Choti Hills, whereas in Bedori Hill there were 64 % hemicryptophytes (25 spp.), geophytes and therophytes having 5 species each (13 %). Nanophanerophytes were 8 % (3 spp.) and chamaephytes were 2 % (1 sp.).

Similarly in monsoon, there were 39 % hemicryptophytes (46 spp) followed by therophytes 24% (29 spp.). Geophytes 17% (20 spp.), nanophanerophytes 10 % (12 spp.), megaphanerophytes 8 % (4 spp.) and lianas and chamaephytes 1 % and 0.48 % with (2 spp.) and (1 sp.), respectively (Table 7).

Leaf spectra

The leaf size spectra has been shown in Table 8.

It shows that in spring 40 % were microphyllous (48 spp.) followed by nanophylls 32 % (39 spp.), 22 % (26 spp.), leptophylls 6 % (7 spp.), microphyll harboured in Ganga Hills, whereas in Bedori Hills nanophylls were dominant 41 % (16 spp.) followed by 33 % (13 spp.) microphylls, 20 % (8 spp.) leptophylls 5 % (2 spp.).were mesophyll (Table 8).

Similarly in monsoon at Ganga Hill, nanophylls and microphylls had 37and 36 % with 44 and 43 species respectively whereas ther were leptophylls 18 % (21 spp.) and mesophylls 9% (11 Spp.). In Bedori Hills microphyllous were dominant(41 %,33 spp.) followed by nanophylls 33 % (27 spp.) while leptophylls were 21 % (17 spp.) and mesophylls 5 % (4 spp.).

Phytosociology

Community structure

Spring Aspect

There were nine plant communities in Ganga Chotti hills and 6 communities at Bedori Hills during spring. The details are as follows.

1. *Themeda-Cyperus-Pinus* community (TCP)

At 1700 m, *Themeda-Cyperus-Pinus* community was present (Table 9 and appendix1). Of the 14 recorded species, there were 2 tree, 5 shrub, 5 herb and 2 grass species. The TIV contributed by 3 dominants was 130.79 while TIV of 168.95 was provided by the remaining species. The contribution by tree was 65.90, by shrubs 66.83, herbs 79.06 and grasses 86.36.

Table 4. Number of species and their families in spring and monsoon recorded from Ganga and Bedori hills.

		Monsoon aspect		Spring aspect	
		Ganga	Bedori	Ganga	Bedori
1	Acanthaceae	0	0	1	0
2	Amaranthaceae	01	0	0	0
3	Apiaceae	1	1	2	2
4	Araceae	02	01	0	01
5	Araliaceae	1	0	1	0
6	Asteraceae	12	11	22	06
7	Balsaminaceae	1	2	1	1
8	Berberidaceae	01	0	1	0
9	Boraginaceae	1	1	1	1
10	Brassicaceae	1	0	0	0
11	Buxaceae	1	0	1	0
12	Cannabinaceae	1	0	1	0
13	Caprifoliaceae	1	0	1	0
14	Caryophyllaceae	04	01	01	0
15	Chenopodiaceae	1	0	0	0
16	Companulaceae	0	1	0	0
17	Convolvulaceae	1	0	1	0
18	Cupressaceae	0	1	0	1
19	Cyperaceae	2	2	1	1
20	Dipsacaceae	1	0	0	0
21	Euphorbiaceae	1	1	1	0
22	Fagaceae	1	0	1	0
23	Gentianaceae	02	0	05	01
24	Geraniaceae	02	01	02	01
25	Irridaceae	0	1	0	0
26	Lamiaceae	06	03	06	03
27	Lauraceae	1	0	1	0
28	Leguminosae	06	05	05	02
29	Liliaceae	02	0	0	0
30	Malvaceae	01	01	0	0
31	Moraceae	1	0	1	0
32	Morinaceae	0	1	0	0
33	Myrsinaceae	0	0	1	0
34	Nyctaginaceae	0	0	1	0
35	Onagraceae	1	1	4	2
36	Orchidaceae	1	0	0	0
37	Oxalidaceae	1	1	1	0

33	Myrsinaceae	0	0	1	0
34	Nyctaginaceae	0	0	1	0
35	Onagraceae	1	1	4	2
36	Orchidaceae	1	0	0	0
37	Oxalidaceae	1	1	1	0
38	Pinaceae	04	0	04	0
39	Plantaginaceae	04	0	04	0
40	Poaceae	15	12	15	02
41	Podophyllaceae	0	1	0	0
42	Polygonaceae	05	05	04	01
43	Primulaceae	01	02	0	02
44	Pteridaceae	06	01	06	02
45	Punicaceae	1	0	1	0
46	Ranunculaceae	03	05	01	03
47	Rosaceae	08	07	08	05
48	Rubiaceae	01	02	01	01
49	Rutaceae	1	0	1	0
50	Salicaceae	2	1	2	1
51	Saxifragaceae	1	1	1	0
52	Scrophulariaceae	2	1	1	0
53	Solanaceae	1	0	1	0
54	Triliaceae	2	1	1	0
55	Umbelliferae	0	0	1	0
56	Urticaceae	1	1	1	0
57	Valerianaceae	0	1	0	0
58	Violaceae	2	1	2	0
59	Total	119	81	120	39

Table 5. Floristic composition, life form and leaf spectra recorded from Ganga Chotti and Bedori hills during 1999-2000.

S. No	Species	Family	Monsoon aspect		Spring aspect		Life form	Leaf spectra
			Ganga	Bedori	Ganga	Bedori		
1	*Abies pindrow* Royle	Pinaceae	+	-	+	-	Mp	L
2	*Achillea millefolium* L.	Asteraceae	+	-	+	+	H	L
3	*Aconitum chasmenthum* Stapf	Ranunculaceae	-	+	-	+	H	Mi
4	*Aconitium laeve* Royle	Ranunculaceae	-	+	-	+	H	N
5	*Aconitum violaceum* jacquem ex Stapf	Ranunculaceae	-	+	-	-	H	N
6	*Adiantum venustum* D.Don	Pteridaceae	+	-	+	+	G	L
7	*Adiantum capilus veneris* L.	Pteridaceae	-	-	+	-	G	N
8	*Agrostis alba* auct	Poaceae	-	-	+	-	H	N
9	*Agrostis canina* auct	Poaceae	+	-	-	-	H	N
10	*Agrostis gigantea* Roth	Poaceae	-	+	-	-	G	N
11	*Ajuga bracteosa* Wallich	Lamiaceae	-	-	+	-	Ch	Mi
12	*Allium humile* Kunth	Liliaceae	-	+	-	-	G	N
13	*Amaranthus viridus* L.	Amaranthaceae	+	-	-	-	Th	Mi
14	*Anaphalis margaritacea* (L.) Bth	Asteraceae	-	+	+	-	H	Mi
15	*Anaphalis nepalensis* Spreng. *Hand*	Asteraceae	-	+	+	+	H	Mi
16	*Anaphalis timmua* D. Don	Asteraceae	-	-	+	-	H	Mi
17	*Andropogon munroi* C.B.Clarke	Poaceae	-	-	+	-	H	L
18	*Androsace rotundifolia* Hardw	Primulaceae	+	+	-	+	H	N
19	*Aquilegia pubiflora* Wallich	Ranunculaceae	-	-	-	+	H	Mi
20	*Arenaria neel* Wight and Arn	Caryophyllaceae	+	-	-	-	Th	L
21	*Arenaria orbiculata* Royle	Caryophyllaceae	+	-	-	-	Th	L
22	*Arisaema intermedium* Blume	Araceae	+	-	-	+	G	Me
23	*Arisaema jacquemontii* Blume	Araceae	+	+	-	-	G	Mi

24	*Artemisia wallichiana* Besser	Asteraceae	-	+	-	-	H	N
25	*Artemisia scoparia* Waldst and Kit	Asteraceae	+	-	+	-	H	N
26	*Artemisia herba-alba* Asso	Asteraceae	-	+	+	-	H	N
27	*Arundo donax* L.	Poaceae	-	-	+	-	G	Me
28	*Asplenium adiantum nigrum* L.	Pteridaceae	+	-	-	-	G	N
29	*Aster alpinus*(Clarke) Hutch	Asteraceae	-	+	+	-	H	N
30	*Astragalus floridus* L	Leguminosae	-	+	-	-	Np	L
31	*Athyrium mackinnoni* (Hope) C. Chr	Pteridaceae	+	-	-	-	G	Me
32	*Avena barbata* Pott ex Link	Poaceae	+	+	+	-	Th	N
33	*Berberis lycium* Royle	Berberidaceae	+	-	+	-	Np	Mi
34	*Bergenia ciliata* (Haw) Sternb	Saxifragaceae	-	-	+	_	H	Me
35	*Bergenia ligulata* (Str) Hot	Saxifragaceae	+	+	-	-	G	Mi
36	*Biden bipinnata* L.	Asteraceae	-	-	+	-	H	Mi
37	*Bistorta amplexicaulis*(D.Don) Greene	Polygonaceae	-	+	-	-	H	L
38	*Brachiaria ramosa* (L) Stapf	Poaceae	+	-	+	+	Th	N
39	*Bromus tectorum* L.	Poaceae	-	-	+	-	Th	L
40	*Brunella vulgaris*.L	Lamiaceae	+	+	+	-	H	Mi
41	*Bupleurum longicaule* Wall Ex DC	Apiaceae	-	+	+	+	H	L
42	*Calamintha umbrosum* (M.Bieb) K.Koch	Lamiaceae	-	-	+	+	H	N
43	*Caltha palustris* L.	Ranunculaceae	+	+	-	-	H	N
44	*Cannabis sativa* L.	Cannabinaceae	+	-	+	-	Th	N
45	*Cenchrus biflorus* Roxb	Poaceae	+	-	+	-	Th	L
46	*Cenchrus uniflorus* Ehr	Poaceae	+	-	-	-	H	L

47	*Chenopodium ambrosiodes L.*	Chenopodiaceae	+	-	-	-	H	L
48	*Chrysopogon aucheri* (Boiss) Stapf	Poaceae	-	+	-	-	H	L
49	*Circaea alpina* Asch&Mag	Onagraceae	-	-	+	-	H	N
50	*Circium arvense* (L).Scop	Asteraceae	+	-	+	-	H	N
51	*Clematis grata* Wallich	Ranunculaceae	+	-	-	-	L	N
52	*Clinopodium alpinum* Cass	Asteraceae	-	-	+	-	H	Mi
53	*Codonopsis ovata* Bth	Campanulaceae	-	+	-	-	H	Mi
54	*Convolvulus arvensis Var.linearifolius* Choisy	Convolvulaceae	+	-	+	-	G	N
55	*Conyza canadensis* L.	Asteraceae	+	-	+	-	Th	Mi
56	*Cotoneaster acuminatus* Lindley	Rosaceae	-	-	+	-	Np	N
57	*Cynodon dactylon* (L.) Pers	Poaceae	+	-	+	-	H	L
58	*Cynoglossum lanceolatum* Forssk	Boraginaceae	-	-	-	-	H	N
59	*Cynoglossum glochidiatum* Wallich ex Benth	Boraganaceae	+	-	+	-	H	N
60	*Cyperus niveus* Retz	Cyperaceae	+	+	-	-	G	N
61	*Cyperus panicoides* L.	Cyperaceae	+	+	+	+	G	N
62	*Cypripedium cordigerum* D.Don.Prod	Orchidaceae	+	-	-	-	G	Mi
63	*Cystopteris fragilis* (L) Bth	Pteridaceae	+	+	-	+	G	Mi
64	*Dactylis glomerata* L.	Poaceae	+	+	+	-	H	N
65	*Desmodium multiflorum* DC	Leguminosae	+	-	+	-	Np	N
66	*Desmostachya bipinnata* (L) Stapf	Poaceae	+	-	-	-	G	N
67	*Dichanthium annulatum* (Forssk).Stapf	Poaceae	-	-	+	-	H	L
68	*Dipsacus inermis* Wall	Dipsaceae	+	-	-	-	H	N

69	*Dryopteris stewartii* Fress	Pteridaceae	+	-	-	-	G	Me
70	*Elsholtzia strobilifera* Bth	Nyctaginaceae	-	-	+	-	Th	N
71	*Elymus repens* (L.)Gould	Poaceae	-	+	-	-	G	L
72	*Epilobium cylindricum* D.Don	Onagraceae	-	-	+	+	H	N
73	*Epilobium hirsutum* L.	Onagraceae	-	+	+	+	H	N
74	*Erigeron alpinus* L..	Asteraceae	+	-	+	-	Th	N
75	*Erigeron bellidioides* Buch	Asteraceae	-	-	-	-	H	N
76	*Euphorbia helioscopia* L.	Euphorbiaceae	+	-	-	-	Th	N
77	*Euphorbia wallichii* HK..f	Euphorbiaceae	-	+	-	-	H	Mi
78	*Euphorbia prostrata* Ait	Euphorbiaceae	-	-	+	-	H	L
79	*Festuca modesta* Nees	Poaceae	+	+	+	-	H	L
80	*Ficus palmata* Forssk	Moraceae	+	-	+	-	Mp	Mi
81	*Fragaria nubicola* Lindl.	Rosaceae	+	+	+	+	H	Mi
82	*Fritillaria roylei* Hook	Liliaceae	-	+	-	-	G	N
83	*Galium elegan* Wall	Rubiaceae	+	-	+	+	Th	N
84	*Gentiana cachmerica* DC	Gentianaceae	-	+	+	+	H	N
85	*Gentiana decumbens* L.P Clarke	Gentianaceae	-	+	+	-	H	Mi
86	*Gentiana kurroo* Royle	Gentianaceae	+	-	+	-	Th	N
87	*Geranium rotundifolium* L.	Geraniaceae	+	-	+	-	Th	N
88	*Geranium wallichianum* D.Don	Geraniaceae	+	+	+	+	H	Me
89	*Gerbera gossypina* Royle	Asteraceae	+	-	+	-	Th	Mi
90	*Geum elatum* Wall	Rosaceae	-	+	-	-	H	Mi
91	*Hedra nepalensis* K. Koch	Araliaceae	+	-	+	-	L	N
92	*Impatiens edgeworthii* H.K.f	Balsaminaceae	+	+	-	+	Th	Mi
93	*Impatiens glandulifera* Royle	Balsaminaceae	-	+	+	-	Th	Mi
94	*Imperata cylindrica* (L.)	Poaceae	+	-	-	-	G	N
95	*Indigofera heterantha* Wallich	Leguminosae	+	-	+	-	Np	N

96	*Ipomoea perforatum* L.	Convolvulaceae	-	-	+	-	Th	Mi
97	*Iris lactea* L.	Iridaceae	-	+	-	-	G	L
98	*Jasminum officinale* L.	Oleaceae	+	-	+	-	Np	N
99	*Juniperus communis* L.	Cupressaceae	-	+	-	+	Np	L
100	*Koeleria macrantha* (Ledeb) Schult	Poaceae	–	+	-	-	G	L
101	*Lactuca dissecta* L.	Asteraceae	+	-	-	-	H	N
102	*Lavaetra cachemiriana* Camb	Malvaceae	-	+	-	-	H	N
103	*Leontopodium alpinum* Cass	Asteraceae	+	+	+	+	H	N
104	*Lepidium sativum* L.	Brassicaceae	+	-	-	-	H	N
105	*Lespedeza sericea* (Thunb) Miq	Leguminosae	+	+	+	+	Th	L
106	*Machilus odoratissima* Nees	Lauraceae	+	-	+	-	Mp	N
107	*Malva sylvestris* L.	Malvaceae	+	-	-	-	H	Mi
108	*Malva verticillata* L.	Malvaceae	-	+	-	-	Th	Mi
109	*Medicago falcata* L.	Leguminoseae	-	+	-	-	H	N
110	*Medicago leciniata* (L) Mill	Leguminoseae	-	-	+	-	Th	N
111	*Melilotus indica* (L) All	Leguminosae	+	-	-	-	H	N
112	*Mentha longifolia* (L.)Hudson	Lamiaceae	+	-	+	-	Th	Mi
113	*Micromeria biflora* (Ham) Bth	Lamiaceae	+	-	+	-	Th	L
114	*Minuartia kashmirica* (edgew) Mattf	Caryophyllaceae	-	+	-	-	H	N
115	*Morina coulteriana* Royle	Morinaceae	-	+	-	-	H	N
116	*Myriactus nepalensis* Bth	Asteraceae	-	-	+	-	H	N
117	*Myrsine africana* L.	Myrsinaceae	-	-	+	-	Np	Mi
118	*Nepeta podostachys* Bth	Lamiaceae	+	-	+	+	Ch	L
119	*Oenanthe javanica* (Blume) DC	Apiaceae	-	-	+	-	Ch	Mi
120	*Oenothera rosea* (L). Her	Onagaracea	+	-	+	-	H	N

121	*Onychium japonicum* (Kunze) Wall	Pteridaceae	+	-	+	-	G	L
122	*Oxalis corniculata* L.	Oxalidaceae	+	+	+	-	H	N
123	*Phalaris minor* Retz	Poaceae	-	-	-	-	Th	L
124	*Phlomis bracteosa* Royle ex Bth	Lamiaceae	+	-	-	-	H	Mi
125	*Phleum alpinum* L.	Poaceae	+	+	-	+	G	L
126	*Picea smithiana*(Wallich) Boiss	Pinaceae	+	-	+	-	Mp	L
127	*Pinus roxburghii* Sargent	Pinaceae	+	-	+	-	Mp	L
128	*Pinus wallichiana* A.B.Jackson	Pinaceae	+	-	+	-	Mp	L
129	*Plantago lanceolata* L.	Plantaginaceae	+	-	+	-	H	N
130	*Plantago major* L	Plantaginaceae	+	-	-	-	H	Mi
131	*Plantago ovata* Forssk	Plantaginaceae	-	-	+	-	Th	L
132	*Plectranthus rugosus* Wall	Lamiaceae	+	-	-	-	Np	N
133	*Pleurospermum govanianum* (DC) Clarke	Apiaceae	-	-	+	+	H	L
134	*Poa annua* L.	Poaceae	+	+	+	-	Th	L
135	*Poa bactriana* Rozhev	Poaceae	-	+	-	-	H	L
136	*Poa infirma* H.Bk	Poaceae	-	+	-	-	Th	L
137	*Podophyllum hexandrum* Royle	Podophylaceae	-	+	-	-	H	Me
138	*Polygonum album* Ham	Polygonaceae	+	-	-	-	H	Mi
139	*Polygonum amplexicaulis* D.Don	Polygonaceae	+	+	+	-	H	Mi
140	*Polygonum alpinum* All	Polygonaceae	-	+	-	-	H	MI
141	*Polypogon monspeliensis* (L.) Desf	Poaceae	-	+	-	+	Th	Mi
142	*Potentilla cuneata* Wallich	Rosaceae	-	+	-	-	H	L
143	*Potentilla eriocarpa* Wallich	Rosaceae	+	+	+	+	H	N

144	*Potentilla gelida* C.A. Meyer	Rosaceae	+	-	-	-	H	L
145	*Potentilla geradiana* L.	Rosaceae	-	+	+	-	H	L
146	*Primula denticulata* Smith	Primulaceae	-	+	-	-	H	Mi
147	*Pseudomertensia echioides*(Bth) Riedl	Boraginaceae	-	-	-	+	H	N
148	*Pseudomertensia moltkioides* (Royle) Kazmi	Rosaceae	-	-	-	+	H	N
149	*Pteris cretica* L.	Pteridaceae	+	-	+	-	G	Mi
150	*Pteris vitata* L.	Pteridaceae	+	-	+	-	G	Mi
151	*Punica granatum* L.	Punicaceae	+	-	+	-	Mp	Mi
152	*Pyrus pashia* Buch	Rosaceae	+	-	+	-	Mp	Mi
153	*Quercus dilatata* Royle	Fagaceae	+	-	+	-	Mp	Mi
154	*Ranunculus repens* L.	Ranunculaceae	+	-	-	-	H	Mi
155	*Ranunculus laetus* Wallich	Ranunculaceae	+	+	+	+	H	Mi
156	*Rosa ellipticus* Smith	Rosaceae	-	-	+	-	Np	Mi
157	*Rosa macrophylla* Lindley	Rosaceae	-	+	-	+	Np	Mi
158	*Rosa webbiana* Wallich ex Royle	Rosaceae	+	-	+	-	Np	Mi
159	*Rubia tinctorum* L.	Rubiaceae	+	-	-	-	H	N
160	*Rubus niveus* Wallich	Rosaceae	+	-	+	-	Np	Me
161	*Rumex hastatus* D. Don	Polygonaceae	+	-	+	-	H	Mi
162	*Rumex dentatus* L.	Polygonaceae	+	-	+	-	H	Mi
163	*Rumex nepalensis* D.Don	Polygonaceae	+	+	+	-	H	Mi
164	*Saccharum spontaneum* L.	Poaceae	+	-	+	-	G	L
165	*Salix albeda* Anderson	Salicaceae	+	-	+	-	Np	Mi
166	*Salix denticulata* Anderson	Salicaceae	+	-	+	-	Np	Mi
167	*Salix grandiflorum* L.	Salicaceae	-	+	-	+	Np	Mi
168	*Sarcococca saligna* (D.Don)	Buxaceae	+	-	+	-	Np	Mi

	Muel							
169	*Saussurea lappa* Clark	Asteraceae	+	+	-	-	H	Me
170	*Saxifraga ciliata* Royle	Saxifragaraceae	-	-	-	-	H	Me
171	*Scutellaria chamaedrifolea* Bth	Lamiaceae	-	+	-	-	H	Mi
172	*Senecio ligularia* Hook	Asteraceae	-	+	-	+	H	Mi
173	*Senecio chrysanthemoides* DC	Asteraceae	-	+	+	+	H	Mi
174	*Senecio graciliflorus* DC	Asteraceae	-	+	+	-	H	Mi
175	*Senecio nudicaulis* DC	Asteraceae	-	-	+	-	H	Mi
176	*Senecio quadriflorum* Pall	Asteraceae	-	-	-	-	H	Mi
177	*Selinum tenuifolium* Wall	Apiaceae	-	+	-	-	H	N
178	*Sibbaldia cuneata* Hornem	Rosaceae	+	+	+	+	H	N
179	*Solanum nigrum* L.	Solanaceae	+	-	+	-	Th	Mi
180	*Sonchus arvense L.*	Asteraceae	+	-	-	-	Th	Mi
181	*Sonchus asper* Hill	Asteraceae	+	-	+	-	Th	Mi
182	*Sorghum halepense* (L)Pers	Poaceae	+	-	+	-	G	N
183	*Spiraea canescens* D.Don	Rosaceae	+	-	-	-	H	Me
184	*Stellaria media* (L) Vill	Caryophyllaceae	+	-	-	-	Th	N
185	*Stellaria monosperma* Buch	Caryophyllaceae	+	-	+	-	H	N
186	*Strobilanthes attenuata* Nees	Acanthaceae	-	-	+	-	H	Mi
187	*Swertia petiolata* D.Don	Gentianaceae	-	-	+	-	Th	Mi
188	*Tagetes minuta* L.	Asteraceae	-	-	+	-	Th	Mi
189	*Taraxacum officinales* Weber	Asteraceae	+	+	+	+	H	Mi
190	*Thlaspi arvense* L.	Brassicaceae	-	-	+	-	Th	Mi
191	*Themeda anathera* Ness ex Steud	Poaceae	+	+	+	-	H	L
192	*Thelypteris levinger* Clark	Pteridaceae	-	-	+	-	G	Me
193	*Thymus serphyllum* L.	Lamiaceae	+	+	-	+	Th	N

194	*Trifolium repens* L.	Leguminosae	+	+	-	+	H	N
195	*Trifolium resupinatum* L.	Leguminosae	+	+	+	-	H	N
196	*Trillidium repen* L.	Trilliaceae	+	-	+	-	G	Me
197	*Trilidium govanianum* (D. Don) Kunth	Trilliaceae	+	+	-	-	G	Me
198	*Tussilogo farfara* L.	Asteraceae	-	-	+	-	H	L
199	*Urtica dioica* L.	Urticaceae	+	+	+	-	H	Mi
200	*Valeriana pyrolifolia* Dcne	Valairanaceae	-	+	-	-	G	Mi
201	*Verbascum thapsus* L.	Scrophullariaceae	+	-	-	-	Th	Me
202	Veronica *melissaefolia* Royle	Scrophullariaceae	+	+	+	-	H	Mi
203	*Viburnum grandiflorum* Wallich ex DC	Caprifoliaceae	+	-	+	-	Np	Me
204	*Viola odorata* L.	Violaceae	+	-	+	-	Th	Mi
205	*Viola serpen* Wallich	Violaceae	+	+	+	-	Th	Mi
206	*Zanthoxylum armatum* DC	Rutaceae	+	-	+	-	Np	Mi
		Total	**119**	**81**	**120**	**39**		

Table 6. Phenology of plants recorded from Ganga Choti and Bedori Hills during 1999-2000.

S.No	Species	Seedling	Flowering	Fruitin g	Dormant
	Tree Layer				
1	*Abies pindrow* Royle	Mar	Apr	May	July
2	*Ficus palmata* Forssk	Through out year	May	Aug	Sep
3	*Picea smithiana*(Wallich) Boiss	Mar	Apr	May	July
4	*Pinus roxburghii* Sargent	Mar	Apr	May	July
5	*Pinus wallichiana* A.B.Jackson	Mar	Apr	June	July
6	*Punica granatum* L.	Through out year	Jul	Aug	Sep
7	*Pyrus pashia* Buch	April	May	July	Aug
8	*Quercus dilatata* Lind	Mar	Apr	June	July
9	*Machilus odoratissima* Nees	May	July	Aug	Sep
10	*Astragalus floridus* L	June	Aug	Sep	Oct
	Shrub layer				
11	*Berberis lycium* Royle	Mar	Apr	June	July
12	*Cotoneaster acuminatus* Lindley	May	June	July	Sep.
13	*Desmodium multiflorum* DC	June	July	Sep	Oct
14	*Indigofera heterantha* Wall	June	July	Sep	Oct
15	*Jasminum officinale* L.	Through out year	June	July	Aug
16	*Juniperus communis* L.	Mar	May	June	July
17	*Minuartia kashmirica* Mattf	May	Aug	Sep	Oct
18	*Myrsine africana* L.	Mar	May	June	July
19	*Rosa ellipticus* Smith	May	June	July	Sep
20	*Rosa macrophylla* Lindley	May	June	July	Sep
21	*Rosa webbiana* Wallich ex Royle	May	July	Aug	Sep
22	*Rubus niveus* Wallich	May	July	Aug	Sep
23	*Salix albeda* L	June	July	Aug	Oct
24	*Salix denticulata* Anderson	May	June	July	Aug
25	*Salix grandiflorum* L.	May	July	Aug	Sep
26	*Sarcococca saligna* (D.Don) Muel	Through out year	Apr	May	June
27	*Viburnum grandiflorum* Wallich ex DC	Oct	Nov	May	June
28	*Zanthoxylum armatum* DC	Mar	Apr	May	June

	Herb Layer				
29	*Achillea millefolium* L.Yarrow	May	July	Aug	Sep
30	*Aconitum chasmenthum* Stapf	July	Aug	Sep	Oct
31	*Aconitium laeve* Royle	July	Aug	Sep	Oct
32	*Aconitum violaceum* Stapf	July	Aug	Sep	Oct
33	*Ajuga bracteosa* Wallich	April	June	July	Oct
34	*Allium humile* Kunth	May	July	Sep	Oct
35	*Amaranthus viridus* L.	May	July	Aug	Sep
36	*Anaphalis margaritacea* (L) Bth	July	Sep	Oct	Nov
37	*Anaphalis nepalensis* (Spreng) Hand	May	July	Aug	Sep
38	*Anaphalis timmua* D. Don	May	July	Sep	Oct
39	*Androsace rotundifolia* Hardw	Mar	Aug	Sep	Oct
40	*Aquilegia pubiflora* Wallich	May	Jul	Sep	Oct
41	*Arenaria neel.* Wight Arn	Mar	Apr	Aug	Sep
42	*Arenaria orbiculata* Royle	June	Aug	Sep	Oct
43	*Arisaema intermedium* Blume	May	June	Jul	Aug
44	*Arisaema jacquemontii* Blume	May	June	July	Aug
45	*Artemisia wallichiana* Besser	June	July	Aug	Sep
46	*Artemisia scoparia* Waldst and Kit	Apr.	July	Aug	Sep
47	*Artemisia herba- alba* Asso	May	July	Sep	Oct
48	*Aster alpinus*(Clarke) Hutch	May	June	Aug	Sep
49	*Bergenia ciliata* (Ham) Sternb	Apr	June	July	July
50	*Bergenia ligulata* (Str) Hot	Apr	May	June	July
51	*Biden bipinnata* L.	Apr	May	July	Sep
52	*Bistorta amplexicaulis(D.Don) Greene*	May	July	Aug	Sep
53	*Brunella vulgaris*.L	May	June	Aug	Sep
54	*Bupleurum longicaule* Wall ex DC	May	July	Sep	Oct
55	*Calamintha umbrosum* Wallich ex Bth	May	July	Aug	Sep
56	*Caltha palustris* L.	May	July	Aug	Oct
57	*Cannabis sativa* L.	May	June	July	Aug
58	*Chenopodium ambrosioides* L.	May	June	July	Sep

59	*Circaea alpina* Asch&Mag	June	Jul	Aug	Sep
60	*Circium arvense* (L).Scope	June	July	Aug	Oct
61	*Clematis grata* Wall	Through out year	July	Aug	Sep
62	*Clinopodium alpinum* Cass	Oct	June	July	Aug
63	*Codonopsis ovata* Bth	June	July	Aug	Oct
64	*Convolvulus arvensis Var. linerarifolius* Choisy	Through out year	July	Aug	Sep
65	*Conyza canadensis* L.	May	June	July	Aug
66	*Cotoneaster acuminatus* Lindley	May	June	July	Aug
67	*Cynoglossum lanceolatum* Forssk	Apr	June	July	Aug
68	*Cynoglossum* glochidiatum Wall	May	July	Aug	Sep
69	*Cyperus niveus* Retz	May	June	July	Sep
70	*Cyperus panicoides* L.	June	July	Aug	Sep
71	*Cypripedium cordigerum* D.Don.	May	June	July	Sep
72	*Dipsacus inermis* Wall	June	July	Aug	Sep
73	*Elsholtzia strobilifera* Bth	Through out year	July	Sep	Oct
74	*Epilobium cylindricum* D.Don	May	Jul	Sep	Oct
75	*Epilobium hirsutum* L.	May	Jul	Sep	Oct
76	*Erigeron alpinus* L.	Apr	June	Aug	Sep
77	*Erigeron bellidioides* Buch	Apr	June	Aug	Sep
78	*Euphorbia helioscopia* L.	Apr	July	Aug	Sep
79	*Euphorbia wallichii* HK.f	Apr	May	Sep	Oct
80	*Euphorbia prostrata* Ait	Through out year	Aug	Sep	Oct
81	*Fragaria nubicola* Lindl.	Apr	June	July	Aug
82	*Fritillaria roylei* H.K.f	May	July	Aug	Sep
83	*Galium elegan* Wall	June	July	Aug	Sep
84	*Gentiana cachmerica* DC	July	Aug	Sep	Oct
85	*Gentiana decumbens* L.P Clarke	July	Aug	Sep	Oct
86	*Gentiana kurroo* Royle	July	Aug	Sep	Oct
87	*Geranium rotundifolium* L.	Mar	May	June	Aug
88	*Geranium wallichianum* D.Don	June	July	Sep	Oct
89	*Gerbera gossypina* Royle	Oct	May	July	Aug
90	*Geum elatum* Wall	May	June	Aug	Sep
91	*Hedra nepalensis* K.Koch	Through out year	Aug	Oct	Nov

92	*Impatiens edgeworthii* H.K.f	June	Sep	Oct	Nov
93	*Impatiens glandulifera* Royle	July	Aug	Sep	Oct
94	*Ipomoea perforatum* L.	May	June	Aug	Sep
95	*Iris lactea* L.	May	June	Aug	Sep
96	*Lactuca dissecta* L.	May	July	Aug	Sep
97	*Lavaetra kashmiriana* Camb	May	July	Aug	Sep
98	*Leontopodium alpinum* Cass	Apr	June	Aug	Oct
99	*Lepidium sativum* L.	May	June	July	Aug
100	*Lespedeza sericea* (Thunb) Miq	June	July	Aug	Sep
101	*Malva sylvestris* L.	Apr	June	Aug	Sep
102	*Malva verticillata* L.	Apr	June	July	Sep
103	*Medicago falcata* L.	May	July	Aug	Sep
104	*Medicago leciniata (L) Mill*	May	July	Aug	Sep
105	*Melilotus indica (L) All*	May	July	Aug	Sep
106	*Mentha longifolia (L)Hudson*	May	June	July	Sep
107	*Micromeria biflora* (Ham) Bth	May	June	July	Aug
108	*Morina coulteriana* Royle	May	July	Aug	Oct
109	*Myriactus nepalensis* Bth	Aug	Sep	Oct	Nov
110	*Nepeta podostachys* Bth	July	Aug	Sep	Oct
111	*Oenanthe javanica* (Blume) DC	Apr	July	Aug	Sep.
112	*Oenothera rosea*(L).Her	May	July	Aug	Oct
113	*Oxalis corniculata L.*	Apr	May	June	July
114	*Phlomis bracteosa* Royle	May	June	July	Aug
115	*Plantago lanceolata L.*	Apr	Aug	Sep	Oct
116	*Plantago major* L	July	Aug	Sep	Nov
117	*Plantago ovata* Forssk	May	July	Aug	Nov
118	*Plectranthus rugosus* Wall	July	Sep	Oct	Nov
119	*Pleurospermun govanianum* DC Clarke	May	July	Aug	Oct
120	*Podophyllum emodi* Wall	Apr	May	June	July
121	*Polygonum album* Ham	May	July	Aug	Sep
122	*Polygonum amplexicaulis* D.Don	May	July	Aug	Sep
123	*Polygonum alpinum* All	May	June	July	Aug
124	*Potentilla cuneata* Pall	June	July	Aug	Sep
125	*Potentilla eriocarpa* Wallich	June	July	Aug	Sep
126	*Potentilla gelida* C.A. Meyer	May	July	Sep	Oct

127	*Potentilla geradiana* L.	June	July	Aug	Sep
128	*Primula denticulata* Smith	Apr	July	Aug	Sep
129	*Pseudomertensia echioides* Bth	May	July	Aug	Sep
130	*Pseudomertensia moltkioides* (Royle) Kazmi	May	July	Aug	Sep
131	*Ranunculus repens* L.	May	June	July	Aug
132	*Ranunculus laetus* Wallich	May	June	July	Aug
133	*Rubia tinctorum* L.	May	June	July	Aug
134	*Rumex hastatus* D. Don	May	July	July	Sep
135	*Rumex dentatus* L.	May	Aug	Sep	Oct
136	*Rumex nepalensis* D.Don	May	July	Aug	Nov
137	*Saussurea lappa* Clark	April	June	July	Sep
138	*Saxifraga moorcroftiana* (Ser) Sternb	July	Aug	Sep	Oct
139	*Scutellaria chamaedrifolea* Bth	Apr	June	Aug	Sep
140	*Senecio ligularia* Hook	July	Aug	Sep	Oct
141	*Senecio chrysanthemoides* DC	July	Aug	Sep	Oct
142	*Senecio graciliflorus* DC	July	Aug	Sep	Oct
143	*Senecio nudicaulis* DC	July	Aug	Sep	Oct
144	*Senecio quadriflorum* Pall	July	Aug	Sep	Oct
145	*Selinum tenuifolium* Wall	July	Aug	Sep	Oct
146	*Sibbaldia cuneata* Hornum	June	July	Aug	Oct
147	*Solanum nigrum* L.	Through out year	July	Sep	Nov
148	*Sonchus arvense* L.	Apr	July	Sep	Nov
149	*Sonchus asper* Hill	Apr	July	Sep	Nov
150	*Spiraea canescens* D.Don	June	July	Aug	Sep
151	*Stellaria media* (L) Vill	May	July	Aug	Sep
152	*Stellaria monosperma* Buch	May	July	Aug	Sep
153	*Strobilanthes attenuata* Nees	May	July	Aug	Sep
154	*Swertia petiolata* D.Don	June	July	Aug	Sep
155	Taraxacum officinales Weber	Apr	June	July	Aug
156	*Thlaspi arvense* L.	May	June	July	Aug
157	*Thymus serphyllum* L.	May	July	Aug	Sep
158	*Trifolium repens* L.	May	June	July	Aug
159	*Trifolium resupinatum* L.	May	June	July	Aug
160	*Trillidium repen* L.	May	June	July	Aug

161	*Trillidium govanianum* (D.Don)Kunth	May	June	July	Aug
162	*Tussilogo farfara* L.	June	July	Aug	Sep
163	*Urtica dioica* L.	June	Aug	Sep	Oct
164	*Valeriana pyrolifolia* DC	Apr	May	June	Aug
165	*Verbascum thapsus* L.	June	July	Aug	Oct
166	*Veronica melissaefolia* Royle	May	June	July	Aug
167	*Viola odorata* L.	Mar	Apr	June	Aug
168	*Viola serpen* Wallich	Mar	May	July	Sep
	Grasses				
169	*Agrostis alba* HK.f	May	July	Aug	Sep
170	*Agrostis canina* L.	May	July	Aug	Sep
171	*Agrostis gigantea* Roth	May	July	Aug	Sep
172	*Andropogon munroi* C.B. Clarke	Mar	Apr	Aug	Sep
173	*Arundo donax* L.	May	Jun	Oct	Nov
174	*Avena barbata* Pott ex Link	Mar	Apr	May	June
175	*Brachiaria ramosa* (L) Stapf	May	July	Oct	Nov
176	*Bromus tectorum* L.	May	June	July	Aug
177	*Cenchrus biflorus* Roxb	Aug	Sep	Nov	Dec
178	*Cenchrus unciflorus* Her	July	Aug	Jan	Feb
179	*Chrysopogon aucheri* (Boiss) Stapf	Feb	April	May	June
180	*Cynodon dactylon* (L.) Pers	Feb	March	Sep	Oct
181	*Dactylis glomerata* L.	June	July	Aug	Sep
182	*Desmostachya bipinnata(L)* Stapf	Sep	Oct	Dec	Jan
183	*Dichanthium annulatum* (Forssk).Stapf	Feb	Apr	Sep	Oct
184	*Elymus repens* L.Gould	June	July	Aug	Sep
185	*Festuca modesta* Nees	Mar	Apr	Aug	Sep
186	*Imperata cylindrica* (L) Raeuschel	Mar	Apr	June	July
187	*Koeleria macratha* (Ledb) Schult	Mar	Apr	Sep	Oct
188	*Phalaris minor* Retz	Feb	Apr	Aug	Sep
189	*Phleum alpinum* L.	June	July	Sep	Oct
190	*Poa annua* L.	Feb	Apr	Sep	Oct

191	*Poa bactriana* Rozhev	Mar	Apr	May	June
192	*Polypogon monspeliensis* L.Desf	Mar	Apr	Jul	Aug
193	*Saccharum spontaneum* L.	June	July	Sep	Oct
194	*Sorghum halepense* (L)Pers	Apr	May	Oct	Nov
195	*Themeda anathera* Ness ex Steud	May	June	Oct	Nov
196	*Vetiveria zizanioides* (L) Nasch	Aug	Sep	Oct	Nov
	Ferns				
197	*Adiantum venustum* D. Don	June	Jul	Aug	Sep
198	*Adiantum capilus veneris* L.	June	Jul-	July	Oct
199	*Aspelenium adiantum nigrum* L.	June	Aug	Sep	Oct
200	*Athyrium mackinnoni* (Hope) C. Chr	June	Aug	Sep	Oct
201	*Cystopteris fragilis* (L) Bth	May	June	July	Aug
202	*Dryopteris stewartii* Fress	May	July	Aug	Sep
203	*Onychium japonicum* (Kunze) Wall	May	June	July	Oct
204	*Pteris cretica* L.	May	June	Aug	Sep
205	*Pteris vitata* L.	May	June	Sep	Oct
206	*Thelypteris levinger* Clark	May	June	Sep	Oct

Table 5b. Summary of the classification of plants of Ganga Choti and Bedori Hills on the basis of economic uses.

S. No.	Economic use classes	No. of species	Percentage
1.	Fodder/Forage species	134	46.20
2.	Medicinal species	83	28.62
3.	Vegetables/Edible fruit species	20	6.89
4.	Fuel wood species	15	5.17
5.	Poisonous species	12	4.13
6.	Tanning/Dying species	7	2.41
7.	Herbal tea species	7	2.41
8.	Resin yielding species	6	2.06
9.	Timber wood species	4	1.37
10.	Roof thatching species	1	0.34
11.	Evil repellant species	1	0.34

The major life form was nanophanerophytic (33.33%) that was followed by megaphanerophytic and hemicryptophytic species (20% each). Therophytes and geophytes were 13.33% each. On quantitative basis, hemicryptophytes were 32.38%, megaphanarophytes 24.12%, nanophanerphytes 20.69%, geophytes 15.88% and therophytes 6.89%.

The leaf spectra consisted of microphylls (53.33%), leptophylls (26.66%), and nanophylls (20%).

2. *Themeda-Pinus-Desmodium* community (TPD)

Themeda-Pinus-Desmodium community was present at 1800 m.There were 2 tree, 4 shrub, 5herb and 3 grass species. The total importance values (TIV) contributed by three dominants was 119.10. The remaining species shared a TIV of 180.64. The contribution by tree was 72.85, by shrubs 49.94, by herbs 81.77 and by grass 95.19(Table 9 and appendix 1).

The vegetation was predominantly nanophanerophytic (40%) followed by hemicryptophytes (26.66%), megaphanerophytes and geophytes (13.33%each) and therophytes (6.66%). Quantitatively, hemicryptophytes were dominant (39.03%).They were followed by nanophanerophytes (31.67%), megaphanerophytes (20.87%), geophytes and therophytes (4.00 and 4.40%).

The leaf spectra consisted of microphylls (60 %), leptophyll (26.66%) and nanophylls (13.33%).

3. *Andropogon-Pinus-Berberis* community (APB)

Andropogon-Pinus-Berberis community at 1900 m, was composed of 15 species (Table 9 and appendix 1). It included 2 trees, 6 shrubs, 4 herbs and 3 grasses. Three dominants and the remaining species had TIV of 156.85 and 142.95, respectively. The grasses were the major contributor with a TIV of 112.97.The contribution by shrubs was 94.97, by trees 62.59 and by herbs 29.27.

Hemicryptophytic species were dominant with a share of 42.85 %. They were followed by nanophanerophytes (28.57 %), megaphanerophytes (14.28%), therophytes and geophytes (7.14 % each). Quantitatively, nanophanerophytes were dominant (25.13%). They were followed by hemicryptophytes (24.25%), megaphanerophytes (20.25%), geophytes (15.45%) and therophytes (14.90%).

The leaf spectra was composed of microphylls (50%), leptophylls (28.57%), and nanophylls (21.42%).

4. *Pinus-Cyperus-Gerbera* community (PCG)

At 2000 m, *Pinus-Cyperus-Gerbera* community was composed of 14 species. There were 2 tree, 4 shrub, 7 herb and 1 grass species. The TIV by 3 dominants was 141.25 and by the remaining species 158.60. The contribution towards TIV by tree was 60.73, by shrubs 75.35, by herbs 135.23 and by grass 28.22 (Table 9 and appendix 1).

The community was hemicryptophytic (43.75%) that was followed by therophytes (25%), nanophanerophytes(18.75%) while megaphanerophytes and geophytes had equal share of (6.25% each). Quantitatively, hemicryptophytic species were dominant (37.75%). They were followed by megaphanerophytes (26.31%), nanophanerophytes (16.92%), therophytes (16.82%) and geophytes (2.16%).

There were 43.75% microphylls, 31.25% nanophylls, and 25% leptophylls. (Table 9 and appendix 1)

5. *Abies –Pinus-Viburnum* community (APV)

At 2400 m, *Abies-Pinus-Viburnum* community existed which include 2 tree, 3 shrub, 12 herb, and 2 grass species. A TIV of 152.59 and 147.05 was recorded for dominants and other species, respectively. The contribution by tree was 119.03, by shrubs 49.12, by herbs 116.31 and by grass species 15.26.

On Raunkiaerian scale, hemicryptophytic species were dominant (47.36%) followed by nanophanerophytes and therophytes (15.78% each). Megaphanerophytes and geophytes contributed 10.52% each while quantitatively, megaphanerophyte (39.67%), hemicryptophytes (24.43%), nanophanerophytes (16.37%), therophytes (13.75%), geophytes (5.43%) were recorded.

The leaf size spectra consisted of microphylls (42.10%), leptophylls and nanophylls (26.31% each) and mesophylls (5.26%).

6. *Abies-Viburnum-Medicago* community (AVM)

At 2500-2600 m, *Abies-Viburnum-Medicago* community consisted of 2 tree, 2 shrub, 21 herbs and 2 grass species, respectively. The TIV contributed by three dominants was 150.07 while the remaining species shared a TIV of 149.78. The contribution by herbs was 158.23, by tree (93.84), by shrubs 28.07 and by grasses 21.02.

Hemicryptophytic (54.44 %) were dominant followed by therophytes (26.15%). Megaphanerophytes and nanophanerophytes (8.39 %) each and geophytes (2.63%).

Microphylls (37.17%), nanophylls (31.40%), leptophylls (23.02%) and mesophylls (8.39%) were the major leaf forms.

7. *Picea-Epilobium-Bromus* community

At 2800 m, *Picea-Epilobium-Bromus* community was composed of one tree, 1 shrub, 11 herbs and 1 grass species. The TIV contributed by 3 dominants was 141.13 while the remaining species shared a TIV of 158.66. The contribution by the tree was 64.11, by shrubs 12.54, by herbs 191.50 and by grasses 31.64.

Hemicryptophytic species dominated (64.28%) which were followed by therophytes (14.28%), megaphanerophytes, nanophanerophytes, and chamaephytes each having an equal share of 7.14%. Quantitatively, hemicryphtophytic species were 59.45%, megaphanerophytes 21.38%, therophytes 10.40% nanophanerophytes 4.18% and chamaephytes 4%.

The community consisted of microphylls (37.50 %), nanophylls (31.25 %), leptophylls (21.42 %) and mesophylls (7.14 %).

8. *Veronica-Sibbaldia-Poa community* (VSP)

Veronica-Sibbaldia-Poa community was established at 2900 m. It consisted of 1 shrub, 11 herb and 2 grass species. TIV by 3 dominants was 130.71. The major contribution was by herbs, which was 230.80.

Hemicryptophytic (71.42%) were dominant life form followed by therophytes (17.45%), geophytes (8.62%) and nanophanerophytes (2.85%). Quantitatively, hemicryptophytic (71.06%) species were dominant. They were followed by therophytes (17.45%), geophytes (8.62%) and nanophanerophytes (2.88%).

The leaf spectra was composed of nanophylls (42.85%), microphylls (35.71%), leptophylls (14.28%) and mesophylls (7.14%).

9. *Sibbaldia-Aster-Rumex* community (SAR)

At the top of Ganga Choti hill (Alt. 3000 m.) *Sibbaldia -Aster-Rumex* dominated with a TIV of 179.31.The contribution by herbs was 271.96 (Table 9).

Hemicryptophytic species dominated (78 %). They were followed by nanophanerophytes and therophytes (11.11% each). Quantitatively, hemicryptophytic were 79%, nanophanerophytes 11% and therophytes 9 %.

The community consisted of nanophylls 77.77%, leptophylls and microphylls 11.11% each.

10. *Euphorbia-Phleum-Artemesia* community (EPA)

At 3050 m at Bedori Hills *Euphorbia-Phleum-Artemesia* community was present that consisted of 2 shrub, 14 herb and 2 grass species (Table 9). The three dominants had a TIV of 102.36. The contribution to TIV by herbs by 230, by grasses 40 and by shrubs 30.

Hemicryptophytic species were dominant (73.68%), which were followed by nanophanerophytes (10.52 %), therophytes and geophytes had equal share of 5.26 %. Quantitatively, hemicryptophytic (76.08%), geophytes (10.85 %), megaphanerophytes (7.75%), therophytes (2.77 %) and nanophanerophytes (2.52 %) were evident.

Nanophylls and microphylls (36.84 %), leptophylls (21.05 %) and mesophylls (5.26%) were the leaf size spectra.

11. *Potentilla-Geranium-Achillea* community (PGA)

Potentilla-Geranium-Achillea community at 3250 m was composed of 19 species (Table 9). There were 1 shrub, 17 herb and 1 grass species. TIV by 3 dominants was 126.63. The contribution by herbs was 272.01. The hemicryphtophytes were dominant both qualitatively (84%) and quantitatively (87%)

The leaf spectra consisted of microphylls 47%, nanophylls 32% and leptophylls 21%.

12. *Potentilla-Juniperus-Phleum* community (PJP)

At 3350 m *Potentilla-Juniperus-Phleum* community included 1 shrub, 13 herbs and 1 grass species. Three dominants had a TIV of 164.66. The major share198.94 was by her0bs. Qualitatively, hemicryptophytes was dominant (80 %) followed by geophytes (13%) and nanophanerophytes (7%). By quantitatively hemicryptophytes followed the same pattern as Raunkiaerian.

The leaf spectra consisted of microphylls (66.66%), nanophanerophytes (22.22 %) and mesophylls (11.11 %).

13. *Potentilla-Phleum-Achillea* community (PPA)

At 3505 m, *Potentilla-Phleum-Achillea* community existed, which included 14 herb and one grass species. The TIV contributed by 3 dominants was 161.71 while the remaining species shared a TIV of 138.06. The contribution by herbs alone was 250.89 and by grass 48.88 (Table 9).

Hemicryptophytic species dominated (80%) which were followed by therophytes (13.33%) and geophytes (6.66%). Quantitatively, hemicryptophytic (76.70%) were dominant followed by geophytes (16.30%) and therophytes (6.98%).

The leaf spectra consisted of microphylls (47%), nanophylls (33%) and leptophylls (20%).

14. *Potentilla-Androsace-Polygonum* community (PAP)

At 3650 m, *Potentilla-Androsace-Polygonum* community existed with 10 herb and one grass species. The TIV contributed by 3 dominants was 155.74 while the remaining species shared a TIV of 144.10. The contribution by herbs alone was 258.76 and by grasses 41.08.

Hemicryptophytic species dominated (63.63 %), followed by geophytes (27.27%) and therophytes (9.09%). Quantitatively, hemicryptophytes were dominant (79.57 %), with geophytes (15.23 %) and therophytes (5.18 %). Raunkiaerian and quantitative data in this community are alike.

The leaf spectra consisted of nanophylls (46 %), microphylls (36%), leptophylls and mesophyll (9 % each).

15. *Polygonum-Phleum-Leontopodium* community (PPL)

Polygonum-Phleum-Leontopodium community was present at 3750 m and included 8 herbs and 1 grass species. The TIV contributed by three dominants was 186.84.

Hemicryptophytic species were dominant (67 %) both qualitatively and quantitatively.

The leaf spectra consisted of nanophylls (56 %), microphylls (33 %) and leptophylls (11%).

Monsoon Aspect

There were nine communities in Ganga Choti Hills and six communities at Bedori Hills during the monsoon. The details are as follows.

1. *Imperata - Pinus – Sonchus* Community (IPS)

At 1700 m, *Imperata – Pinus – Sonchus* community existed (Table 10 and appendix 2). There were 22 recorded species. Besides, *Pinus wallichiana* (Tree), it included 5 shrubs, 14 herbs and 2 grasses. The TIV contributed by 3 dominants was 151.84. The remaining species shared a TIV of 148.16. The contribution by tree was 47.20, by shrubs 43.83, herbs 141.62 and grasses 67.97.

Hemicryptophytic species dominated (33.33%), which were followed by therophytes (28.57%), nanophanerophytes (19.04%), megaphanerophytes and geophytes (9.52). Quantitatively, the order of importance was hemicryptophytes (37.75%), therophytes (28.50%), megaphanerophytes (16.51%), nanophanerophytes (14.72%) and geophytes (2.49%).

The leaf spectra was composed of nanophylls (48.%), microphylls (38.%) and leptophylls (14.%).

2. *Desmodium-Pinus-Lespedeza* Community (DPL)

At 1800 m, *Desmodium-Pinus-Lespedeza* community existed (Table 10) which consisted of 25 species. There were one tree, 4 shrub, 17 herb and 3 grass species. The TIV contributed by the 3 dominants was 97.96 while the remaining species shared a TIV of 201.04. The contribution by tree was 35.67, by shrub 66.48, by herbs 163.33 and by grasses 31.96 (Table 10).

Therophytic species dominated (43.47%), which were followed by hemicryptophytes (30.43%), nanophanerophytes (13.04%), megaphanerophytes (8.69%) and chamaephytes (4.34%).

Quantitatively, a similar pattern was achieved. It was therophytes (37.10%), hemicryptophytes (27.11%), nanophanerophytes (21.78%), megaphanerophtes (12.97%) and chamaephytes (1.01%).

The leaf size was predominantly microphyllous type (42.%) followed by nanophylls (31.%) and leptophylls (27.%).

3. *Berberis-Desmodium-Agrostis* Community (BDA)

This community was recorded at an altitude of 1900 m (Table 10). It had 2 tree, 5 shrub, 16 herb and 4 grass species. The TIV shared by 3 dominants was 98.82 while the remaining species had contributed TIV of 201.18. The share by tree was 34.76, by shrubs 89.94, by herbs 114.90 and by grasses 59.93 (Table 10).

Hemicryptophytic species dominanted (38.46%), which was followed by nanophanerophytes and therophytes having share of 19.23% each. Megaphanerophytes (11.53%), geophytes, chamaephytes and lianas had equal share of 3.84% each. Quantitatively, hemicryptophytic species dominated (42.97%) which was followed by nanophanerophytes (31.28%), megaphanerophytes (14.49%), therophytes (6.59%), chamaephytes (2.52%), geophytes (1.37%) and lianas (0.75%).

There were of (38%) nanophylls, (31%) leptophylls, (27%) microphylls and (4%) mesophylls.

4. *Desmodium-Berberis-Cynodon* Community (DBC)

Desmodium-Berberis-Cynodon Community at 2000 m, was composed of 23 species (Table 10). It included 2 tree, 6 shrub 11 herb and 4 grasses. The TIV contributed by 3 dominants and remaining species was 100.25 and 199.75, respectively. The trees contributed 25.29, shrubs 84.34, herbs 132.92 and grass 57.45 (Table 10).

Hemicryptophytic (35%) dominated the community. They were followed by nanophanerophytes and therophytes (20% each), magaphanerophytes (15%), geophytes and lianas (5% each). Quantitatively hemicryptophytic species had 43.99% share, nanophanerophytes 27.97%, magaphanerpphytes 9.50%, therophytes 15.37%, geophytes and lianas had 2.33 and 0.81%.

Nanophylls (50%), microphylls (25%), leptophylls (20%) and mesophylls (5%) were the major leaf sizes.

5. *Abies – Viburnum – Poa* Community (AVP)

Abies – Viburnum – Poa community existed at 2400 m (Table 10). It was composed of one tree, 2 shrub, 19 herb, and 3 grass species (Table 10). The TIV contributed by 3 dominants was 122.00, while the remaining species shared a TIV of 178. The contribution by tree was 47.77, by shrubs 51.38, by herbs 153.84 and by grasses 47.01.

The community was dominated by hemicryptophytic species (40%), followed by therophytes (28%), geophytes and nanophanerophytes (12%) each, while megaphanerophytes and lianas had 4% shares. Quantitatively, hemicryptophytic species were dominated (37.52%) which was followed by
therophytic (21.22%), nanophanerophytes (17.69%), megaphanerophytes (15.94%), geophytes (7.07%) and lianas (.54%).

The major leaf forms were nanophylls (40%) and microphylls (32%) followed by leptophylls (16%) and mesophylls (12%).

6. *Pinus-Fragaria-Cenchrus* Community (PFC)

At 2500 m, *Pinus-Fragaria-Cenchrus* community had 23 species (Table 10). Besides *Pinus wallichiana* there were 4 shrubs, 18 herb and one grass species. The TIV contributed by 3 dominants was 169.04. The remaining species shared a TIV of 30.98. The contribution by tree was 99.00, by shrubs 17.89, herbs 149.18 and grasses 33.93 (Table 10).

Hemicryphotophic species (37.50%) dominated the community. They were followed by therophytes (20.83%), nanophanerophytes and geophytes (16.66% each), megaphanerophytes and lianas (4.16% each). Quantitatively, megaphanerophytes were dominant (33.01%), followed by hemicryptophytes (29.51%), therophtytes (6.13%), nanophanerophytes (5.96%), geophytes (4.64%) and lianas (0.72%).

Microphylls (38%), nanophylls (29%), leptophylls (21%) and mesophylls (12%) were the important leaf forms.

7. *Abies-Viburnum-Cenchrus* Community (AVC)

At 2600 to 2800m, *Abies-Viburnum-Cenchrus* community existed (Table 10). Besides *Abies pindrow* (tree) there were one shrub 18 herb and one grass species. The TIV contributed by 3 dominants was 160.33, while; the remaining species shared a TIV of 139.67. The contribution by tree was 102.59, by shrub 29.89, by herbs 139.67 and by grass 27.85 (Table 10).

Hemicryptophytic and therophytic species were dominants (38.09%). They were followed by geophytes (9.52%). Megaphanerophytes, nanophanerophytes and chamaephytes showed equal share of (4.76%). Megaphanerophytes were dominant quantitatively(34.57%).It was followed by hemicryptophytes (30.89%), therophytes(21.75%),nanophanerophytes(11.57%)and chamephytes(0.34%).

Microphylls (38%), leptophylls and manophylls (24% each) and mesophyll (14%) were the major leaf sizes.

8. *Lespedeza-Poa-Fragaria* community (LPF)

Lespedeza-Poa-Fragaria community at 2900m was composed of 20 species (Table 10). It included 18 shrub and 2 grasses. The T I V contributed by 3 dominants and remaining species was 133.54 and 166.46, respectively. The herbs shared 223.21 and grasses 76.79.

Hemicryptophytic (58.%) were dominants, which were followed by geophytes (21.05%), therophytes (15.78%) and nanophanerophytes (5.26%). Quantitatively, hemicryptophytes were dominant (46.82%).They were followed by therophytes (32.38%), nanophanerophytes (10.96%) and geophytes (9.82%).

Nanophylls species were dominant (42%), followed by microphylls (26%), leptophylls and mesophylls (16% each).

9. *Poa-Salix-Abies* community (PSA)

At the top (Alt.3000 m) of Ganga Chotti *Poa-Salix-Abies* community consisted of 18 species with 2 tree, 2 shrub, 13 herb and one grass species.

The TIV contributed by 3 dominants was 128.69 while the remaining species shared a TIV of 171.31. The contribution by tree was 80.04, by shrubs 25.95, by herbs 145.36 and by grass 48.65. The life form spectra consisted of hemicryptophytic speices (42.10%), geophytes (31.57%), therophytes andmagaphanerophytes(10.52%) each and nanophanerophytes

(5.26%).While quantitatively, hemicryptophytes had 40.44%, magaphanerophytes 3.01%, therophytes 18.94%, geophytes 5.23% and nanopanerophytes 2.35% were in order of importance.

The dominant leaf spectra was microphyllous - nanophyllous type (each with 37%), followed by mesophyll (16%) and leptophylls (10%).

10. *Pseudomertensia-Potentilla-Pedicularis* community (PPP)

At 3050 m, *Pseudomertensia-Potentilla-Pedicularis* community was composed of one shrub and 8 herbs. The TIV contributed by 3 dominants and the remaining species was 146.06 and 153.94 respectively. Herbs have a TIV of 276.56.

It is dominated by hemicryptophytes (55.55%). Next were therophytes (22.22%), nanophanerophytes and geophytes (11.11% each). Quantitatively, hemicryptophytic species (68.29%), therophytes (12.61%), geophytes (11.27%) and nanophanerophytes (7.81%) were important life form classes.

The species with large leaves (microphylls) were dominant (55%), followed by nanophylls (33%) and mesophylls (11%).

11. *Parnassia-Agrostis-Polypogon* Community (PAS)

At 3250 m, *Parnassia-Agrostis-Polypogon* community harboured the moist places. It consisted of one shrub, 6 herb and 2 grass species. A TIV of 138.01was provided by 3 dominants. Shrubs had a TIV of 2.88, herb 209.94 and grasses species 87.18 (Table 10).

Hemicryptophytes had 73% and therophytes 27% share. Quantitatively, hemicryptophytes (71%), therophytes (27%) and nanophanerophytes (1%) were important.

There were 67% microphylls, 22% nanophylls and 11% mesophylls.

12. *Senecio-Bupleurum* Community (SB)

Senecio-Bupleurum community at 3350m was composed of 1 shrub, 6 herb and 2 grasses (Table 10). The dominants had a TIV of 131.33, and remaining species had a TIV of 168.67.

Hemicryptophytic species were dominant (56 %), followed by therophytes (22 %), geophytes and nanophaneropytes (11% each). While quantitatively, hemicryptophytes (62%), therophytes (18 %), geophytes (11 %) and nanophanerophytes (9 %) were important.

Microphylls (55.55%), nanophylls (33.33%) and mesophylls (11.11%) were the important leaf size spectra.

13. *Lavaetra-Leucas-Ranunculus* Community (LLR)

At 3505 m *Lavaetra-Leucas-Ranunculus* community was present in moist grassy areas. There was 8 herb species only. The dominants had TIV of 123.73; while the remaining species shared a TIV of 176.27. The major contribution was by herbs 299.72 (Table 10).

Hemicryptophytes were dominated (80%), followed by therophytes (13%) and geophytes (7%). Quantitatively, hemicryptophytes (76%) followed by geophytes (16%) and therophytes (7%) were significant.

The leaf spectra was composed of microphylls (67%) and mesophylls (33.%).

14. *Primula-Oxalis-Phleum* Community (POP)

At 3650 m *Primula-Oxalis-Phleum* community occurred in moist places. There were 2 shrub, 8 herb and 2 grass species (Table 10). The TIV contributed by 3 dominants was 108.84, while the remaining species shared a TIV of 191.16. The shrub contribution 33.31, herbs 210.86 and grasses 55.83 to the total value.

Hemicroyptophytic species dominated (42 %). They were followed by geophytes (25%). Nanophanerophytes and therophytes contributed (16.66% each). Quantitiatively, hemicryptophytes were (46.52%), geophytes (29.15%), therophytes (13.21%) and nanophanerophytes (10.66%).

The leaf spectra consisted of microphylls (67%), nanophylls (17%), mesophylls and leptophylls (8% each).

15. *Juniperus-Malva-Lespedeza* Community (JML)

At 3750m *Juniperus-Malva-Lespedeza* community existed (Table 10) which included 2 shrub, 8 herb and 1 grass species. The TIV by 3 dominants was 106.84. The contribution by shrubs was 58.44, by herbs 219.05 and by grasses 22.51.

Hemicryptoptyies species dominated (54.54%). They were followed by nanophanerophytes(27.27%),therophytes and geophytes(9.09%each).On the basis of quantitative analysis, hemicryptophytes were 54.39%, nanophanerophytes 30.65%, geopytes 7.51% and therophytes 7.43%.

The leaf spectra was composed of microphylls (45.45%), nanophylls (27.27%), mesophylls (18.18%) and leptophylls (9.09%).

Table 7: The life form spectra of plant of Ganga Choti and Bedori Hills

Life form	Spring Aspect				Monsoon Aspect			
	Ganga		Bedori		Ganga		Bedori	
	No.	%	No.	%	No.	%	No.	%
Megaphanerophytes	9	8	-	-	9	8	-	-
Nanophanerophytes	12	10	3	8	12	10	5	6
Chamaephytes	3	3	1	3	1	1	-	-
Hemicryptophytes	54	45	25	64	46	39	51	62
Geophytes	11	9	5	13	20	17	14	17
Therophytes	28	23	5	13	29	24	11	14
Lianas	1	1	-	-	2	2	-	-
Total	**118**		**39**		**119**		**81**	

Table 8: Leaf spectra of plants of Ganga and Bedori Hills

	Spring aspect				Monsoon aspect			
	Ganga		Bedori		Ganga		Bedori	
Leaf spectra	No	%	No	%	No	%	No	%
Leptophyll	26	22	8	20	21	18	17	21
Nanophyll	39	32	16	41	44	37	27	33
Microphyll	48	40	13	33	43	36	33	41
Mesophyll	05	06	2	5	11	9	4	5
Total	**118**		**39**		**119**		**81**	

Table 9: Number and the total importance values (TIV) of the tree, shrub and herb species of Ganga Choti and Bedori hills during spring.

	TCP	*TPD*	*APB*	*PCG*	*APV*	*AVM*	*PEB*	*VSP*	*SAR*	*EPA*	*PGA*	*PIP*	*PPA*	*PAP*	*PPL*
Total species	*15*	*14*	*15*	*14*	*19*	*18*	*14*	*14*	*09*	*19*	*19*	*15*	*15*	*11*	*09*
1.Trees	2	2	2	2	2	2	1	0	0	0	0	0	0	0	0
2.Shrubs	5	4	6	4	3	2	1	1	0	2	1	1	0	0	0
3.Herbs	5	5	4	7	12	21	11	11	8	15	17	13	14	10	8
4.Grasses	2	3	3	1	2	2	1	2	1	2	1	1	1	1	1
a-TIV contributed by3 dominants	130.79	119.10	156.85	141.25	152.59	150.07	141.13	130.71	179.31	102.36	126.63	164.66	161.71	155.74	186.84
b-By remaining spp.	168.95	180.64	142.95	158.60	147.05	149.93	158.66	169.0	120	197.34	173.37	135.08	138.08	144.10	113.01
c-By trees	65.90	72.85	62.59	60.73	119.03	93.84	64.11	0	0	0	0	0	0	0	0
d-By shrubs	66.83	49.94	94.97	75.35	49.12	28.07	12.54	8.55	0	30.81	8.09	52.64	0	0	0
e-By herbs	79.06	81.77	29.27	135.23	116.31	158.23	191.50	230	271.96	230.45	272.01	198.94	250.89	258.76	238.54
f-By grasses	86.36	95.19	112.97	28.22	15.26	21.02	31.64	60.45	27.86	39.70	19.61	48.16	48.88	41.80	61.31

Key: 1=*Themeda-Cyperus-Pinus* Community (TCP)
2=*Themeda-Pinus-Desmodium* Community (TPD)
3= *Andropogon-Pinus-Berberis* Community (APB)
4= *Pinus-Cyperus-Gerbera* Community (PCG)
5=*Abies-Pinus-Viburnum* Community (APV)
6=*Abies-Viburnum-Medicago* Community (AVM)
7=*Picea-Epilobium-Bromus* Community (PEB)
8=*Veronica-Sibbaldia-Poa* Community (VSP)
9= Sibbaldia-Aster-Rumex Community (SAR)
10= Euphorbia-Phleum-Artemisia Community (EPA)
11= Potentilla-Geraium-Achillea Community(PGA)
12= *Potentilla-Juniperus-Phleum* Community (PJP)
13= *Potentilla-Phleum-Achillea* Community (PPA)
14= *Potentilla-Androsace-Polygonum* Community (PAP)
15= *Polygonum-Phleum-Leontopodium* Community (PPL)

Table 10. Number of species and the total importance values (TIV) of the tree, shrub and herb species on Ganga Chotti and Bedori hills during monsoon.

Communities	*IPS*	*DPL*	*BDA*	*DBC*	*AVP*	*PFC*	*AVC*	*LPF*	*PSA*	*PPP*	*PAF*	*SB*	*LLR*	*POP*	*JML*
Total species	22	25	27	23	25	24	21	20	18	09	09	09	09	12	11
Trees	1	1	2	2	1	1	1	0	2	0	0	0	0	0	0
Shrubs	5	4	5	6	2	4	1	0	2	1	1	1	1	2	2
Herbs	14	17	16	11	19	18	18	08	13	08	06	06	08	08	08
Grasses	02	03	04	04	03	01	01	02	01	00	02	02	00	02	01
ı.TIV contributed by 3 dominants	151.84	97.96	98.82	100.25	122	169.04	160.33	133.54	128.69	140.06	138.01	131.33	123.73	108.84	106.84
b.by remaining Species	148.16	201.04	201.18	199.75	178	130.95	139.67	166.45	171.30	153.94	161.90	168.67	176.27	191.16	193.10
c. by trees	47.20	35.67	34.76	25.29	47.77	99.00	102.59	00	80.04	0	0	0	0	0	0
d. Shrubs	43.83	66.48	89.94	84.34	51.38	17.89	29.89	00	25.95	23.44	02.88	27.35	00	33.31	58.44
Ierbs	141.62	163.33	114.90	132.92	153.84	149.18	139.67	76.89	145.36	276.56	209.94	206.87	299.72	210.86	219.05
irasses	67.97	31.96	59.93	57.45	47.01	33.93	27.85	223.71	48.65	00	87.18	65.80	00	55.83	22.51

Key:

1= *Imperata-Pinus-Sonchus* Community (IPS)
2= *Desmodium-Pinus-Lespedeza* Community (DPL)
3= *Berberis-Desmodium-Agrostis* Community (BDA)
4= *Desmodium-Berberis-Cynodon* Community (DBC)
5= *Abies-Viburnum-Poa* Community (AVP)
6= *Pinus-Fragaria-Cenchrus* Community (PFC)
7= *Abies-Viburnum-Cenchrus* Community (AVC)
8= *Lespedeza-Poa-Fragaria* Community (LPFP)
9= *Poa-Salix-Abies* Community (PSA)
10= *Pseudomertensia-Potentilla-Pedicularis* (PPP)
11= *Parnassia-Agrostis-Polypogon* Community (PAP)
12= *Senecio-Bupleurum* Community (SB)
13= *Lavaetra-Leucas-Ranunculus* (LLR)
14= *Primula-Oxalis-Phleum* Community (POP)
15= *Juniperus-Malva-Lespedeza* Community (JML)

Table 11. Raunkiaerian and quantitative biological spectra of plants of Ganga Choti and Bedori Hill during spring.

Altitude (m.)	Mp		Np		Ch		H		G		Th	
a.	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q
1700	20	24.12	33.33	20.69	-	-	20	32.38	13.33	15.88	13.33	6.89
1800	13.33	20.87	40.00	31.67	-	-	26.66	39.03	13.33	4.00	6.66	4.40
1900	14.28	20.25	28.57	25.13	-	-	42.85	24.25	7.14	15.45	7.14	14.19
2000	6.25	26.31	18.75	16.92	-	-	43.75	37.75	6.25	2.16	25.00	16.82
b. 2400	10.52	39.67	15.78	16.37	-	-	47.36	24.43	10.52	5.43	15.78	13.75
2600	8.39	29.30	8.38	14.75	-	-	54.45	30.69	2.63	0.24	26.15	24.74
2800	7.14	21.38	7.14	4.18	7.14	4.0	64.20	59.45	-	-	14.20	10.90
2900	-	-	2.85	2.88	-	-	71.42	71.06	.62	8.62	17.45	17.45
3000	-	-	11.11	11.35	-	-	77.77	79.35	-	-	11.11	9.29
c. 3050	5.26	7.75	10.52	2.52	-	-	73.68	76.08	5.26	10.85	5.26	2.77
3250	-	-	5.26	2.69	-	-	84.21	8.74	5.26	6.54	5.26	3.00
3350	-	-	6.66	17.56	-	-	80.00	58.68	13.33	24.75	-	-
d. 3505	-	-	-	-	-	-	80.00	76.10	6.66	16.30	13.33	6.90
3650	-	-	-	-	-	-	63.63	79.57	27.27	15.23	9.09	5.18
3750	-	-	-	-	-	-	66.66	77.09	11.11	20.44	22.22	2.45

Key: Mp=Megaphanerophytes
Np=Nanophanerophytes
R= Raunkiaerian value
Ch= Chamaephytes
H=Hemicryptophytes
Q=Quantitative value from importance value
G=Geophytes
Th=Therophytes

Monsoon aspect.

Altitude (m.)	Mp		Np		H		G		Th		L		Ch	
a.	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	Q
1700	9.52	16.51	19.04	14.72	33.33	37.75	9.52	2.49	28.57	28.50	-	-	-	-
1800	8.69	12.97	13.04	21.78	30.43	27.11			43.47	37.10	-	-	4.34	1.01
1900	11.53	14.49	19.23	31.28	38.46	42.97	3.84	1.37	19.23	6.59	3.84	0.75	3.84	2.52
2000	15	9.50	20	27.97	35	43.99	5	2.33	20	15.37	5	.81	-	-
b. 2400	4	15.94	12	17.69	40	37.52	12	7.07	2	21.22	4	.54	-	-
2500	4.16	33.01	16.66	5.96	37.50	29.51	16.66	4.64	20.83	6.13	4.16	.72	-	-
2600	4.76	34.57	4.76	11.57	38.09	30.89	9.52	0.80	38.09	21.75	-	-	4.76	0.34
2800	5.55	22.61	5.55	15.26	55.55	39.76	22.22	5.06	11.11	17.27	-	-	-	-
2900	-	-	5.26	10.96	57.89	46.82	21.05	9.82	15.78	32.38	-	-	-	-
3000	10.52	33.01	5.26	2.35	42.18	40.44	31.57	5.23	10.52	18.94	-	-	-	-
c. 3050	-	-	11.11	7.81	55.55	68.29	11.11	11.27	22.22	12.61	-	-	-	-
3250	-	-	-	0.96	72.60	70.64	-	-	27.39	27.39	-	-	-	-
3350	-	-	11.11	9.12	55.55	61.84	11.11	11.41	22.22	17.61	-	-	-	
d. 3505	-	-	11.11	8.58	55.55	55.13	-	-	33.33	36.28	-	-	-	-
3650	-	-	16.16	10.66	41.66	46.52	25.00	29.51	16.66	13.21	-	-	-	-
3750	-	-	27.27	30.65	54.54	54.39	9.09	7.51	9.09	7.43	-	-	-	-

Key: Mp=Megaphanerophytes
Np=Nanophanerophytes
R= Raunkiaerian value
Ch= Chamaephytes
H=Hemicryptophytes
Q=Quantitative value from importance value
G=Geophytes
Th=Therophytes
L= Lianas

Table 12: The percentage of plants in different Leaf size spectra of plant communities recorded during Monsoon and Spring..

	Monsoon				Spring Aspect			
Altitude(M.)	L	N	Mi	Me	L	N	Mi	Me
1700	14.28	47.61	38.09	0	26.66	20.00	53.33	0
1800	26.92	30.76	42.30	0	26.66	13.33	60.00	0
1900	30.76	38.46	26.92	3.84	28.37	21.42	50.00	0
2000	20.00	50.00	25.00	5.00	25.00	31.25	43.75	0
2400	16.00	40.00	32.00	12.00	26.31	26.31	42.10	5.26
2500	20.83	29.16	37.50	12.50	21.05	31.57	36.84	10.52
2600	23.80	23.80	38.09	14.28	25.00	31.25	37.50	6.25
2800	22.11	33.33	33.33	11.11	21.42	28.57	42.85	7.14
2900	15.78	42.10	26.31	15.78	14.28	42.85	35.71	7.14
3000	10.52	36.84	36.84	15.78	11.11	77.77	11.11	0
3050	0	33.33	55.55	11.11	21.05	36.84	36.84	5.26
3250	0	22.22	66.66	11.11	21.05	31.57	47.36	0
3350	0	33.33	55.55	11.11	40.00	46.66	13.33	0
3505	0	0	66.66	33.33	20.00	33.33	46.66	0
3650	8.33	16.66	66.66	8.33	9.09	45.45	36.36	9.09
3750	9.09	27.27	45.45	18.18	11.11	55.55	33.33	0

Key: L = Leptophyll, N= Nanophyll, Mi= Microphyll, Me=Mesophyll

Classification

Based on the cluster analysis the following four plant associations could be recognized. Each one is confined to a definite altitudinal range and is composed of characteristic species.

1. Woodland temperate association

The vegetation between 1700-2000 m consisted of *Pinus wallichiana* (I.V=38.65); *Berberis lycium* (I.V=20.17) and *Desmodium multiflorum* (I.V=17.33), which made its own association. *Pinus wallichiana* acquired the highest importance value amongst the arborescent members and formed the tree layer. *Berberis lycium* and *Desmodium multiflorum* respectively dominated shrub layer (Table 13). The association consisted of four communities and supported 71 species, of which 17 were woody. The communities were: *Imperata-Pinus-Sonchus, Desmodium-Pinus-Lespedeza, Berberis-Desmodium-Agrostis* and *Desmodium-Berberis-Cynodon.*

2. Woodland alpine association

The vegetation between 2000-3000m was dominated by *Abies pindrow* (I.V=40.31) and *Pinus wallichiana* (I.V=16.72) in the tree layer and, *Sarcococca saligna* in the shrub layer and *Fragaria nubicola* (I.V=9.51) in the herb layer. The association was comprised of 6 communities with 67 components species including only 5 woody plants. The component communities were: *Abies-Viburnum-Poa, Pinus-Fragaria-Cenchrus, Abies-Viburnum-Cenchrus, Lespedeza-Poa-Fragaria* and *Poa-Salix-Abies.*

There were many ferns such as *Adiantum venustum, Asplenium adiantum nigrum, Cystopteris fragilis, Dryopteris stewartii, Onychium japonicum* and *Pteris vitata* due to cool and shady habitat. Grasses such as *Agrostis canina, Poa bactriana, P.annua, Sorghum halepense* and *Themeda anathera* were also common while *Sibbaldia cuneata, Veronica melissaefolia, Rumex nepalense, Sarcococca saligna* and *Picea smithiana* were associated components.

3. Shrubland alpine association

The region stretching between 3050-3400m had shrubby alpine association. There were 58 species including 3 woody species (Table 13). *Juniperus communis* (I.V=18.22) was dominant in shrub layer, while *Phleum alpinum* and

Potentilla eriocarpa (I.V=26.27) were dominant in the herb layer. *Geranium wallichianum*, *Fragaria nubicola, Minuartia kashmiriana* and *Salix grandiflorum* were the other important species. This association was comprised of three plant communities: *Pseudomertensia-Potentilla-Pedicularis, Parnassia-Agrostis-Polypogon* and *Senecio-Bupleurum.*

4. Alpine grassland association

Alpine grassland association was present in between 3500-3750m. Here *Phleum alpinum* (I.V=27.06) was dominant along with *Androsace rotundifolia* (I.V=14.73), *Juniperus communis* (I.V=14.13) as the co-dominants. *Leontopodium alpinum*, *Poa bactriana* and *Elymus repens* were next common species. *Medicago falcata* was important forb. All the grasses were tufted, perennial and rhizomatous except *Festuca modesta.* This association comprised of three plant communities such as, *Lavaetra-Leucas-Ranunculus, Primula-Oxalis-Phleum* and *Juniperus-Malva-Lespedeza.*

Family importance value (FIV)

There were 31 and 38 families respectively in spring and monsoon seasons (Table 14). Based on the number of species Asteraceae (17 spp.), Rosaceae (11 spp.), Poaceae (10 spp), Pinaceae and Lamiaceae (4 spp. each) were the important families while the remaining families had less than 4 species in spring. In monsoon, Poaceae (19 spp.), Rosaceae (12 spp.), Ranunculaceae and Lamiaceae (5 spp. each), Leguminosae, Caryophyllaceae (4 spp. each) most prevalent. The remaining families had less than 4 species (Table 14).

However, quantitatively based on the family importance value (FIV) the situation drastically changed. Pinaceae (FIV= 634.85), Ranunculaceae (FIV= 628.08), Asteraceae (FIV= 580.75), Polygonaceae (FIV= 320.72) and Rosaceae (FIV= 275.79) became important families during spring. While in monsoon Poaceae (FIV=721.96) was the leading family followed by Pinaceae (FIV= 565.80), Asteraceae (509.01), Rosaceae (FIV= 297.66), Leguminosae (FIV= 287.76) Ranunculaceae (FIV= 190.71), Caprifoliaceae (FIV=172.60), Rubiaceae (FIV=134.34), Salicaceae (FIV= 119.26) and Lamiaceae (115.69).

Degree of Aggregation

The over all situation is depicted in Table 15. It is seen that with increase in altitude from woodland temperate association to alpine grassland association there is a declining tendency of regular pattern. The percentage of aggregated and intermediate pattern with few exceptions enhances as one moves from lower to higher altitude. The woodland temperate association and woodland alpine association extending from 2000-3000m consisted for 6 communities (Table 15). It was seen that all of the communities exhibited aggregated pattern of occurrence. In the shrubland alpine association lying between 3050 up to 3350m, there were three communities (Table 15) and all of them exhibited regular pattern. In the alpine grassland association lying in between 3505 to 3750, the three component communities showed regular pattern. It was concluded that the pattern changes from aggregated in the lower altitude to regular at higher altitude.

REGENERATING CAPACITY

The number of trees of each of the species in different girth classes is presented in Table 16.

It was observed that *Abies pindrow* and *Pinus wallichiana* had a maximum girth of 390 cm and *Pinus wallichiana* 300cm in the investigated area .The plants were distributed among different girth classes, which show that plants of different age group were present. The presence of young plants from seedling to mature or over mature shows a fair chance of regeneration of both these tree species.

The remaining species such as *Picea smithiana*, *Pyrus pashia*, *Salix denticulata*, *Quercus dilatata*, *Prunus persica*, and *Ficus palmata* were not regenerating as there were sporadic individuals in some of the girth classes.

Degree of Homogeneity

The results are depicted in Table17.

A- Spring

There were fifteen plants communities in spring. Of them, 12 communities were heterogeneous whereas three communities were homogeneous (Table17).

Similarly in monsoon, ten communities were heterogeneous and five were homogeneous (Table 17).

Table 13. Mean relative importance values of species in 4 associations during monsoon detected by normal cluster analysis.

S.No	Species	Associations			
		A	B	C	D
1	*Abies pindrow* Royle	0	40.31	0	0
2	*Acer pictum* Thunb	0	0	3.54	3.93
3	*Achillea millefolium* L.	1.10	1.40	0	0
4	*Aconitum laeve* Royle	0	0	0	0.82
5	*Aconitum violaceum* Jacquem	0	0	0.33	3.08
6	*Adiantum venustum* D. Don	0.23	1.83	0	0
7	*Agrostis canina* auct.	1.21	1.08	5.24	4.45
8	*Ajuga bracteosa* Wallich	0	0.11	0	0
9	*Allium humile* Kunth	0	0	2.41	3.16
10	*Alopecurus myosuroides* Huds	0	0	1.26	0
11	*Amaranthus viridus* L.	0.24	0	0	0
12	*Angelica cyclocarpa* L.	0	0	0	3.37
13	*Anaphalis nepalensis* (sprengel)Hand Mazz	0	0	11.0 3	6.41
14	*Androsace rotundifolia* Hardwick	0.06	0	0	14.73
15	*Arabidopsis himalaica* Edgew	0	0.09	0	0
16	*Arenaria neelgherrensis* Wight & Arn	0	0.09	0	0
17	*Arenaria orbiculata* Royle	0	0.25	0	0
18	*Arisaema intermedium* Blume	0	0.56	0	0
19	*Artemisia wallichiana Besser*	0	0	6.46	3
20	*Artemisia scoparia* Waldst & Kit	0.62	0	6.46	3.00
21	*Asplenium adiantum-nigrum* L.	0	0.44	0	0
22	*Aster alpinum* (Clarke) Hutch.	0	0	3.73	1.79
23	*Astragalus floridus* Bth	0	0	2.79	3.92
24	*Avena barbata* Pott	0.17	0	0	6.54
25	*Berberis lycium* Royle	20.17	0.23	0	0
26	*Bergenia ligulata* (Str) Hot	0	0.03	0	7.37
27	*Bistorta amplexicaulis* D.Don	0	0	3.19	0
28	*Brunella vulgaris L.*	0	0	6.30	5.06
29	*Caltha palustris L.*	0.66	0.11	2.87	7.53

30	*Cannabis sativa* L.	0.25	0	0	0
31	*Cenchrus biflorus* Roxb	0	1.71	0	0
32	*Chenopodium album* L.	0.19	0	0	0
33	*Chrysopogon aucheri (*Boiss) Stapf	0	0	0	2.49
34	*Circium arvense*(L). Scope	0.43	0.11	0	0
35	*Clematis grata* Wallich	0.19	0	0	0
36	*Codonopsis ovata* Bth	0	0	0	4.80
37	*Conolvulus arvensis Var linearifolius* Choisy	0.71	0	0	0
38	*Conyza canadensis* L	0.90	0	0	0
39	*Corydalis govaniana* Wall	0	0	0	6.79
40	*Cynodon dactylon* (L). Pers	5.05	1.27	0	0
41	*Cynoglossum lanceolatum* Forssk	1.67	0	0	0
42	*Cyperus panicoides* L.	0.07	0	2.89	0
43	*Cystopteris fragilis* Bernh	0	0.31	0	0
44	*Dactylis glomerata* L.	0	0.14	1.69	2.44
45	*Desmodium multiflorum* DC.	17.33	0.73	0	0
46	*Dichanthium annulatum (*Forssk) Stapf	0.38	0	0	0
47	*Diospyros lotus* L.	0.33	0	0	0
48	*Dipsacus inermis* Wall	0	0.20	0	0
49	*Dryopteris stewartii* Fress	0	0.51	0	0
50	*Elymus repens* (L.) Gold	0	0	5.20	11.16
51	*Epilobium cylindricum* D. Don	1.76	0.45	0	0
52	*Erigeron bellidioides* Buch	0.21	0	0	0
53	*Euphorbia helioscopia* L.	0.06	0	0	0
54	*Euphorbia wallichi* H. kf	0	0	1.10	2.30
55	*Festuca modesta* Nees	1.78	0	6.06	2.92
56	*Ficus palmata* Forssk	1.31	0	0	0
57	*Fragaria nubicola* Lindly	3.01	9.51	10.2 6	0
58	*Fritillaria roylei* Hook	0	0	0	3.24
59	*Galium boreale* L.	7.68	1.45	0	2.46
60	*Gentiana cachmerica* DC	0	0	2.35	3.17
61	*Gentiana decumbens* Wall	0	0	2.15	2.24
62	*Geranium wallichianum* D. Don	0	0	15.0 2	10.03

63	*Hedera nepalensis K.Koch*	0	0.10	0	0
64	*Hypericum perforatum* L	0.28	0	0.99	0
65	*Impatiens edgeworthii* Hook. f	0.36	0.20	6.16	0.26
66	*Imperata cylindrica* (L) Raeuschel	2.76	0	0	0
67	*Ipomoea perforatum* L.	0.26	0	0	0
68	*Iris lactea L.*	0	0	1.01	2.00
69	*Jasminum officinale* L.	0.75	0	0	0
70	*Juniperus communis* L.	0	0	18.2 2	14.13
71	*Koeleria macrantha* (Ledeb) Schutt	0	0	3.80	3.42
72	*Lactuca scariola* L.	0	0.29	0	0
73	*Lavaetra kashmiriana* Camb	0	0	6.43	0
74	*Leontopodium alpinum* Cass	0	2.97	5.99	12.02
75	*Lespedeza sericea* (Thunb) Miq	1.54	1.48	0	3.71
76	*Leucas lanata* Bth	0	0	0	3.09
77	*Lolium perenne* L.	0	0	0.79	0
78	*Machilus odoratissima* (Nees) Kostern	1.48	0	0	0
79	*Malva verticillata* L.	0.12	0	0	4.07
80	*Medicago falcata* L.	0	0	0	9.12
81	*Melilotus alba* Desf	1.47	1.40	0	0
82	*Mentha longifolia* (L.) Hudson	1.17	0.59	0	0
83	*Micromeria biflora* Ham. Bth	8.00	0.09	0	0
84	*Minuartia kashmiriana* (Edgew) Mattf	0	0	8.87	0
85	*Morina coulteriana* Royle	0	0	0	7.41
86	*Nepeta podostachys* Bth	0	0.12	4.67	0
87	*Oenothera rosea* L. Her	1.81	0.24	0	0
88	*Onychium japonicum* (Kunze) Wall	0	1.21	0	0
89	*Oxalis corniculata* L.	10.35	1.63	1.82	3.97
90	*Poa bactriana* Rozhev	0	0.94	0	12.12
91	*Potentilla geradiana* L.	0	0	3.70	1.80
92	*Potentilla. major L.*	0	0.26	0	0
93	*Pedicularis siphonatha* D. Don	0	0	8.74	0
94	*Pteris vitata* L.	0.42	0	0	0
95	*Parnassia cabulica* Planch	0	0	5.65	0
96	*Pedicularis pectinata* Wallich	0	0	1.83	0.2
97	*Phacelurus speciosus* Stead	0	0	4.79	0

98	*Phalaris arundinacea* L.	0.50	0	0	0
99	*Phleum alpinum* L.	0	0	11.1 4	27.06
100	*Phlomis bracteosa Royle.*	0	0.09	0	0
101	*Picea smithiana* (Wallich) Boiss	0	4.37	0	0
102	*Pinus roxburghii* Sargent	1.40	0	0	0
103	*Pinus wallichiana* A.B. Jackson	38.65	16.72	0	0
104	*Plantago lanceolata* L	3.69	1.37	0	0
105	*Plectranthus rugosus* Wallich ex Bth	0.31	0	0	0
106	*Pleurospermum govanianum (*DC) Clarke	0	0	1.25	0
107	*Poa annua* L.	1.05	8.17	6.99	3.33
108	*Poa infirma* H.B.K	0	0	0	3.51
109	*Podophyllum hexandrum* Royle	0	0	1.60	1.06
110	*Polygonum plebejum* R. Br	0	1.53	0	0
111	*Polygonum amplexicaulis* D. Don	0	.2.61	11.7 2	15.86
112	*Polypogon alpinum All*	0	0	4.45	0
113	*Potentilla eriocarpa* Wallich	0	1.74	26.2 7	21.21
114	*Potentilla cuneata* Wall	0.	0.07	0	0
115	*Prangos pabularia* Lind	0	0	0	3.48
116	*Primula denticulata* Sm	0	0	1.97	7.69
117	*Prunus persica* Stapf	2.70	0	0	0
118	*Pseudomertensia echioides* Bth	0	0	7.71	0
119	*Pteris cretica* L.	0	0.81	0	0
120	*Punica granatum* L.	0.84	0	0	0
121	*Pyrus pashia* Buch	3.95	0	0	0
122	*Quercus dilatata* Royle	4.83	0	0	0
123	*Ranunculus laetus* Wallich	0.45	3.61	5.21	10.90
124	*Ranunculus repens* L.	0	0.63	0	0
125	*Rosa macrophyla* Lindley	2.46	0.09	5.86	4.51
126	*Rubia tinctorum* L.	0	0.68	0	0
127	*Rubus fruticosus* L.	3.50	0	0	0
128	*Rumex nepalensis* D.Don	2.09	3.34	2.71	2.48
129	*Salix grandiflorum* Anderson	0	0	10.5	7.18

				9	
130	*Saccharum spontaneum* L.	0.02	0	0	0
131	*Salix denticulata* Anderson	0.95	0	0	0
132	*Salvia hians* Royle ex Bth	0	0	0.99	0
133	*Sarcococca saligna* (D. Don) Muell	1.37	2.72	0	0
134	*Saussurea lappa* DC	0	0.74	7.01	3.93
135	*Sedum quadriflorum* Pall	0	0	0	4.48
136	*Selinum tenuifolium* Wallich	0	0	0	4.30
137	*Senecio chrysanthemoides* DC.	0	0.40	8.68	0.41
138	*Senecio ligularia* HK. F	0	0	0	2.81
139	*Sibbaldia cuneata* Hornem	0	4.90	0	0
140	*Solanum nigrum* L.	0.08	0	0	0
141	*Sonchus asper* Hill	4.07	0.49	0	0
142	*Sorghum halepense* (L.) Pers	0.29	0	0	0
143	*Stellaria decumbens* Edgew	0	0.36	0	0
144	*Taraxacum officinale* Weber	2.40	1.78	4.28	3.52
145	*Themeda anathera* Nees ex Steud.	4.06	0.15	0	0
146	*Thymus serphyllum* L.	0	1.88	2.32	6.25
147	*Trifolium resupinatum* L.	2.48	2.93	0	0
148	*Trigonella emodii* Bth	0	0	0	0.4
149	*Tlillidium govanianum* (D. Don) Kunth	0	1.05	0	0
150	*Urochloa panicoides* P. Beauv	1.35	0	0	0
151	*Urtica dioica* L.	0.16	1.83	0	0
152	*VaSleriana pyrolifolia* DC	0	0	0	4.43
153	*Verbascum thapsus* L.	0.19	0	0	0
154	*Veronica melissaefolia* Royle	0	3.84	2.94	1.97
155	*Viola odorata* L.	1.72	0.97	0	0
156	*Viola serpens* Wall ex Roxb	0	2.13	0	0
157	*Zanthoxylum armatum* DC	2.41	0	0	0
	Total	**70**	**68**	**59**	**65**

Key: A= Woodland temperate association, B= Woodland alpine association
C= Shrub land alpine association and D= Alpine grassland association.

Table 14. Family Importance Values recorded for spring and monsoon plant communities.

	Spring		Monsoon	
Family	Species	FIV	Species	FIV
Apiaceae	3	97.05	2	21.55
Araceae	-	-	1	15.00
Asteraceae	17	580.75	9	509.01
Balsaminaceae	1	17.34	-	-
Berberidaceae	1	119.32	1	5.44
Boraginaceae	2	27.63	1	97.62
Buxaceae	1	61.04	1	13.40
Caprifoliaceae	1	54.65	1	172.60
Caryophyllaceae	-	-	4	33.64
Cruciferae	-	-	1	0.88
Cyperaceae	1	121.57	2	22.22
Dipsacaceae	-	-	1	21.03
Euphorbiaceae	1	1.58	1	20.70
Gentianaceae	1	41.64	1	25
Geraniaceae	1	74.85	-	-
Hypericaeae	1	8.92	-	-
Lamiaceae	4	82.81	5	115.69
Lauraceae	-	-	1	17.83
Leguminosae	2	177.82	4	287.76
Liliaceae	-	-	1	2.13
Malvaceae	-	-	1	35.60
Moraceae	-	-	2	5.57
Myrisinaceae	1	4.67	-	-
Nyctaginaceae	1	17.74	-	-
Oleaceae	-	-	1	3.21
Onagraceae	2	123.70	1	18.33
Orchidaceae	-	-	1	7.50
Oxalidaceae	-	-	1	68.87
Pinaceae	4	634.85	2	565.80
Plantaginaceae	2	88.46	1	47.39
Poaceae	10	628.08	19	721.96
Podophyllaleae	-	-	1	10.50
Polygonaceae	2	320.72	3	93.39
Primulaceae	2	87.97	2	39.11
Pteridaceae	2	4.61	-	-
Ranunculaceae	3	62.93	5	190.71
Rosaceae	11	275.79	12	297.66
Rubiaceae	2	42.27	2	134.34
Rutaceae	1	11.42	-	-
Salicaceae	1	4.79	1	119.26
Scrophulariaceae	3	133.41	1	61.171
Solanaceae	-	-	1	27.83
Triliaceae	-	-	1	2.32
Urticaceae	1	13.89	1	1.52
Violaceae	2	17.87	1	95.17
Total	87		95	

Total no of families 31 38

Total no of families in both seasons = 47

Table 15. Degree of aggregation of plant associations recorded from Ganga Chotti and Bedori Hills.

Spring					Monsoon			
Alt.(m)	Regular	Aggregate	Intermediate	Unity	Regular	Aggregate	Intermediate	Unity
1700-2000	35	18	48	0	28	40	28	4
2000-3000	17	46	37	0	14	53	25	8
3050-3350	17	36	47	0	37	22	41	-
3505-3750	17	37	46	0	35	35	30	-

Table 16. The regenerating capacity of woody species as depicted by their girth class.

S. No	Girth class (cm)	*Abies pindrow*	*Pinus wallichiana*	*Picea smithiana*	*Pyrus pashia*	*Salix denticulata*	*Quercus dilatata*	*Prunus persica*	*Ficus palmata*
1	0-30	17	13	0	01	09	0	07	0
2	30-60	01	17	0	01	0	2	02	1
3	60-90	0	18	0	0	05	5	01	0
4	90-120	03	02	0	0	0	1	0	2
5	120-150	17	08	0	0	0	0	0	0
6	150-180	07	07	0	0	0	0	0	2
7	180-210	10	10	02	0	0	0	0	0
8	210-240	05	03	0	0	0	0	0	0
9	240-270	05	0	01	0	0	0	0	0
10	270-300	06	02	0	0	0	0	0	0
11	300-330	02	0	0	0	0	0	0	0
12	330-360	0	0	0	0	0	0	0	0
13	360-390	01	0	0	0	0	0	0	0
14	390-420	0	0	0	0	0	0	0	0
15	420-450	0	0	0	0	0	0	0	0
16	450-480	0	0	0	0	0	0	0	0

Table 17 a. Degree of homogeneity based on frequency classes of plansts in different communities of Ganga Chotti and Bedori Hills during spring, 1999-2000.

A. spring

S.No	Altitude (m.)	Community	Frequency classes					Remarks
			A	B	C	D	E	
1	1700	*Themeda- Cyperus-Pinus*	5	6	1	5	0	He
2	1800	*Themeda-Pinus-Desmodium*	8	3	0	3	2	Ho
3	1900	*Andropogon-Pinus-Berberis*	0	6	3	1	4	He
4	2000	*Pinus-Cyperus-Gerbera*	2	6	3	2	3	He
5	2400-2500	*Abies-Pinus-Viburnum*	4	3	7	4	1	He
6	2600	*Abies-Viburnum-Medicago*	3	6	4	0	3	He
7	2800	*Picea-Epilobium-Bromus*	4	6	1	2	1	He
8	2900	*Veronica-Sibbaldia-Poa*	4	4	4	2	-	He
9	3000	*Sibbaldia-Aster-Rumex*	-	5	2	-	2	He
10	3050	*Euphorbia-Phleum-Artemisia*	5	-	-	2	2	Ho
11	3250	*Potentilla-Geranium-Achillea*	1	4	1	1	1	He
12	3350	*Potentilla-Juniperus-Phleum*	4	4	1	-	1	He
13	3505	*Potentilla-Phleum-Achillea*	-	2	2	1	1	He
14	3650	*Potentilla-Androsace-Polygonum*	3	2	2	1	-	He
15	3750	*Polygonum-Phleum-Leontopodium*	4	1	-	-	1	Ho

B. Monsoon

S.No	Altitude (m.)	Communities	Frequency classes					Remarks
			A	B	C	D	E	
1	1700	*Imperata-Pinus-Sonchus*	13	4	1	2	2	Ho
2	1800	*Desmodium-Pinus-Lespedeza*	12	4	6	5	1	He
3	1900	*Berberis-Desmodium-Agrostis*	17	6	3	3	5	Ho
4	2000	*Desmodium-Berberis-Cynodon*	7	6	1	5	3	He
5	2400	*Abies-Viburnum-Poa*	9	7	1	5	3	He
6	2500	*Pinus-Fragaria-Cenchrus*	9	6	2	2	6	He
7	2600-2800	*Abies-Viburnum-Cenchrus*	10	4	4	3	2	He
8	2900	*Lespedeza-Poa-Fragaria*	9	5	1	1	3	Ho
9	3000	*Poa-Salix-Abies*	10	4	2	1	2	Ho
10	3050	*Pseudomertensia-Potentilla-Pedicularis*	7	4	5	2	1	He
11	3250	*Parnassia-Agrostis-Polypogon*	5	6	5	2	1	He
12	3350	*Senecio-Bupleurum*	7	1	2	2	2	Ho
13	3505	*Lavaetra-Leucas-Ranunculus*	6	3	3	1	2	He
14	3650	*Primula-Oxalis-Phleum*	4	-	2	3	2	He
15	3750	*Juniperus-Malva-Lespedeza*	2	1	2	2	2	He

Key: Ho= Homogeneous A= 0-20 % frequency C=41-60 % frequency E= 81-100 % frequency
He= Heterogeneous B= 21-40% frequency D= 61-80 % frequency

Index of diversity and its components

In spring, index of diversity decreased from 1700 to 3350 m. with average value 2.70 to 1.66. In alpine grassland association it increased (Table 18). The species richness decreased from lower altitude to higher altitude. Equitability increased form 1700 m. to 3350 m. and thereafter decreased. Similarly, species maturity almost remained the same.

Index of diversity among communities increased from 1700m to 3000m. in monsoon with an average value of 2.27 to 2.37. It decreased in shrubland alpine association (Alt.3050-3350m) and thereafter a declining trend was observed in alpine grassland association (Table18). The species richness decreased with increasing altitude from1700 to 3750 m from 2.57 to 1.25 in all the four associations. Similarly, equitability increased while moving from low altitude (1700m) to high altitude (3000m), but declined to 0.61 at 3750m.

The recorded species maturity shows declining tendency while moving from lower (1700 m) to higher altitude (3750m). It was 51.27 at the base (1700m) and 31.82 at the top (3750) (Table 19).

SIMILARITY (IS) AND DISSIMILARITY (ID) INDICES

A. Spring

Muller Dum bois and Ellenberg (1974) stated that communities having less than 65% similarity are regarded as dissimilar. The present results shows that the highest similarity (65 %) was recorded between *Abies-Pinus-Viburnum* and *Abies-Viburnum-Medicago*, *Potentilla-Androsace-Poly*gonum and *Polygonum-Phleum-Leontopodium* (65 %). The similarity between *Themeda-Cyperus-Pinus* and *Andropogon-Pinus-Berberis* (60%), *Themeda-Cyperus-Pinus* and *Themeda-Pinus-Desmodium* (60. %), *Potentilla-Juniperus-Phleum* and *Potentilla-Phleum-Achillea* (56 %) and *Potentilla-Geranium-Achillea* and *Potentilla-Phleum-Achillea* (55 %) communities were low (Table 20).

Pinus-Cyperus-Gerbera, *Abies-Pinus-Viburnum*, *Abies-Pinus-Viburnum*, and *Veronica – Sibbaldia - Poa*, *Potentilla - Phleum - Achillea* and *Potentilla-Androsace-Polygonum* communities shared 31.50 to 46 % similarity among themselves.

The remaining communities had less than 30% similarity among themselves.

B. Monsoon

The results are shown in Table 21. The highest similarity (61 %) was reported between *Berberis-Desmodium-Agrostis* and *Desmodium-Berberis-Cynodon.* While *Berberis - Desmodium-Agrostis* and *Desmodium-Berberis-Cynodon* (60 %), *Abies-Viburnum-Poa* and *Abies-Viburnum-Cenchrus* (51%), *Desmodium-Pinus Lespedeza* and *Desmodium -Berberis-Cynodon* (46%) and *Desmodium-Pinus-Lespedeza* and *Berberis-Desmodium-Agrostis* (46%) communities had low similarity.

All the remaining communities were less than 32 %. similarity among themselves.

Soil Analysis

There were 4 plant associations in the investigated area. Woodland temperate association occupies zone between 1700-2000 meters. The soil varied from silty loam, loam to clay loam while pH varied from 5.96 to 7.29, electrical conductivity form 0.17 to 0. 45 ds/m, NO_3-N from 0.43-3.50 ppm, phosphorous from 0.16 to 2.80 ppm, potassium from 56-188 ppm, organic matter 1.1 to 2.9 % and total soluble salts from 101-211.30 (Table 22).

Woodland alpine association lies in between altitude 2000-3000 m. and has loamy to loamy clay and clay soil. The pH varied from 5.15-7.66, electrical conductivity from 0.07 to 0.49, NO_3-N from 1.75 to 6.85 ppm, phosphorous 0.41 to 6.43 ppm, potassium 60-280 ppm, organic matter 2.4-5.3 % and total soluble salts 59-337.

In shrubland alpine association with altitude 3050-3400m soil varied from sandy clay loam to clay loam, pH from 5.51 to 6.15, electrical conductivity from 0.38 to 0.97, potassium 60-230 ppm, organic matter 2.5-3.3 %, Na 9-12, NO_3 31.10 to 72.10, phosphorous 1.50 to 23.65 ppm, total soluble salts 243-582, HCO_3 2.00 to 3.66, Chlorine 2.16 to 3.00 and Ca+Mg 10.33 to 19.66.

In alpine grassland association (altitude 3500-3750) soil varied from sand to sandy loam and clay loam, pH 5.45-7.76, organic matter 2.2-2.9 % Ec 0.43-0.60, potassium, 50-130 ppm and Na 8-11%.

HERBACEOUS PRODUCTIVITY (BIOMASS)

During both the years i.e. 1999 and 2000, there was an increasing trend of biomass of grasses and forbs up to the month of July-August. However, it declined towards the progressing November. The amount of biomass was significantly higher during 2000 as compared to 1999 in the same months.

The biomass of grasses and forbs generally had tendency to increase up to August but thereafter both declined forwards during October and November. On the contrary, the amount of litter decreased from May to June (25 – 21 Kg / h), showed a slight increase during July (45 Kg / h) followed by decline in August-September, high in October, and decreased in November.

In woodland alpine association (Alt.2000-3000m), the average biomass of grasses and forbs from May to July increased and from here onwards they had (824-461 Kg / h) showing a decline.

During May to July amount of litter increased from (12 to 17 Kg / h), decreased during August-September (38-27 Kg / h) and again enhanced during October (28 Kg / h) and November (32 Kg / h) (Table 22).

The biomass of grasses in shrubland alpine association improved during May-July (103-315 Kg / h) and was low during August to September (216-155 Kg / h). The litter in this zone also registered an increasing trend up to July and declined in the next months.

In alpine grassland association (Alt 3500-3750m) grasses and forbs had the tendency of increasing biomass from May to July and then it declined from August to September (188 Kg / h). There was a gradual decrease in the amount of litter along the growing season.

In 2000, generally the biomass remained high as compared to 1999 (Table 23). Similarly, litter generally was better in 2000 than in 1999.

EFFECT OF ALTITUDE

The altitude also affected the amount of biomass of grasses, forbs and litter. It was seen that the amount of biomass in grasses and forbs gradually declined while moving from low altitude (1700—2000m) to high altitude (3550-3750m) during all the months of both the years (Table 23).

Productivity of Shrubs

Rubus fruticosus produced the highest shoot biomass of 1530 Kg /h, during 1999 in Ganga hills which was followed by *Rosa macrophylla* (1200 kg /h), *Rosa elliptica* (1025 Kg /h), *Viburnum* grandiflorum (912 Kg /h), respectively at Ganga and Bedori hills

(Table 24). *Zanthoxylum alatum* had 315 Kg/h, *Berberis lycium* 309 Kg/h and *Desmodium grandiflorum* 296 Kg /h.

Similarly, during 2000 *Rubus fruticosus* produce a maximum of 2800 kg /h. It was followed by *Rosa macrophylla* 2220 Kg /h. *Rosa elliptica* 1970 Kg /h, *Viburnum grandiflorum* 1240 Kg /h. *Desmodium multiflorum* and *Zanthoxylum alatum* produced 520 and 500 Kg /h, respectively. *Berberis lycium* produced the least production of 412 Kg /h.

The total productivity of plants harbouring Ganga and Bedori hills was highest during the year 2000 (9662 Kg /h) as compared to 1999 (5587 Kg /h). All the shrub species had more biomass during 2000 as compared to 1999. The biomass increases from May to August (3677 Kg /h) and thereafter exhibited a continued decline till October which gave only 1910 Kg /h. production during 1999.

Similarly, in 2000 the biomass increased from May to August (6272 Kg /h) and in the remaining months it declined to 3390 Kg /h up to October.

The period from May to August was more productive months during 1999 and 2000. However, due to dryness and low rainfall in 1999, the biomass decreased in September and October as compared to production of 2000.

As a whole shrub biomass was 15249 Kg /h, in Ganga and Bedori hills which continuously increased from May to August 9949 Kg /h, and then declined from September to October 5300 Kg /h.

The overall productivity of forage

The total average biomass for both the years was 7610 Kg /h. The month of July and August were the most productive having 1357 and 1536 Kg /h, in Ganga and Bedori hills respectively. The biomass gradually increased from May to August 4970 Kg /h and progressively decreasing trend till November 2640 Kg /h.

DEGREE OF PALATABILITY

There were a total of 206 species, which belonged to 46 families. Of them, 115 were palatable to varying degrees. They included 19 species (9.2%), which were highly palatable, 16.01% (33 species), mostly palatable, 15.5% (32 species) less palatable and15.05% (31 species) rarely palatable. The ratio of species to the palatable species was 16.5% highly palatable, 28.6% most palatable, 27.7% less palatable and 26.9% rarely palatable and 26.9% rarely palatable. The ratio of palatable to total species was 1:2 and non palatable to the total was 1:3.

Desmodium and *Viburnum* were highly preferred by both sheep and goats during earlier spring (May and June)

Among the shrubs, 3 species (16.66%) were mostly palatable while only one species (5.26%) was less palatable and 6 species (31.58%) were rarely palatable. The livestock generally preferred the shrub species. *Rosa macrophylla, Berberis lycium, Desmodium multiflorum* and *Viburnum grandiflorum* were mostly preferred species during early spring and late monsoon (July). However, these species were not grazed during August, and September. *Myrsine africana* were preferred over other species from August to September and less preferred in other months (i.e. seedling and dormant stage). Similarly *Rosa elliptica* was preferred the most from July to October and less preferred from May to June.

There were 24 species (85.71%) of palatable grasses. Of them, 9 species (32.14%) were highly palatable, 6 species (21.43%) mostly palatable, 6 species (21.43%) less palatable, two species i.e. *Phalaris arundinacea* and *Polypogon* was rarely palatable and *Phalaris* minor were unpalatable species (Table 24 appendix 4).

PREFERENCE BY ANIMALS

Among the palatable species (55.8%), 77 species were used by goat. They included 14.3% shrubs, 68.8% herbs and 12.9% grasses. Sheep preferred 53 species (46.09%) species, which comprised of one shrub, 38 (33%) herbs, and 14(12.2%) grasses (Table 24).

CLASSIFICATION BY PARTS USED

It was found that in 49 species (23.7%) shoots/whole plants were used, in 64 species (31.06%) foliage/leaves were used, while in 33 species (16.02%) floral parts were consumed (Table 24).

AVAILABILITY OF FODDER SPECIES

The availability of fodder species during the year depended upon the season. There were 21 species available in April, 15 species in May, 53 in June, 81 in July, 28 is August, 6 in September and one species in October and November each.

The perennial species like *Juniperus communis*, *Rosa macrophylla*, *Prunus persica* and *Themeda anathera*, *Dichanthium annulatum* and *Poa bactriana* were available throughout the growing season (Table 25).

It was observed that majority of the highly palatable species were available in higher percentage (16.01%) during May and June that gradually declined during October (1%) through course of time.

The species which are most palatable gradually increased from May to August (66-80%) and thereafter they decreased.

The highly and most preferred shrub component were almost equal (42-50%) from May to August. Highly palatable herbaceous species were available abundantly during May and June and thereafter gradually decreased. The availability of most palatable herbaceous species was almost similar (15-20%) from July to August as compared to other months. The highly palatable grasses were available in higher percentage during May and June (30%).

The species, which were highly preferred by goats, were available during May and June and therefore, they had better choice for fodder. Similarly, 50% and 60% species of grasses were available during May and June, respectively which declined gradually up to September. The shrub species that were highly and most preferred showed relatively constant availability from May to September (33%). However, they decreased in October (9%) onwards. The 10 to 15 % highly preferred herbs were available in May and June only. While most preferred herb species showed gradual increase from May to June (20 to30 %) remained almost constant upto September and then decreased in October (5%). All those species, which were low preferred by livestock, were abundant in July as compared to other months. The leaves of *Desmodium multiflorum* and *Viburnum grandiflorum* are grazed only in May and June by goats, sheep and cattle.

Similarly, sheep had variety of choices for fodder during May as highly preferred species (42%) remained almost constant upto September. The fodder choices were limited during October due to onset of dormant season (5 %). The number of highly preferred herbs was relatively greater (20-30 %) in May and June as compared to other months. There was a 65.1% most preferred herb during June, which decreased in July (50%).

NON-PALATABLE / POISONOUS SPECIES

There were 91(44.17%) species, which were non-palatable due to various reasons. They included *Sarcococca saligna*, *Juniperus communis* among shrubs; and *Aconitum violaceum*, *A. laeve*, *A. chasmenthum*, *Mentha longifolia*, *Codonopsis ovata* and *Urtica dioica* among herbs. Some species such as *Euphorbia helioscopia* and *E. wallichii* were considered as poisonous to livestock.

Table 18 : Diversity and its components recorded by the communities during spring.

Association	Altitude	Diversity	Species richness	Equitibility	Species maturity
a. Woodland Temperate association	1700	2.16	3.5	0.69	30.60
	1800	2.96	4.31	0.88	41.78
	1900	2.94	4.92	0.4	41.24
	2000	2.76	3.50	0.87	52.46
	Average	2.70	4.06	0.71	41.52
b. Woodland alpine association	2400	2.67	3.67	0.82	40.13
	2500	2.50	3.9	0.75	37.68
	2600	2.56	3.39	0.83	40
	2800	2.53	2.83	0.85	50.17
	2900	2.45	2.97	0.81	34.99
	3000	2.34	2.97	0.79	35.08
	Average	2.51	3.29	0.81	39.67
c. Shrubland alpine association	3050	1.54	1.54	0.86	46.29
	3250	1.64	1.37	1.32	42.49
	3350	1.79	1.78	0.93	32.33
	Average	1.66	1.56	1.07	40.37
d. Alpine grassland association	3505	1.36	0.93	0.84	54.44
	3650	1.82	1.39	0.79	35.83
	3750	1.85	1.07	0.68	28.88
	Average	1.71	1.13	0.77	39.72

Table 19 : Diversity and it components recorded by the communities during monsoon.

Association	Altitude	Diversity index	Species richness	Equtibility	Species maturity
a. Woodland Temperate association	1700	2.24	2.61	0.78	47.55
	1800	2.05	2.47	0.82	43.55
	1900	2.30	2.48	0.82	60.23
	2000	2.48	2.74	0.72	53.75
b. Woodland alpine association	Average	2.27	2.57	0.78	51.27
	2400	2.65	3.07	0.90	49.12
	2500	2.59	3.01	0.88	43.68
	2600	2.36	2.53	0.58	43.74
	2800	2.30	2.35	0.87	39.99
	2900	2.38	2.37	0.90	38.09
	3000	1.92	1.42	0.87	54.81
c. Shrubland alpine association	Average	2.37	2.46	0.83	44.90
	3050	1.64	1.37	0.79	42.49
	3250	1.79	1.78	0.77	32.33
	3350	1.36	1.93	0.75	54.44
d. Alpine grassland association	Average	1.59	1.69	0.77	43.09
	3505	1.82	1.39	0.87	35.83
	3650	1.70	1.30	0.70	30.75
	3750	1.63	1.07	0.26	28.88
	Average	1.72	1.25	0.61	31.82

Table 20. Index of Similarity and Dissimilarity between the communities during spring.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	x	39.95	39.63	53.62	73.73	86.48	96.43	100	100	100	100	100	100	100	100
2	60.05	x	46.27	50.77	75.66	88.33	100	98.65	100	100	92.96	100	100	100	100
3	60.37	53.73	x	46.65	74.65	86.61	94.96	96.18	100	94.34	94.95	88.10	94.96	100	100
4	46.38	49.23	53.35	x	68.48	81.25	95.85	95.45	100	95.25	100	100	100	97.55	98.33
5	26.27	24.34	25.35	31.50	x	34.58	95.82	55.52	95.11	96.83	100	100	100	97.35	97.35
6	13.52	11.67	13.36	18.75	65.42	x	95.81	84.10	96.47	96.06	100	100	100	100	100
7	3.57	0	5.04	4.15	4.18	4.18	x	77.02	76.55	98.16	95.63	99.42	100	97.21	95.76
8	0	1.35	3.82	4.55	44.48	15.90	22.98	x	75.11	89.40	92.57	98.32	98.87	95.09	95.09
9	0	0	0	0	4.89	3.53	23.45	24.89	x	95.53	96.50	99.42	98.87	100	100
10	0	0	5.66	4.75	3.16	3.94	1.84	10.60	4.47	x	61.58	68.33	71.30	64.04	86.46
11	0	7.04	5.05	0	0	0	4.37	7.43	3.50	38.42	x	52.41	45.06	59.49	65.77
12	0	0	11.89	0	0	0	0.58	1.68	0.58	31.67	47.59	x	44.52	54.28	58.57
13	0	0	5.04	0	0	0	0	1.13	1.13	28.70	54.94	55.48	x	60.58	65.24
14	0	0	0	2.45	2.64	0	2.79	4.91	0	35.96	40.51	45.72	39.42	x	35
15	0	0	0	1.66	2.64	0	4.24	4.91	0	13.54	34.23	41.43	34.76	65	x

I.S (below diagonal); ID (above diagonal)

Key: 1. *Themeda-Cyperus-Pinus* Community (TCP)
2. *Themeda-Pinus-Desmodium* Community (TPD)
3. *Andropogon-Pinus-Berberis* Community (APB)
4. *Pinus-Cyperus-Gerbera* Community (PCG)
5. *Abies-Pinus-Viburnum* Community (APV)
6. *Abies-Viburnum-Medicago* Community (AVM)
7. *Picea-Epilobium-Bromus* Community (PEB)
8. *Veronica-Sibbaldia-Poa* Community (VSP)
9. *Sibbaldia-Aster-Rumex* Community (SAR)
10. *Euphoriba-Phleum-Artemisia* Community (EPA)
11. *Potentilla-Geranium-Achillea* Community (PGA)
12. *Potentilla-Juniperus-Phleum* Community (PJP)
13. *Potentilla-Phleum-Achillea* Community (PPA)
14. *Potentilla-Androsace-Polygonum* Community (PAP)
15. *Polygonum=Phleum-Leontopodium* Community (PPL)

Table 21. Index of similarity and dissimilarity between the communities during monsoon, 1999.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
01.	X	67.25	80.30	78.56	89.49	70.81	89.75	94.52	99.51	99.51	99.24	99.24	100	97.15	94.47
02.	32.75	X	53.61	53.14	82.03	67.65	82.01	91.72	92.50	94.10	96.45	99.44	96.84	97.82	92.47
03.	19.70	46.39	X	38.66	83.77	81.67	89.53	90.09	94.30	94.30	99.04	98.45	100	95.07	0
04.	21.44	46.86	61.34	X	91.05	85.63	91.22	95.70	99.26	100	99.04	91.65	100	94.20	0
05.	10.51	17.97	16.23	8.95	X	74.58	48.29	83.22	75.43	86.90	98.58	100	100	98.49	98.23
06.	29.19	32.35	18.33	14.37	25.42	X	81.93	87.95	88.71	87.71	100	99.61	100	100	95.09
07.	10.25	17.99	10.47	8.78	50.71	18.07	X	85.05	76.84	90.79	96.89	100	100	100	94.95
08.	5.48	8.28	9.91	4.30	16.78	12.05	14.95	X	79.27	88.97	97.19	100	100	100	87.71
09.	0.49	7.50	5.70	0.74	24.57	11.29	23.16	20.73	X	87.50	90.93	100	90.92	94.58	92.06
10	0.49	5.90	5.70	0	13.10	12.29	9.21	11.03	12.50	X	86.12	84.88	100	86.74	93.13
11.	0.76	3.55	0.96	0.96	1.42	0	3.11	2.81	9.07	13.88	X	88.59	78.84	89.55	100
12.	0.76	0.56	1.55	8.35	0	0.39	0	0	0	15.12	11.41	X	78.38	100	100
13.	0	3.16	0	0	0	0	0	0	9.08	0	21.16	21.62	X	93.97	100
14.	2.85	2.18	4.93	5.80	1.51	0	0	0	5.42	13.26	10.45	0	6.03	X	81.37
15.	5.53	7.53	0	0	1.77	4.91	5.05	12.29	7.94	6.87	0	0	0	18.63	X

IS (lower left) ID (upper right)

Key is the same as in the table 10.

Table 22. Physico-chemical analysis of the communities recorded from Ganga Choti and Bedori Hills.

Association	Altitude	Soil texture	pH	Ecx10 (ds/m)	No_3-N ppm	P ppm	K ppm	O.M %	T.S.S
Woodland temperate association	(1700-2000)m	Silty loam to clay loam	5.96-7.29	0.17-0.45	0.43-3.50	0.16-2.80	56-188	1.1-2.9	101
Woodland alpine Association	(2000-3000)m	Loamy, Loamy clay, clay	5.15-7.66	0.07. 0.49	1.75-6.85	0.41-6.43	60-280	2.4-5.3	59-33
Shrubland alpine Association	(3000-3400)	Sandy clay loam, clay loam	5.51-6.35	0.38-0.97	31.10-72.10	1.50-23.65	60-230	2.8	243-
Alpine grassland Association	(3500-3750)	Sand, Sandy loam, Clay loam	5.45-7.76	.43-.60	37-78	2.34-179.63	50-130	2.4	275

Key : Ec = Electrical conductivity , No_3–N = Nitrate, P = Phosphorous , K = Potassium, O.M = Organic matter and T.S.S = Total soluble salts

Table 23. The Seasonal and altitudinal Variation in the biomass (kg / h) of shrubby species of Ganga Choti and Bedori hills during the year 1999-2000

Species		May	June	July	Aug	Sep	Oct	Nov
Viburnum grandiflorum	1999	120	130	152	170	150	110	80
	2000	170	190	200	210	180	160	130
	Average	145	160	176	190	165	135	105
Rosa macrophylla	1999	160	180	210	230	190	150	80
	2000	300	340	390	400	350	300	140
	Average	230	260	300	315	270	225	110
Rosa elliptica	1999	140	160	185	190	150	120	80
	2000	260	300	350	370	280	240	170
	Average	200	230	267	280	215	180	125
Zanthoxylum alatum	1999	30	45	60	70	50	40	20
	2000	60	50	100	120	80	60	30
	Average	45	47	80	95	65	50	25
Berberis lycium	1999	40	46	52	61	50	40	20
	2000	60	70	62	80	60	50	30
	Average	50	56	57	70	55	35	25
Desmodium grandiflorum	1999	35	45	55	61	50	30	20
	2000	60	70	100	110	90	60	30
	Average	47	57	77	86	70	45	25
Rubus fruticosus	1999	150'	200	300	400	260	150	70
	2000	350	400	500	600	500	300	150
	Average	250	300	400	500	380	225	110

Table 24. The seasonal and altitudinal variation in the biomass (Kg/h) of herbaceous species of Ganga Chotti and Bedori Hills during the year 1999 and 2000.

		Woodland temperate association			Woodland alpine association			Shrubland alpine association			Alpine grassland association		
Month		G	F	L	G	F	L	G	F	L	G	F	L
May	1999	770	220	20	720	190	11	60	70	40	80	90	50
	2000	1250	750	30	510	1020	20	140	290	20	170	380	20
	Average	1010	485	25	615	605	15	100	180	30	125	235	35
June	1999	860	270	20	830	240	20	110	160	3	160	170	7
	2000	1400	640	20	610	980	30	280	580	20	330	530	30
	Average	1130	455	20	720	560	25	195	370	12	245	350	19
July	1999	970	390	30	960	360	30	210	360	7	140	190	7
	2000	1890	1110	60	1120	1850	60	420	700	30	450	600	27
	Average	1430	750	45	1040	1105	45	315	530	18	300	390	17
August	1999	1140	480	30	1100	460	31	90	210	5	220	370	7
	2000	1450	1230	26	750	1490	45	340	540	19	340	520	24
	Average	1290	850	28	925	975	38	215	375	12	280	445	15
September	1999	1200	150	13	910	400	30	120	120	10	80	110	8
	2000	830	1120	22	730	170	23	190	330	15	160	270	15
	Average	1015	635	17	820	285	27	155	225	13	120	190	12
October	1999	1140	430	38	820	320	38	-	-	-	-	-	-
	2000	620	470	19	360	570	19						
	Average	880	450	28	590	450	28	-	-	-	-	-	-
November	1999	1010	330	36	660	190	44	-	-	-	-	-	-
	2000	570	380	13	257	400	20						
	Average	790	365	19	458	295	33	-	-	-	-	-	-

Key: G= Grass F= Forb L= Litter

DISCUSSION

Discussion

Floristic structure and composition

Floristic diversity is a reflection of vegetation and plant resources of any area. Plant recourses of an area are affected by agriculture, intense grazing, by nomads, local inhabitants and natural disasters.The floristic list of Ganga Chotti and Bedori Hills comprised of 206 species that were distributed among 47 families.

Pinaceae, Poaceae, Asteraceae, Rosaceae and Polygonaceae were the dominant families in spring and monsoon on the basis of family importance values (FIV). Stewart (1972) also reported that these families are well represented in Pakistan including Azad Jammu and Kashmir. Badshah *et al.* (1996) and Hussain *et al.* (2000) also observed that these families were well represented in their areas of study. Some other studies also indicated these families to be major families in the flora of Pakistan (Jafri, 1962; Stewart, 1972; Nasir and Ali,1971-1994; Ali and Qaiser,1995-2000). Our findings are invariably supported by them as the same families have emerged as the most common families in the present case. Durrani (2000) also stated the abundance of such families in Kalat. The members of these families have wide ecological range and for that reason they are well represented in variety of habitats. In the present case, climatic conditions vary from subtropical to alpine and because of this variability in climate and wide ecological range of species, these families were well represented.

Some trees such as *Picea smithiana, Quercus dilatata, Pyrus pashia, Prunus persica* and *Ficus palmata* appear to be at the verge of elimination from the area due to severe deforestation and other human influences. Beg and Khan (1980, 1984) stated that deforestation has driven many species to the endangered level including *Quercus dilatata* from other parts of Pakistan. Malik and Hussain (1990a), Malik *et al.* (2001) and Malik and Malik (2004a) reported that *Pinus wallichiana* and *Abies pindrow* were present in Dhirkot and Pirchinasi hills; While *Picea smithiana* and *Quercus dilatata* were present in low percentage due to severe deforestation by local inhabitants. Such trees are used lavishly for fuel purposes by the local population throughout the year. Similarly, *Ficus palmata, Pyrus pashia* and *Prunus persica* are also used as fuel wood.

Avena barbata, Chrysopogon aucheri, Elymus repens and *Koeleria macrantha* were present between altitudes from 3050 to 3750m. Grasses such as *Dichanthium annulatum, Festuca modesta, Imperata cylindrica, Polypogon alpinum* and *Urochloa panicoides* were present in between altitude from 1700 to 3000 m with low abundance.

Festuca modesta, Poa annua, Bromus and *Phalaris* were the major grasses in dry temperate area of Zagros and Eburz (Iran) under the canopy of *Juniper* (Koocheki & Bakar,1993). In this case their presence might be due to their wide ecological range.

Although, floristically many species were found at Ganga Chotti and Bedori rangelands, yet, they had limited distribution and restricted life cycle. Many species of Asteraceae and Lamiaceae are aromatic. In moist temperate flora *Allium* and *Gentiana* are aromatic plants and are cultivated in Germany. *Thymus, Valeriana, Aconitum* and *Mentha* are some of the aromatic plants in the investigated area. A rich flora indicates high species diversity and species richness in the investigated area. However, floristic composition is a qualitative character and it alone cannot indicate the true picture of range productivity. Thus, there is a need of quantitative assessment of the vegetation resources.

Floristic composition is a better parameter of plant life, gene pool and diversity of plants of any area. The ecological behaviour of plants such as life cycle, leaf size spectra, life form, habit and its economic potential is to be worked out. These aspects have been worked out in the present study.

Economic uses of plants

Plant-human interaction can never be separated. Right from the time immentable man and his animals depended upon plants or their products. There is a close obligate dependence of man on plants. The plant resources lead to the economic wealth of an area. It is the utility and use of the plants that make the plants important in that area. In the same context when plants of Ganga Chotti and Bedori hills were analyzed, it was seen that area is primarily suited to rangeland. The major bulk of 134 species (46%) were classified as fodder / forage species. They had different degree of palatability. This clearly suggests that the area is more suitable for rangeland. Poor vegetation cover, moist and cold conditions cannot support agriculture. Most of the recorded species in the present study have also been reported as fodder species by other workers (Hussain & Mustafa, 1995; Shinwari and Shah, 1996). The present findings regarding the similarity in use of plant as a fodder agree with them.

The next major utility of plant (29%) was their medicinal uses. Medicinal plants are invariably used in local health system in the investigated area. With the increasing demands of pharmaceutical industries, there was increasing exploitation of medicinal plants that has caused a drastic decrease in their occurrence and products. The preferred medicinal plants grow within thickets of shrubs or at high altitudes where man and grazing animals could not reach easily. The increasing population has pressurized the medicinal plants that has dramatically decreased the species and population of medicinal plants. The nomads collect medicinal plants for their earnings. They uproot and collect each part of species in a non scientific way. Prior to this study no reference exist on medicinal plants of this area. However, Amin (1984) reported 10 medicinal plants of Leepa Valley, Azad Jammu and Kashmir. *Bergenia, Podophyllum, Dioscorea,Iris, Sausurea, Aconitum, Arisaema* and *Valeriana* are geophytes. These medicinal plants also reduce their population. According to FAO (1997) 14 medicinal plants are used in Kanak valley Baluchistan.

Deforestation, overgrazing and soil erosion were the main causes for the reduction of medicinal and other plants in this area. The local livestock graze most of the medicinal plants which caused the destruction of medicinal plants. It therefore, becomes essential to have conservation strategy for the medicinal plants. The collection of plants must be correlated with phenological cycle. The plants that abrupt to graze collection for medicinal or fuel wood purpose suffer the most in their regeneration. Similarly, a plant that is grazed and collected for roots, rhizome or bulb or flower becomes more threatened. The shoots fail to develop flower and seeds while rhizomatous plants and roots are destructively collected. This will reduce the chances of their regeneration eg. *Bergenia ciliata, Iris lactea, Caltha palustris* and *Fritillaria roylei.*

In the investigated area most of the people are poor and lack basic facilities. They depend on the forest for fuel wood. There are 15 species, which are used as fuel wood. They include *Pinus wallichiana, Quercus dilatata, Abies pindrow, Picea smithiana* , *Morus alba* , *Ficus palmata, Prunus persica* , *Astragalus floridus, Zanthoxylum alatum, Viburnum grandiflorum* and *Desmodium multiflorum* for domestic fuel purpose. There is tremendous pressure in the form of fuel wood on rangeland due to increasing demand for fuel wood. In winter local people have to keep their homes warm for themselves and cattles. Grazing and collection of medicinal plants coupled with fuel wood collection has drastically hampered the regeneration capacity of these species. Fuel wood collectors irrespective of any other value of plant, gather, rather uproot any plant with some woody bases, root or stem. Thus, the vegetation has become open that further degrades due to heavy grazing especially in cold winters. One can frequently see the local inhabitants carrying timber wood in the area.

There are some 20 species that are used as wild vegetable in the area. The leaves of *Allium humile, Amaranthus viridus, Artemesia, Polygonum, Rumex, Lactuca, Medicago, Mentha,Taraxacum, Trifolium* and *Valeriana* are used as vegetable. It was observed that there was a decrease in the populations of these plants over the years as a result of over exploitation.

The major utility of this ecosystem could be a pasture, therefore, efforts be directed to improve the area as a rangeland and wildlife conservation unit. This will automatically conserve the over all vegetation resources.

These resources have to be conserved for future as a refuge for animal, birds and future bioresources. The investigated area is faced with problems like deforestation, overgrazing and over-exploitation of medicinal and fuel wood species. A plant subjected to multiple pressures viz; grazing, medicinal utility and fuel wood is under immense biotic pressure that arrests its spread and surviving capability. The area is climatically varied from moist temperate, sub alpine to alpine rangeland where the management will be varied. The poor vegetation cover has promoted soil erosion that has further deteriorated the habitat. Besides scientific approach awareness among the local inhabitants be created.

Life form

Humboldt was the first to formulate the concept of life forms for which he used the term "Vegetative form". The life form of the plant is the physiognomic form produced as a result of all life processes in union with environment. The consideration of life forms helps in the ecological interpretation of the vegetation. Life form classification of Raunkiaer (1934) is the most compact and consistent which is based upon the principle of position and degree of protection to perennating bud during the unfavorable or adverse seasons. He distinguishes 3 main types of phytoclimates on the basis of life form on the earth. It includes phanerophytic climate in the tropics, therophytic in the deserts and hemicryptophytic in the greater part of cold temperate zone. According to Muller-Dumbois and Ellenberg (1974) the simplest way is to classify all the species on a list into 5 basic Raunkiaerian life form classes.

Accordingly, life forms of the various species recorded from Ganga and Bedori Hills were classified into major life form classes. A biological spectrum is formed when all the species of higher plants of a community are classified into life forms and their ratio expressed in number or percentage. Biological spectra are useful in comparing geographically widely separated plant communities and is also regarded as an indicator of prevailing environment. Occurrence of similar biological spectrum in different regions indicate similar climatic conditions.

According to Raunkiaer (1934) the plant climate of a region, is characterized by life form while in biological spectrum of the region exceeds the percentage of the same life form in the normal biological spectrum. However, due to biological disturbance, the proportion of life forms may be altered. Biological spectrum may be materially changed due to introduction of therophytes like annual weeds, due to biotic influences like agricultural practices and grazing, deforestation and trampling etc.

The life form spectra of flora and different plant communities in the present study indicated that hemicryptophytes and therophytes were dominant during spring and monsoon seasons. Quantitatively, hemicryptophytes were dominant both in spring and monsoon while therophytes appeared as a major group in the monsoon. Cain and Castro (1959) and Shimwell (1971) reported that hemicryptophytes are indicator of temperate zone while therophytes are characteristic of desert climate and geophytes are indicator of mediterranean climate.

The climate of study area varies from moist temperate, subalpine to alpine types at different altitudes. The biological spectrum obtained in the present study is a reflection of the existing environmental conditions. The Ganga Chotti and Bedori hills are climatically cool with scattered trees and shrubs. Malik *et al.* (1994) observed that in the moist temperate part of Dhirkot and Neelum valleys hemicryptophytes and therophytes were the major life form classes. The present findings regarding the dominance of hemicryptophytes and therophytes agree with them. Although, the area has the potential to support the growth of trees and shrubs yet megaphanerophytes and nanophanerophytes decreased due to human activity. Deforestation is one of the major factors that has dwindled the regeneration of woody species. The lower percentage of phanerophytes and chamaephytes indicate the condition that deforestation are conducive for the development of these life forms.

Hussain *et al.*(1997a) reported that in Girbanr hills, chamaephytes increased from lower altitude to higher altitude. Chamaephytes are generally the most common life form in high altitude and high latitude. Tareen and Qadir (1993) reported that from Harnai to Duki moist and cold conditions, low temperature and wind are characteristic. Almost a similar situation also exists at the investigated sites. Geophytes were present in low percentage. Normally they are characteristic of mediterranean climates. They were least in the area probably because of their ability to withstand long period of adverse climatic condition. The storage of food in the perennating organs is also important aspect for their survival.

Therophytes were generally high in almost all the altitudinal zones which might be due to disturbed habitat because of deforestation, overgrazing and trampling. Generally, they were more abundant in the spring as it reflected spring aspect. During spring there is always a flush of annuals which gives a outlook to the community. Similar trend regarding prevalence of therophytes was observed by Hussain *et al.* (1997 a, b) in Girbanr and Dabargai hills. The dominance of therophytes occurs due to unfavorable habitat conditions. Many studies have reached to similar conclusion (Shimwell, 1971; Malik & Hussain, 1987, 1988, 1990) and our findings are supported by them.

Barik and Misra (1998) reported that the biological spectrum of grassland ecosystem of South Orissa consisted of therophytes, chamaephytes, hemicryptophytes and cryptophytes in order of 51.61,22.58, 16.13 and 9.68, respectively. The predominance of therophytes is reflected similar to the present study. In alpine habitat cushion and chamaephytes became more prominent because of adverse soil and climatic conditions.

Ram and Arya (1991) reported 36% short forbs, 27% cushion and spreading forbs,17% each in the alpine vegetation at Rudranth. In our case too chamaephytes were more apparent than in other life forms in the alpine part of the study area.

Qadir and Shetvy (1986) considered chamaephytes and therophytes as the major life form in unfavorable environment in desert region. In the investigated area cold conditions, low temperature, wind and biotic factors result in unfavourable conditions paving way for chamaephytes. Saxena *et al.* (1987) stated that hemicryptophytes dominated temperate and alpine zones in overlapping and loose continuum. The present findings in this regard also agree with them. The findings of Qadir and Tareen (1987) and Tareen and Qadir (1993) are also in line with our findings as they reported the dominance of hermicryptophytes in temperate vegetation of Balochistan. Therophytes survive adverse condition through seeds. The predominance of therophytes in variable conditions such as dry, hot or cold met for low to higher elevation might be the reason for their higher percentage in the present study.

Raunkiaerian life form spectra fails to explain the numerical status of plants in the field whereas quantitative characters such as density, frequency and canopy cover are more useful parameters in depicting the existing quantitative vegetation structure and related climatic conditions. Khan *et al.* (1999) stated similar importance of quantitative feature as compared to qualitative feature.

Leaf Spectrum

Leaf size spectrum of the plant and their communities revealed that microphyllous species followed by nanophyllous species were dominant in spring and monsoon in the investigated area.

Microphylls are usually characteristic of steppes, while nanophylls and leptophylls are characteristic of hot deserts (Cain and Castro, 1959; Tareen and

Qadir, 1993). The present study shows that leptophylls were high at the foot hills while microphylls and nanophylls were present in high altitudes (2800m). Species with large leaves occur in warmer moist climates while smaller leaves are characteristic of cold and dry climates and degraded habitats.

Malik *et al.* (1990) reported higher percentage of leptophyll and nanophyll in the dry subtropical semiever-green from Kotli Azad Jammu and Kashmir. Species with small leaves are generally characteristics of dry and adverse habitat conditions. Though the area of Kotli falls within subtropical mountain belt but the adverse habitat conditions exist due to deforestation and overgrazing in the area. The observed relationship between small leaves and cold or hot desert climates are adaptive features in retaining moisture. Moisture retention is critical when root sensitive to low temperatures result in a decreased rate of water absorption from the soil (Greller, 1988). The soil is generally poor in the mountainous area where roots feel difficulty in absorbing soil moisture. In the present study the high percentage of microphylls might be the result of cool climate in subalpine and alpine. Here the soil is poorly developed with thin sheet that prevented penetration of root. Furthermore, roots absorb low moisture and nutrients under cold conditions. In alpine regions the plant face drought during winter especially in frozen soil. The species with microphyllous and nanophyllous leaves were abundant due to ecological adaptation for these arid conditions. The present findings agree with those of Qadir and Tareen (1987) who reported high percentage of microphylls and nanophylls in the dry temperate climate (wind, snowfall and aridity) of Quetta district.

In the present case it was observed that the percentage of various leaf form classes varied with increasing altitude. Saxena *et al*. (1987) also observed that the percentage of microphylls was positively related with the increasing altitude and this also support our findings. However in the tropical wet forest such as those of Costarica (Dolph and Dilcher, 1980 a,b) reported the large leaves species were dominant. This disagreement is mainly due to climatic variation such has temperature and wet tropical condition. The situation in our case is for more xeric than in the wet tropics. The size of leaves alone could not be used to identify specific leaf zone or climates. Other features of plants such as habit and root system might also play important role.

Phenological characteristics

Phenology is a periodic phenomenon in plants that are tied to periodic environmental changes. The phenological behavior of plant was observed from May to November 1999 and then in 2000. This study envisages a relationship between climate and growing periods of plants of an area and such types of studies are essential for planning regeneration, aforestation and conservation in rangeland and forestry. The vegetation expressed a different physiognomic contrast in different seasons and in different altitudinal zones. The species varied in their appearance disappearance, flowering etc during different times of the year. The present study showed that the growing season started at the end of April whereby only few herbaceous and shrubby plants initiated vegetative growth. The blooming of few plants occurred during early May. Plants such as *Ficus, Pyrus, Juniperus,* *Myrsine, Bergenia, Biden, Euphorbia, Geranium, Gerbera, Oxalis, Podophyllum* and *Valeriana* etc. were active during this period.

The majority of herbaceous, shrubby and tree species flowered from May to June. The flowering reached to the peak during July and August. The first spell of flowering in the investigated area started at the beginning of spring (May to June), while fructifications occurred during (July to August). Most species produced fruits during the first spell.

In first spell, 111 Species (53.88%) flowered, which included 7% trees, 10% shrubs, 26% herbs, 4% grasses and 6.89% ferns. During the second flowering spell, lasting from September to November 95 species (46%) were blooming. Of them, there were 1 % trees, 2% shrubs, 21% herbs, 17% grasses and 5% ferns. The month of June and July appeared to be the peak flowering season. The flowering declined from September to November. Most trees and shrubs flowered during April to May. The fructification however can be observed in July-August. Shrestha *et al.* (1998) reported that majority of the plants flowers during April/May in Riyale, Nepal. Similarly, Zhanghe *et al.* (1999) also reported that peak of flowering occurred during May in different parts of China. Stranghethi & Ranga (1997) stated that in Brazil shrubs exhibited continuous flowering throughout the year. But in our case majority of shrubs flowered from May to August. Our finding are in line with those of Kim (1996) and Stranghethi and Ranga (1997) who also reported two flowering seasons in to their areas. Durani (2000) also reported two flowering seasons in Harboi range, Kalat.

The fruiting occurring during the dry period is probably related to the fact that the beginning of the next rainy period will offer favorable condition for seed germination (Morellato *et al.* 1989).

Another study in Brazil (Morellato, 1995) indicated that the flowering starts at the end of dry season and beginning of wet period. Fruiting was more intense during dry season. Most species were in flowering session between July to September and fruiting in December, which is the end of dry and beginning of rainy seasons. Morellato and Leitao-Filho (1992) and Janzen (1975) pointed out that this period (December) has the advantage of providing the seeds with more intense luminosity and thus greater probability to germinate. Foster (1982) mentioned that the phenology of fructification is strongly related to the seasons which offer better condition for seed germination. In our case seeds are deposited in November and December that remain dormant during the cold season and are subjected to natural treatments such as chilling, stratification and moisture treatment before they could germinate in the next spring, whereby climate becomes warmer.

Morellato and Leitao-Filho (1992) suggested that a greater disponibility of nutrient during the transition of the dry season to the wet could be an important factor determining the fruitification period of many species. The low precipitation rate and the fall of the leaves of many species during the dry seasons would offer good condition for seed dispersal. In our case organic matter remains undecayed in the soil during cold season and its degradation starts in the spring that releases nutrients for the seedling growth and other phenological activities of the plants.

Kikim and Yadava (2001) stated that majority of the species exhibited peak of leaf drop in cool dry period (January -February) and leaf flushing in the beginning of warm dry period (March-April) and another in rainy season (August) of the year. Both over-storey and under-storey species showed a sharp flowering peak in April. The peak period of fruit maturation occured during September-October. This is what happened in our case. Leaf flush and flowering were simultaneous in over- and under-storey tree species. While the fruiting of under-storey tree species was one month earlier than that of over-storey tree species. In our case trees such as *Abies pindrow, Picea smithiana, Pinus roxburghii* flowered and produced fruits in April and May when temperature was low. *Ficus palmata* flowered in May -August, *Pinus wallichiana* in April -June, *Pyrus pashia* in May-July, *Quercus dilatata* from April to June in low rainfall area, while *Machilus* and *Astragalus* in July-August and August- September during rainy seasons. In cool temperate forest, the proportion of flowering tree species is small in early spring; this proportion increases around June, and then decreases again (Rathcke, 1988; Inoue *et al*.1990; Kato, *et al*. 1990). In the present study a similar situation was seen because of similarity in climatic factor. The investigated area is of cool temperate type with low temperature in winter that restricts the reproductive timing of woody plants. Wright and Calderon (1995) indicated the importance of phenology in determining the flowering season of a species. The flowering sequence of several genera e.g. *Rhododendron* and *Viburnum* conducted in cool temperate forest in N. America (Rathcke, 1988). This suggests that phenological patterns might not change significantly through the data of one year.

Some trees on Yakushima Island flowered even in winter (Yumoto, 1987), probably because of difference in latitude. Evergreen in typical warm tropical forest flower throughout the year, although the proportion of flowering tree is small in winter.

Osada *et al*. (2003) stated that various tree species bloomed sequentially from the middle of February to the end of October and flowering tree species were particularly abundant around May. This corresponds to the season of leaf emergence, as flowers of most species were produced at the same time. In our case, too, the season started from the month of May whereby some species flowered in May such as *Abies, Picea* and *Pinus roxburghii* and shrub such as *Juniperus, Myrsine, Bergenia, Biden, Euphorbia, Geranium, Gerbera, Oxalis, Podophyllum, Valeriana* and *Viola* flowered sequentially.

During, year 2000, the climate was comparatively moist due to rainfall while in 1999 climate was dry. The phenological activities were almost similar in both the years from April to August. Species of spring aspect completed their life cycle one month earlier during 2000 as compared to 1999.The major vegetation elements remained dormant from November onward. Morellato and Leitao-Filho (1992) stated that lack of nutrients during transition from dry to wet season might be an important factor in controlling phenological activities. In the investigated area low precipitation rate and fall of the leaves of many species during dry season offer a good chance with climatic cycle. Normally plants disperse seeds/fruits after completing the life cycle. During winter seeds receive cold treatment that triggeres germination and sprouting from below ground parts or shoots during early monsoon.

The grazing period must coordinated with phenological cycle. Grazing be allowed in most plants or in vegetative fall. Once the shrubs shed the seeds, they may be allowed for grazing. Grazing of annual and herbaceous plants before flowering will slowly decrease their population as seeds are the only source of survival and regeneration. Seed collection can be achieved after fruiting seasons for storage as a gene bank. The critical grazing period which coordinate with flowering or seeding can be avoided to ensure a good seed bank for future generation. The annuals usually flush flowering during early spring or during monsoon season. Rainfall in the investigated area is uncertain for the last few years, therefore the amount of seed produced and emergence of seedling might be invariable during different years.

Community structure

The vegetation, climate and soil are intricately related to each other. The variation in anyone of these components might cause a change in the other associated component. By knowing two of the factors, prediction about the third factor might be possible within certain limits. The existence and establishment of a community reflects the plant type and the habitat condition under which they develop. Biotic factors, especially human interactions, mould the shape and the course of succession of a çommunity or vegetation type (Grubb,1987). A community is defined as an aggregate of living plants having mutual relations among themselves and to the environment, or a collection of plant populations found in one habitat type in one area, and integrated to a degree by a competition, complementarity and dependence.

Some of the major environmental factors that influence the vegetation or parts thereof are deforestation, overgrazing, trampling, erosion and other related ecological factors. The average elevation of the investigated area varied from 1700 to 3750 m. The investigated area as a whole could be classified as the moist temperate, sub alpine to alpine types. The present study recognizes different communities, which as a whole link up the major vegetational units.

The present study concludes that there could possibly be 15 different plant communities both in spring and monsoon seasons in the area. The observed changes in the plant communities are due to season and time of sampling the vegetation. During monsoon many annuals exert local dominance to change the aspect of the vegetation. These may represent the seasonal aspects. The woody and perennial herbaceous species almost remained the same but the predominance of annuals change the community composition. The recorded species exhibit different dominance value due to change in the habitat condition at different altitudes. The communities established in the present study actually reflect the different remnants, edaphic, degraded or seral stages of the major vegetational types.

It appeared that *Themeda-Pinus-Desmodium* community might be the remenant of the original temperate forest. The associated woody species are *Berberis lycium, Quercus dilatata, Indigofera heterantha, Sarcococca saligna and Viburnum grandiflorum;* while the perennial grasses are *Andropogon munroi,* *Imperata cylindrica, Agrostis canina* and *Cynodon dactylon.* All these plants are characteristic elements of the temperate zone. This vegetation then shifts to *Abies-Pinus-Viburnum* community. The local people use *Pinus wallichiana* for various utilities that caused the degradation of woody species with hampered regeneration. The habitat conditions got modified with the removal of the vegetational cover. Soil moisture and litter was apparently high under *Themeda-Pinus-Desmodium* community. Here soil was loamy with high amount of organic matter. While in the degraded sites, besides soil moisture, organic matter also reduced. Therefore, species requiring low fertility and less moisture make their appearance.

The change of dominance from *Pinus* to *Themeda* as seen in *Themeda-Cyperus-Pinus* and *Themeda-Pinus-Desmodium* communities might be due to low fertility (especially low phosphorus) and poor soil moisture contents. The habitat has deteriorated with increased degradation. *Desmodium* appears as one of the dominants in such sites. The habitat condition was apparently more dry and less fertile as compared to previous sites. The community therefore shifted to *Berberis-Desmodium-Agrostis* and *Desmodium-Berberis-Cynodon* communities. *Desmodium* is a leguminous and rarely palatable plant. It is utilized as a good fuel species. The removal of *Quercus dilatata* and *Pinus wallichiana* from 1700 to 2000 m helped niche forming grassland which is characterized by *Themeda-Cyperus-Pinus, Andropogon-Pinus-Berberis, Desmodium-Agrostis* and *Desmodium-Berberis-Cynodon* communities. Many workers have described similar degraded vegetation types in various parts of Swat and our findings agree with them (Beg and Khan, 1980, 1984; Hussain *et al.* 1992; Hussain and Ilahi, 1991). Hajra and Rao (1990), Haridesan *et al.* (1993), Sakya and Bania (1998) in NW Himalayas in Arunachal Pradesh, India reported a similar situation.

Altitude is the most important factor in determining the vegetation type. The change in altitude is readily reflected by change in the floristic composition and Community set-up (Sakya and Bania, 1998).

With increased in altitude from 2000 to 3000 m, *Abies-Viburnum-Poa, Poa-Salix-Abies, Picea-Epilobium-Bromus, Veronica-Sibbaldia-Poa* and *Sibbaldia-Aster-Rumex* communities became dominant. *Pinus, Abies, Picea* and *Viburnum* were the original components of the sub-alpine forest in Ganga Chotti Hills. The degradation of labitat has further modified the vegetation type. In the disturbed habitats grasses took over the dominance from 3050 to 3350 m. Here *Euphorbia-Phleum-Artemesia, Potentilla - Geranium - Achillea, Potentilla - Juniperus - Phleum, Pseudomertensia -Potentilla- Pedicularis, Parnasia - Agrostis - Polypogon* and *Senecio - Bupleurum* communities existed. The soil under these communities was sandy-clay-loam to clay loam, with acidic pH, EC from 0.38 to 0.97 dS/m-1, NO3-N 31 to 72 ppm, phosphorous 2-24 ppm and potassium 60-230 ppm. The organic mater and total soluble salts were high.

In grassland communities, topography, edaphic factors and disturbances produced regional variation in composition and structure of vegetation (Balsky, 1988; Gibson and Hulbert, 1987). Such factors increase diversity and heterogeneity within communities as well (Milchunus *et. al.*1988). In the present study edaphic factors such as soil condition, topography and human disturbance appeared to be responsible for the observed differences in the composition and structure of vegetation on the investigated sites.

At the top of Bedori Hills, *Levetra - Leucas - Ranunculus , Primula-Oxalis - Phleum, Juniperus-Malva-Lespediza, Potentilla-Phleum-Achillea,Potentilla-Androsace-Polygonum* and *Polygonum-Phleum-Leontopodium* communities were dominant. Soil under neath these communities was sandy, sandy loam to clay loam, pH varied from acidic to basic, EC 0.43 to 0.70 dSm^{-1}, NO_3-N 37 to 78 ppm, P 2.34 to 180 ppm, K 50 to 130 ppm, high organic matter (2.4%) and high total soluble salts (275). Alpine and sub alpine regions in Himalayas are characterized by the cold climate with heavy snowfall in December to April. Hail storms, dense forest, drought low carbon dioxide and oxygen concentration high solar radiation and humid summer with high wind velocity are characteristics of alpine and sub-alpine vegetation (Nautiyal *et al.* 2002). Diverse topography, climate and altitude influence the vegetational patteren in the region (Nautiyal *et al.* 2002). In our case cold climate with heavy snowfall, high wind velocity, low temperature, rainfall and variation in altitude influence the vegetational patteren. The vegetation is open due to deforestation.

Ordination

Gradient analysis

Site and species ordination in the plain of first two axes are presented in Fig. 5 and 6 respectively. These axes provided an efficient summarization of the original data (Eigen value 0.616 and 0.405, respectively Fig. 5). Subsequent axes contained no further useful information (Eigen value less than 0.4), thus they were discarded. Site ordination (Fig. 5) revealed mark relationship between first axis (distribution of species) and soil and topographic factor. There was highly significant correlation ($p<0.01$) between sample scores along DCA axes one and the altitudinal ranges of studied area: correlation co-efficient (R) values exceeded 0.5. Regarding axes two; R-value of this topographic factor was considerably low (less than 0.4). Besides altitude, soil pH showed a significant positive correlation (p 0.05 with DCA axis one but not with axes two). The nitrate availability in the sample plot showed a significant correlation with both DCA axes Table 25. In addition to these ordination axis (1 and 2) appeared to be marked influenced by total soluble salts and to some extent soil EC . It is evident from Fig.5 that sites of woodland temperate association (1 -4) stands belonging to association A) are clearly grouped at one end (DCA high score) and those of alpine complex (5-16) sites belonging to association (B-D) on the other hand (low score) of DCA axis one. Similarity in altitude makes the grouping. However, among the alpine complex, several sites were separated from the other suggesting a degree of floral diversity within this group (Dasti and Agnew, 1994).

Sites 11 and 16 are strongly separated from the rest of the site suggesting again the site-specific factor (Dasti and Malik, 2000). Site 11 lies in 3000 to 3300m while, site 16 lies from 3300 to 3750 m which might have caused differences. The site of the woodland alpine association (stand 5-10) that collect the runoff water occupying the intermediate position along the axes one reflecting the fair condition of water and soil availability for plant growth. On the top of Ganga Chotti a perennial stream is present which caused differences in the habitat. On the other hand DCA indicated that the alpine grassland association represented poor habitat. This association occupy the scrap slope, which generated the runoff and quickly dries after rainfall. Such habitat can be generally classified as leached soils that have poor nutrients.

The results depicted in Fig.6 suggested that several species followed the configuration similar to that evident for the site. However, some species do not follow the site distribution, suggesting that they are largely unaffected by underlying topographic edaphic factors. Comparison of the site and species ordination revealed that separation of woodland temperate association from the rest as a distinct group at the resource poor end of the gradient is due to the relative abundance of *Pinus wallichiana* and the presence of *Berberis lycium*, *Prunus persica*, *Quercus dilatata*, *Pyrus pashia*, *Punica granatum*, *Rubus fruticosus* and *Salix denticulata*. These species are virtually absent in the rest of the associations due to severe deforestation and altitudinal differences.

The ordination position of *Abies pindrow*, *Picea smithiana*, *Sibbaldia cuneata*, *Trilidium govanianum* and *Viola odorata* suggest that there are characteristic of moderate site habitat and are altogether absent in communities occupying in the extreme habitats. In extreme alpine habitat, *Phelum alpinum* and *Juniperus communis* grow successfully in runoff generating disturbed habitats. The frequencies of these species decrease as one moves from alpine to temperate association. *Juniperus communis* showed marked peak in frequency in shrubland alpine association while *Phelum alpinum* showed the same in alpine grassland association.The dominance of *Caltha palustris*, *Leontopodium alpinum*, *Lespedeza sericea*, *Malva verticillata*, *Polygonum amplexicaule*, *Potentilla eriocarpa*, *Ranunculus laetus*, *Rosa macrophylla*, *Rumex nepalensis*, *Sausurea lappa* and *Thymus serphyllum* increases from poor habitat to rich habitat i.e. from 1700-3700 m low to high altitude due to the deficiency of nutrients such as potassium and nitrogen. Contrary to the above species, the dominance of *Aconitum violaceum*, *Allium humile*, *Androsace rotundifolia*, *Artemesia scoparia*, *Avena barbata*, *Dactylis glomerata*, *Elymus repen* and *Leontopodium alpinum* decreased from high altitude to low altitude. The remainder of the species occupy ordination position that suggest a lack of any association to the site configuration along the gradient. These are identified as a group within the mark boundary of Fig.6.

The forementioned facts indicate that landscape (slope); edaphic factor and redistribution of rainfall water by runoff are the main source of spatial variation in the study area. These geomorphologic factors delimit the boundaries and composition of communities. Apart from the fact that the landscape variables are indeed relevant for explaining the main vegetation types, the correspondence between the results of cluster analysis and the DCA planes permit a direct interpretation of scores of stand data in DCA plane in relation to soil variable. The four associations produced by cluster analysis appendix 7 are plotted on the first two axes as a scattered diagram (Fig. 7). The ordination axes may represent in some way the major substrate influence that affect the stands in these data and have been used by the plant and soil characteristics of the association (Table 25) to discuss the overriding features of the environment. The importance of soil pH and nitrate contents as an environmental factor, affecting plant species association is not surprising but has close relationship with plant growth and germination. The present analysis and assessment of pattern and zonation along first ordination axes suggest that the most important environmental gradient and boundaries across the landscape are associated with soil reaction and nitrates availability. The distribution of species along ordination axes 2 is significantly related with not only nitrate availability but with soil EC as well. However, it is difficult to assess the relative importance of these factors but consistent negative interaction terms between these factors suggest that some combined affect are important. The reason for these correlations must be hydrological particularly the pattern of runoff generation and distribution of soil electrolytes in this study area (Dasti and Malik, 2000).

Similarities among communities

Similarity indices does not consider the relative abundance of species. It is most useful when major interest lies in the presence or absence of species. Degree of similarity between two plant communities allows combining them into an association or vegetation types. It reduces the higher number of plant communities into few similar vegetation types. In the investigated area there were 15 plant communities in each of spring and monsoon seasons. Based on the similarity indices, four plant communities showed similarity above 60% during spring. It included APV and AVM, PAP and PPL, TCP and APB and TCP and TPD and one community pair BDA and DBC in monsoon. Here soil was silty-loam to clay-loam, loamy-clay with organic matter 1.1 to 2.9 % and potash 56 to 60 %. The communities with less than 60% similarities were PJP and PPA, PGA and PPA, PCG and APV and APV and VSP.

The higher similarities between the communities might be due to altitude similarity in nutrients, proximity of stands to each other which almost had similar habitat conditions in terms of nutrients such as potash , phosphorous and soil from clay loam to loamy clay textures within the zone. The least similarity among the communities was due to change in altitude, climatic, edaphic and biotic conditions, such as erosion, soil differences, such as silty loam to sandy loam, pH, EC, nitrate and phosphate deforestation and overgrazing. Such differences cause changes in nutrients status and light relationship of habitats and thus species. The indices of similarities between plant communities showed high differences among themselves owing to the variation in altitude and biotic factors (Malik *et al.* 1990).

Considering the seasonal differences, it was seen that the communities BDA and DBC, DPL and BDA, TCP and TPD, APV and PEB had greater similarity (above 50%) between two seasons. The similarity during spring and monsoon communities might be due to the presence of common trees, shrubs and perennial evergreen herbs and geophytes. The communities exhibiting least similarity were mainly composed of large number of spring annuals that disappeared in the next season. This created the differences among seasonal aspect and similarity. The present finding are in agreement with those of Shah *et al.* (1991) and Durrani (2000) who reported that differences among the plant communities due to topography, exposure, erosion and biotic factors.

Degree of Aggregation

Individuals in a population may be distributed according to three broad patterns: random, uniform and clumped. Random distribution is, however, relatively rare in nature as it occurs where the environment is very uniform with no tendency of aggregation. Uniform distribution may occur where competition between individuals is severe for resources. Dice (1952) stated that climax forest trees that have reached a sufficient height to form a part of the forest crown may form a uniform distribution because of competition for sunlight while trees spaces at very regular intervals.

In plants, aggregation might occur in response to 1. Local habitat difference 2. In response to daily and seasonal weather changes and 3. As the result of reproductive processes as aggregation is inversely related to mobility of disseminules (seeds; spores, etc). In the study area most plants showed intermediate pattern, which was followed by aggregated species in spring. While in monsoon aggregated pattern of species was dominant followed by intermediate distribution.

Dominant grasses such as *Poa*, *Phleum*, *Andropogon*, *Chrysopogon*, *Bromus* and *Dichanthium* showed aggregation due to perennial, rhizomatous habit and enormous number of seed out put. Plants like *Berberis*, *Desmodium* and *Zanthoxylum* have heavy seeds that lie close to parent plant. Furthermore, they also reproduce vegetatively from below ground parts that also caused aggregation. The present results are in agreement with those of Kormondy (1996) who reported similar findings in their study area. The seeds of *Berberis*, *Desmodium*, *Zanthoxylum, Juniperus* and Rosa remained around the parent plant and show little movement due to large size . Species with greater power of mobility are dispersed widely while those with poor mobility generally tend to aggregate.

Another possible reason for the aggregation might be the predominance of annuals which exert local pressure for a short season in a localised habitat. They, therefore, exhibit aggregation. .

Dispersion of plants can be used to describe the structure of an ecological community. Although a community may show truly random distribution more after a number of factors result in various degrees of clumping (or contagion), a regularity in spacing, or combination of both. Most often, a clumping of resources (e.g. water, nutrients) leads to clumping of species. Similarly reproductive patterns may also account for clumping. The availability of a resource, such as ground water, or the release of biological inhibitors by sedentary plants (a phenomenon called as allelopathy, (Rice,1974) may inhibit other individuals of the species from developing within the radius of the inhibitor's effect; both situation can result in a more or less regular dispersal of that species.

Aggregation may also be possible owing to favourable conditions prevailing at certain habitat and site. Soil moisture is one of the factors helping in the aggregation of species. Species such as *Cyperus niveus*, *Dichanthium*, *Lespedeza sericea*, *Geranium* and *Ranunculus* tend to aggregate on moist habitat. The communities harbouring relatively dry and degraded sites show spacing and the individuals are dispersed. Plant-plant interactions such as competition or allelopathy or both might also cause low aggregation. Grasses such *as*

Chrysopogon and *Themeda* were isolated with out showing any aggregation. This could be possibly due to allelopathy (Akhtar *et al.* 1978).

In some communities soil organic matter was high when species were aggregated. High organic matter helps aggregation. The under-storey plants generally aggregate beneath top-storey plants.

Regenerating Capacity

Age classes within a population are the ratio of various age groups to each other at a given time. The age structure has been used as a guide to timber management. The diameter of the trunk at breast height or dbh has been used as an indicator of age on the assumption that diameter increases with age. The greater the diameter, the older is the tree. It is valid for dominant canopy trees; but with their growth suppressed by lack of height, moisture, or nutrients, understorey trees and even so-called seedling and sapling add little to their diameter. Although their diameter suggests youth, small trees often are the same age as large individuals in the canopy (Smith and Smith, 1998).

Age pyramids help visualize age structure of a population. As the population changes with time, the number of individuals in each age class also changes. A large number of young individuals, which expand the base of the pyramid, characterize a growing population. This large class of young's eventually moves up into the reproductive age classes. A higher proportion of individuals moving into the older age classes characterize a declining population. With fewer young, fewer individuals will enter the reproductive age classes, further depressing the population. In this way, age structure change over time. In the present study it was observed that *Pinus wallichiana* and *Abies pindrow* were the only tree species showing regenerating. The girth of both these trees ranged upto 330 cm. The remaining tree species such as *Quercus dilatata, Salix grandiflorum, Pyrus pashia, Prunus persica, Ficus palmata* and *Picea smithiana* lacked regeneration as there were almost no younger seedlings of these species. There were few individuals of *Picea smithiana* having a girth in between 180 to 270 cm at 2600 to 2800 m. The remaining plants viz. *Pyrus pashia, Salix denticulata, Prunus persica* and *Ficus palmata* had a girth from 90 to 120 cm. The local inhabitants use *Pinus, Abies, Picea, Quercus, Pyrus, Prunus,* and *Ficus* for fuel purposes and for various other utilities. This continued cutting pressure has reduced the regenerating capacity of these plants.

Chaghtai and Ghawas (1976) observed that *Pinus roxburghii* having 2 to 33 cm girths in various classes in Malakand showed regeneration. In the present study cutting of few mature individuals of *Pinus roxburghii* was present without showing any regeneration. This is because *Pinus roxburghii* grows at lower altitude whereby there is maximum human pressure. The chirpine forests have been removed for settlement and agricultural purpose.

However, in our case the size of *Pinus wallichiana* varies from 5 to 330 cm. Majority of *Pinus wallichiana* and *Abies pindrow* population in Ganga rangeland had medium sized trees which indicated that Pinus and Abies are regenerating under the existing climate and habitat conditions. However, deforestation and degraded edaphic features might be hindrance in its regeneration.

Age and growth rate of plants greatly vary among different species, sites and even with two similar sized trees of same species. In Ganga Chotti range, the tallest trees upto 30 m were found between 2300 to 2750 m elevation. The size of trees generally increased and decreased with increasing altitude. However, Ahmed *et al.* (1990 a) found significantly negative correlation between altitude and growth of trees at Ziarat forests.

Pinus wallichiana and *Abies pindrow* forests at Ganga Chotti hills are adversely affected by fuelwood collection. It was observed that about 1500 kg of *Pinus wallichiana* and *Abies pindrow* wood is being collected and transported to the neighboring villages on every alternate day from this area (personal communication with collectors).This situation becomes severe in winter because of lack of fuel resources and more need for fire wood. The fuelwood is not only collected for daily use but also stored for snowbound. The entire requirement for heating is met from the local forests and rangeland. Similarly, fodder for off-season feeding is also collected from this area. The over exploitation of fuel wood and fodder species has caused not only depletion of resource but have lead to deterioration of habitat.

Homogeneity of Communities

Homogeneity was exhibited by three communities in the spring and five communities in the monsoon seasons. The remaining 22 communities were heterogeneous. The majority of the communities showing heterogeneity might be due to the presence of large number of annuals and altitudinal degradation, climate, soil conditions deforestation, overgrazing, trampling and soil erosion in the investigated area. With increasing altitude heterogeneity occurred in most of communities e.g. *Pinus-Cyperus-Gerbera, Abies-Pinus-Viburnum* and *Picea-Epilobium-Bromus* Community.

Climatic differences in the altitude shows that in lower reaches from 1700 to 1900m similar habitat conditions were seen i.e. altitude, soil conditions were same that is why the communities were homogeneous, and then in upper reaches from 2900-3050m homogeneity occurred due to similar conditions such as nature of soil, organic matter and altitude. At 3750 m homogeneity was observed due to low number of species (8spp). In our case Raunkiaerian law of frequency is not valid due to severe deforestation and grazing.

The homogeneous nature of communities was attributed to few species that had uniform distribution in the investigated area. There were almost similar edaphic condition such as soil moisture, degree of erosion, organic matter and nutrients to creates a uniform habitat. In the investigated area there were differences in species composition. In the lower altitudes species were more as compared to high altitudes where the species were less which could not make a difference in higher altitude.

This sites lie within the same general climate and have similar climatic as well as soil conditions. The area is disturbed which result in more species in the class A to C. Some of the age classes were missing in the investigated area which is due to deforestation, human pressure for fuel purpose.

In spring *Themeda-Cyperus-Pinus, Euphorbia-Phleum-Artemesia* and *Polygonum-Phleum-Leontopodium* showed homogeneity. These communities harboured in

1700- 1800 m. With the change in altitude communities differed. The first 2 communities occurred in moist temperate zone where difference of height was low due to which these species were homogenous while the third community was present in alpine zone where species diversity were low leading to homogeneous condition. Similarly, in monsoon five communities including *Imperata-Pinus-Sonchus (Alt.1700 m)*, *Berberis-Desmodium-Agrostis* (Alt.1900m), and then in *Lespedeza-Poa-Fragaria* ,*Poa-Salix-Abies* (Alt.2900-3000 m) had low variation in altitude that is why these communities were homogeneous. Soil conditions in respect of *Imperata-Pinus-Sonchus* and *Berberis-Desmodium-Agrostis* were similar. *Senecio-Bupleurum* community (Alt.3350 m) showed homogeneity because of low number of species (Durani, 2000).

Diversity and its components

Species diversity is an important character of any vegetation. It not only reflects the health of vegetation but also its productivity. Index of diversity is the measure of complexity of form and function within a community. Its precise measurement leads to understanding of processes involved in the developmental changes and organization of communities (Shaukat *et al.*,1978). Species diversity of an area is the reflection of different factors such as overgrazing, deforestation, environmental stress and susceptibility of species to those factors which lowers the species diversity (Willoughby, 1996). Species diversity is a function of the number of species present in a given area of the evenness with which the individuals are distributed among species. Sai and Misra, 1986 stated that the upper part of his study area on both NE and SW faces had lower species diversity as is evident by the negative correlation with altitude. Nevertheless, the relation was not found significant ($p > 0.05$). Similarly Ohsawa *et al.*(1973) also did not observe any significant relation between species diversity and altitude. Since the stands on both slopes are almost at the same altitude and have mixed forest, there maximum diversity indicates intermediate successional stage (Adhikari *et al.* 1991). Species diversity is controlled not only by habitat condition but also by the interactions of the component species (Ohsawa *et al.*(1973). Low diversity of woody species was reported in forests of Cook Island (Franklin and Merlin 1992). Green and Kauffman (1995) stated that in ungrazed dry and moist meadow communities had significantly lower species richness and diversity as compared with grazed communities. In the most heavily grazed communities, grazing disturbances increased ruderal and competitive ruderal species. They concluded that influence of herbivory on species diversity and evenness vary from one community to another and that basin management recommendation on one component ignore the inherent complexity of riparian ecosystem.

It was observed that in spring there was a high species diversity in the lower altitudes (1700 m) due to more species while diversity was low at higher altitudes (3000 m) due to few number of species. Similar findings were reported by Colinvaux (1993), Malik *et al.*(1996) who reported similar findings in Kotli and Bhimber hills. In spring diversity was positively correlated with species richness and maturity and negatively correlated with equitability while in monsoon species diversity was correlated with species richness, equitability and species maturity. The investigated area is severely overgrazed and local inhabitants that reduced vegetation cut plants. The observed low species diversity in the Ganga Chotti is due to deforestation and overgrazing, collectio of medicinal plants and quick disappearance of annuals/ geophytic and because of cold season of the species.

In a degraded vegetation few species can compete and complete life cycle. Thus, those, which require a better habitat in term of shade, light, nutrients and moisture, are usually excluded. In degraded open vegetation sun tolerant or loving species, which require low moisture, low humidity might do better. This reduced the species diversity as number of sciophytes reduced and this agrees with Malik *et al.* (1993) who reported that in degraded vegetation sun tolerant require low moisture and low humidity in the Kotli hills. Dannin (1999) observed that species diversity of eastern desert vegetation increased with increasing the humidity. In our case, overgrazing, deforestation, and temperature, and erosion might be some of the factors responsible for the observed low species diversity.

In some localities very high species diversity was recorded in moist temperate zone of Ganga Chotti Hills. Malik et al. (2003) while reporting vegetation of Dao Khun observed high species diversity in the upper reaches while low diversity at lower altitude Khan et al.(1999) reported low species diversity due to few species and stressful environmental stress. Sharing of limited resources by associating species is proportionally related to the dominance of species, which becomes clear due to low diversity. In our case species diversity was low due to less number of species in higher altitude and high diversity due to high number of species in lower altitude.

The diversity of species was high in the tree layer in the middle part (2500-2800 m) of altitudinal gradient. It decreased both toward lower and higher altitudes, However, *Pinus wallichiana* and *Abies pindrow* forest occupying the middle altitudinal zone had low diversity. In this case, lower (i.e. 1700 m) and higher altitudinal (3000-3750 m) belts are characterized by severe climate viz, at low altitude temperature was hot with poor rain fall while at higher altitude cold temperature and snow fall restricted the species number to few. It is observed that severe climate keeps the species diversity low, while in the favorable climate with high rainfall and moderate temperature favors the diversification of species. The results are in line with Saxena *et al.* (1987) who reported that in Kumaun Himalayas the diversity of tree layer was higher, which decreased both at lower and upper altitude. Similar, with increasing altitude the average tree height decreased.

Plant diversity is influenced by change in soil type, drainage, nutrient status and elevation etc (Smith and Smith, 1998). In the present case diversity was also influenced by soil type, nutrient status and elevation in some communities at 1700-2000 m soil was silty-loam to clay loam with 0.16ppm phosphorus and 56ppm potassium while at 2000-3000m soil was loamy and clayey with 0.41ppm phosphorus and 60ppm potassium which makes the difference with the increase in altitude from 2000-3000 m. Our findings are in line with him. A community that contains a few individuals of many species will have a higher diversity than will a community containing the same number of individual but with most of them confined to a few species, and this is what happened in the present study. Malik *et* *al.* (2001) observed that vegetation of Kotli Hils had a lower species diversity in the higher altitude (900m) and high diversity in the lower altitude (700m) due to low rainfall and high temperature. Diversity is definitely affected by climate which governs the distribution of plants and thus the development of communities and community structure.

Townsend *et al.* (2000) stated that species richness increases as climatic variations decrease. Further, if high productivity is correlated with a wide range of available resources, it leads to an increase in species richness. The species richness was highest during spring that decreased during monsoon. In spring there was abundance of annuals due to which species richness increased while in post monsoon season most of the annuals and geophytes disappeared that decreased species richness. The higher value of species richness was recorded for communities of moist temperate habitat, which had relatively optimum climatic conditions between lower and higher altitudes. Parthsarathy and Karthikeyan, (1997) stated that species richness, stand diversity and diversity indices consistently decreased with increasing size classes of woody species ranging from 30-180 cm girth. In our case species richness and diversity indices from 30-210 cm girth consistently decreased with increasing size classes of woody species.

The present study showed that vegetation of moist habitats was patchy and aggregated in distribution and this might be the reason that high value for species richness occurred. There were an increase and a decrease in species richness i.e. species richness may be highest at intermediate levels of productivity. In some cases, it has been possible to relate species richness to the spatial heterogeneity of the abiotic environment.

Equitibility resource is the analysis relative abundance of component taxa and is important to land than richness in vegetation (West,1993).The present study showed that spring communities exhibited more equitability value than monsoon communities. The reason might be that annuals were in abundance during spring season. A higher equitability may result in highly stable environment over a prolonged period of time (Shaukat and Khan,1979) .It appears that high equitability value has significant positive correlation with maturity index. Similarly Vujnovic *et al.* (2002) stated that the maximum plant species diversity occurred at intermediate level of disturbance compared with low level or no disturbance for species richness and diversity index. Species diversity decreased at high level, compared with medium level of disturbance. Low species diversity in undisturbed and lightly grazed quadrat was linked with high abundance of the late succession species. The somewhat higher species richness observed at high altitude disturbed significantly. Higher total species evenness at high disturbance levels was recorded at high levels of disturbance. Therefore, the higher total species diversity at the high level of disturbance resulted from the high evenness of a relatively small number of species. Low species diversity is relatively found in higher altitude where the species number are less and here the plant communities are undisturbed. Planty-Tabbachi et al.(1995) reported maximum exotic species diversity at some intermediate disturbance levels.

Range Productivity

Biomass is a measure of resources of a community which is tied up in different species. Vegetation composition based on dry weight is one of the best indicator of the species importance within a plant community (Bonham, 1989). In Ganga and Bedori Hills the above ground biomass production on dry matter basis was 21,275 Kg/h for 1999 as compared to 32714 Kg/h in 2000.The recorded biomass was quite high in amount when compared to annual production of other places such as different parts of Azad Jammu and Kashmir. Malik, 2003 reported 19250 Kg/h production from Sarsawaya.

In the present study, productivity during July and August 1999 was high. The month of July had the maximum production during 2000. The shrub contribution towards the total yield was 5585 Kg/h and 9662 Kg/h for 1999 and 2000, respectively. This was due to rain in late winter and early spring in 1999 (the total annual rainfall for 1993 to 2002 was 705.12 mm which was the highest recorded during the past 10 year). The total rainfall during June and July was 75.96 and 166.80 mm that promoted the growth of the vegetation and hence increased the productivity. This is true herbage productivity, besides other factors, was linearly related to the annual precipitation (Socholes and Baker, 1993). Similarly, Shanmugavel and Ramarathinam (1993) reported that primary productivity of rangelands was higher in wet seasons than in the dry and winter season. Same trend was observed in the present case as there was a decline in the herbage production during dry and winter months. In winter most of the plants were dormant. On the average July and August had high productivity due to more rainfall. The productivity was more during 2000 in May (3460Kg/h), June (4101) Kg/h, July (5985) Kg/h and August (5448) Kg/h when compared to 1999 in the same months. However, differences were greater in dry matter yield among both the years in October due to low rain fall (36mm). As a whole, the productivity was high in 2000 than that observed in 1999. In 1999 rain fall was low as compared to 2000 (100 and 167 mm respectively). The decreased productivity recorded during

1999 was probably due to long dry spell with high temperature which resulted in poor growth of vegetation and early completion of life cycle during late September. Similar findings were reported by Akbar *et al.*(1994) who observed that high dry matter production enhances due to rain received in spring and summer in Mastung and Tomagh rangelands.

Standing crop of herbaceous components peaked during May. Yousaf *et al.* (1996) reported maximum production of herbaceous biomass in May due to moderate temperature and moisture. Similarly the biomass of herbaceous species peaked during July and August in the present study. The annual herbs primarily contributed towards the total productivity that appear mostly during April and May. Danin (1999) also concluded that phytomass produced by annuals was high on good and deep soils. It was observed that nomads and local people collect medicinal plants for the last few years on commercial scale and this had greatly reduced plant population of desired species. Plants were dugout including the bulb which caused permanent loss of such plants and leads to decreased grassland resources. Liu *et al.* (1996) reported increase in desertification due to our expolitation in China. Similarly, Hussain *et al.* (1997b) reported that grazing decreased desirable plant species in the pastures in Nasirabad. Herbivory by other grazers also affect the productivity, species compositions and stability of the communities (West, 1993). In the present case grasses constitutes about 9 – 10% of total dry matter yield as observed during 1999-2000. The phytomass of grasses was 2% greater during 1999 than in 2000. There was an increase of 5- 12% during May to August; while 5% decrease was reported in October,1999.

Although annual grasses such as *Bromus tectorum* and *Poa annua* were abundant during early spring, their biomass contribution was low due to their small size of plants and leaves (about 4-6 cm height). Likewise , *Eragrostris* which is 2-6 cm had little contribution during June to October . The soil in mountainous area are generally thin and unfertile that also reduce the size and vigor of plant due to low water holding capacity , low organic matter and low nutrient. This could also be true in the present case.

Perez and Frangi (2000) stated that in Argentina biomass below ground allocation of net productivity increased with altitude. In our case biomass increases from May to June and then starts declining from August to November. Bassera & Franagi (1994) reported at lower elevation, background dry matter increased linearly & aboveground dry matter decreased exponentially with elevation. In our case biomass was high at the base (11717 kg/h) at 1700 m to 2000 m, 9651 kg/h from 2000 to 3000 m, 2775 kg/h from 3050 to 3300 m and 2771 kg/h from 3350 to 3700 m respectively.

Stocking Rate / Carrying Capacity of Rangeland

Nyamangara and Ndlova (1995) stated that forage intake of grazing animals differs with body weight, forage quantity and availability. Normally, 5-7 hours are required for animal feeding which splits into intensively early morning and late evening feeding period. Grazing time depends on accessibility of plant parts, availability of total forage and quality of consumed diet. Grazing time is reduced when good quality of forage is abundant. It was observed that generally 100 to 150 animals in mixed herd graze in Ganga and Bedori Hills daily during the growing season. According to FAO(1983) estimate the average requirement is as follows.

Species	Average body weight	Dail DM.Kg required	Annual DM.Kg required for 6 months	Available amount of animals	Total required of forage
Sheep	30– 35 Kg	1.8 kg	324 kg	70	22680
Goats	35– 40 Kg	2.7 kg	486 kg	300	145800
Cow	425 Kg	9 kg	1620 kg	50	81000
Buffalo	450–500Kg	13.50 kg	2430 kg	40	97200
Total			**4860**		**37200**

According to the USA recommendation range utilization level is 30 to 40% of key species with 130 to 300 mm annual precipitation for shrub steppe vegetation in semiarid region (Holechek, 1988).It may reach up to 50 % utilization of range during high productive year and reduced during dry period.

It was estimated that Ganga and Bedori rangeland produce an average of 27219 Kg/h of forage. However, based on the number of animal grazing in this area they would require a forage amounting to 3,46,680 Kg per day. The data suggests that the available forage was insufficient for the present stocking rate. It is estimated that the available amount of forage in Ganga and Bedori rangeland could insufficient for 60 sheep/h, 50 goats/h (1 sheep=9 Aum, and for 24 buffalos during growing season (May to November). Wahid (1990) reported 0.89 AUM,S capacity in Zarchi and Tomagh rangelands where climate is of dry temperate type with severe deforestation and overgrazing that leads to low biomass. Based on our observations, it is suggested that the present range is being overgrazed that is adversely affecting its productivity. Overgrazing not only causes compaction of soil, but may remove palatable plant cover and open the way for destructive erosion which is seen everywhere in the investigated rangeland. The rangeland health is the dirge to which the integrity of soil and ecological processes of rangeland ecosystem are restrained.

Major factors influencing range animal nutritional status include stocking rate, grazing system, type of forage species, type of animals and season of use (Holechek *et al.*1998). Hussain and Badshah (1998) stated that grazing and over exploitation by local inhabitant has caused degradation of palatable resources in S.Waziristan. Ahmed *et al.* (1998) reported that protected units show dominance association trend of grass-shrub land and woodland, respectively in Attock. Contrarily, unprotected areas degraded in terms of woodland dominance. It was observed that in the investigated area non palatable species such as *Phalaris* and *Arundo* increases in overgrazed rangeland at the cost of preferred species. The findings are in agreement with those of Hussain and Chughtai, (1984) who reported that non palatable plants has become dominant due to overgrazing in Queta. In our case productivity was high from May to August then it declined due to low temperature.

Likewise, Saleem (1997) reported that protection enhanced the biomass from 81 to 151% in Asghara, Kuch Mulzai and Karez Kadi area. In the investigated area, the plants present with in the thickets of shrubs had high biomass. The local population of adjoining areas depend upon this rangeland for their fuel wood required for room heating during spring, as there is no other facility. They uproot almost every plant for their household need irrespective of its forage or medicinal value protecting from grazing has increased biodiversity and biomass in Kanak Valley, Balochistan (Mori and Rehman,1997).

Better productivity can be observed in an area if it is closed for some years with the co-operation of local inhabitants. This is a great need for improving ranges by adopting scientific measures as this area has great potential for increasing the biomass production, improved forage quality and productivity with properly managed grazing system. Thus, it becomes imperative to conserve the resources. Ashfaque, 2003 reported that in Sarsawa hills the forest was closed for five years resultingly biomass was improved with the ratio of 1:3. It is recommended that low stocking rate during growing seasons and moderate during spring by judicious proper livestock management techniques will improve range biomass, species diversity and range carrying capacity.

Degree of Palatability

Palatability refers to the plant attributes which determines its acceptability by grazing animals. Characteristics of plant species such as chemical composition, growth stage, external plant form and kinds of plants affect the acceptability and may stimulate selective responses by animals or may prevent from grazing (Heady, 1964).

Ganga Choti and Bedori rangeland is freely grazed by cattle, sheep and goat in mixed herds forms. The grazing season commences from the first week of

May and last up to the end of November. Due to traditional grazing system no management is practiced. The vegetation is consumed by grazing livestock as and when produced. Annuals like *Andropogon munroi, Avena barbata, Brachiaria ramosa, Bromus tectorum, Cenchrus biflorus, C. unciflores, Cynodon dactylon, Dactylis glomerata, Elymus repens, Festuca modesta, Koeleria macrantha, Poa annua, P. bacteriana* and *Themeda anathera* emerge frequently during early spring. However, they are quickly grazed by livestock within a short duration even before they could attain maturity.

Similarly, a large number of geophytes sprout in early May but hardly a few can reach to the flowering stage except those found within spiny plants or thickets such as *Allium humile, Cypripedium cordigerum, Valeriana, Fritillaria roylei, Koeleria macrantha, Iris lactea, Phleum alpinum* and *Trilidium govanianum.*

Grazing animals reduced woody plant cover and decrease scrub encroachment. However, the impact varied with grazing animal and woody species involved. Among woody species, only *Pinus wallichiana, Abies pindrow, Picea smithiana, Quercus dilatat* and *Juniperus communis* were least browsed and they not damaged due to there unpalatable nature. *Desmodium multiflorum, Viburnum glandiflorum* and *Indigofera heterantha* were seldom grazed. Cattle and goats prefer leaves of *Desmodium, Viburnum,* and *Indigofera.* lombardi *et al.* 1999 at Italy reported that *Vaccinium myrtillus* was markedly browsed and damaged, while on the contrary *Arctostaphylos uva* – ursi, *Rhododendron* and *juniperus* were seldom affected.

The livestock preferred 75 % of the shrubs in Ganga and Bedori range which makes bulk of their diet selection during May to August. While during Septmber to November 25% shrubs make their diet. The availability of palatability species decreased in September – November. The animals were forced to consume low quality of food (i.e. at mature stage).

The occurrence and growth of shrubs is impaired due to grazing at early stage of life. *Astragalus floridus, Desmodium multiflorum, Berberis lycium, Lespediza sericea, Myrsine africana, Minuartia kashmirica, Indigofera heterantha, Viburnum grandiflorum, Rosa macropylla* and *Zanthoxylum alatum* are most preferred shrubs by cattle, sheep and goats in the area. These have become stunted with deformed or cushion like canopy.

These finding are in line with those of Mohammad (1989) who reported that *Lespediza, Indigofera* and *Quercus* shrubs were equally preferred by livestock such as goats and sheep in other rangelands in Hazara. Furthermore *Themeda anathera, Heteropogon contortus* and *Chrysopogon aucheri* were preferred grasses.

Range vegetation differs greatly in palatability, nutritive value and productive ability. Grazing animals select the most palatable plant first. A poor management, therefore, results in the complete replacement of good quality forage plants by low quality or non-palatable plants such as *Sarcococca* and *Juniperus*. The finding agree with those of Malik *et al* .(1994) who reported that deforestation and overgrazing has promoted the dominance and growth of non palatable species such as *sarcococca saligna* in Dhirkot. The removal of plants also caused accelerated soil erosion in the area. Under heavy grazing eroded soil were present in all over Ganga and Bedori hills.

Palatability of given plant species for a given livestock type changes with the season or stage of maturity, Grasses at the early stage of growth are highly palatable due to their high nutritional contents. But when they become dry and yellow their nutrient content decreases. Certain shrubs and trees that retain their foliage during the winter may continue to be highly palatable.

The palatability of plants depends on nutritional needs of animals. It declines as need are met (Provenza, 1996). In the present study, 18.93% of preferred species were short lived annuals. Of them, 9.46 % are available during early spring and the remaining 9.46 % during monsoon. The plant preferences and feed selection of livestock shifted with the progress of season from spring to monsoon. The preferences for herbaceous speices was highest during May to August that declines from September to November. This was well correlated with the availability of grasses which increased from May to August and thereafter gradually decreased during September to November. *Agrostis alba, Cenchrus biflorus, Poa annua, Poa bacteriana, Urochloa panicoides, Cynodon dactylon, Dactylis glomerata, Calamagrostis spp. Themeda anathera* and *Imperata cylindrica,* were most preferred plants from May to August.

Less palatable grasses such as *Saccharum spontaneum, Phalaris minor* and *Festuca modesta* increased in their occurrence and growth in the range because of less preferences by annuals. Saleem (1993) and Wahid (1990) reported that *Cymbopogon jwarancusa,* have spread over a majority of the grazing land in

Balochistan owing to its low palatability. In our case *Festuca modesta, Imperata cylindrica, Elymus repens* and *Chrysopogon aucheri* were of low palatability and that is why they spread sufficiently compared to the preferred species.

Goyal and Sinha (1996) reported that grazing has replaced palatable grasses by unpalatable species and decreases forage due to intence livestock grazing. A decline in suitable grassland habitat has increased land use conflict. In our case similar situation was seen. Palatable grasses such as *Dactylis, Cenchrus, Avena, Brachiaria* has replaced by non-palatable grasses such as *Arundo* and *Phalaris*.

Shorki *et al.* (1996) observed that rangeland was dominated by unpalatable species due to high stocking rate of sheep. The range condition was considered fair and dry matter production was 90 kg/ha. They recommended conservation of the area for wildlife and ecotourism. In our case the stocking rate was high that has lead to deterioration of range condition. Similarly, Molinillo and Monasterio (1997) reported that range vegetation was dominated by rosette–shrub communities owing to cattle grazing. Like our finding they concluded that palatability data and the indices of selective grazing and preferences were significantly correlated. *Stipa* and *Poa* were selected by cattle most frequently followed by *Calamagrostis*.

Ash and Mclovar (1998) reported that *Themeda* and *Chrysopogon* were grazed by cattle at low, medium and high intensities in either the early wet, late wet or dry seasons. Effects of grazing on species composition were greatest in the early wet season when high rates of utilization significantly reduced the proportion and occurrence of *Themeda* and increased proportion of forbs. In our case *Themeda* and *Chrysopogon* were palatable species grazed by cattle at high intensities in early and late season that is why these grasses reduced the proportion. Further these grasses are allelopathic and fine fodder.

In general, selectivity of forage is directly proportional to the amount of herbage available. This is important to recognize that many annual grasses and forbs grow in periods when perennials are dormant. Annual forbs/ grasses provide an important nutritional contribution to the livestock and reduced pressure on palatable perennial grasses during the growing seasons. In Ganga and Bedori hills annuals and geophytes appear when most of the shrubby component are still dormant. Thus, it provides a chance for shrubs to produce vegetative growth. By the time annuals mature, shrubby forage becomes available.

Unpleasant feeling of physical discomfort are caused by excess of certain nutrients and toxic by nutrients deficiency and animal acquire a version to food. This is manifested when animal no longer eats the food or when it shows less preference for food when offered alternatives (Provenza, 1996). There is not always a sharp distinction between poisonous and non-poisonous plants. Most plants are poisonous only when eaten in large amounts and may provide nutritive forage when consumed in smaller amounts or mixed with other forages (Vallentine, 1990). The toxic components include all species poisonous or injurious to grazing animals. Some species are harmful at a particular stage of growth (Huston and Pinchak, 1993). Gardner *et al.* (1996) repoted that the presence of pyrrolizadin alkaloids in range, plants i.e. species of *Astragalus*, *Solanum, Senecio, Cynoglossum* cause significant livestock loss from hepatoxicity. Reyna and Gonzalez (1996) reported that the alkaloid, glycosides, nitrogenous compounds, oxalate and other organic acid are toxin present in may range plants including *Chenopodium album Clematis graveolens, Conyza canadensis, Euphorbia prostrata, Malva parviflora, Melilotus alba, Solanum nigrum* and *Viburnum grandiflorum.* Malulbekova (1996) reported that *Artemesia scoparia, Euphorbia helioscopea* and *E. prostrata* are poisonous to livestock. Some of the non palatable species recorded in the present study were *Arnudo donax, Phalaris minor* and *Sarcococca* in agreement with above situation.

Some of the preferred species recorded in the present study might be harmful to livestock owing to their unfavourable chemical composition or texture such as *Viburnum, Artemesia, Senecio, Solanum, Chenopodium, Taraxacum, Euphorbia, Astragalus, Clematis, Conyza, Malva* and *Salvia.* It might be possible that poor health and performance of livestock in this range are partly due to the eating of these toxic species. Since there is always shortage of forage in the area, therefore, these less to non-palatable species are grazed, under compulsion as no other choice are available to the livestock. *Viburnum* and *Euphorbia* are non-palatable species in other parts of country but in Ganga and Bedori range these plants grazed under compulsion. There were 60.67% palatable and 39.32% as non palatable species in moist temperate pasture of District Bagh. While the same 39.32 % non-palatable are highly preferred by livestock in the present case. This contrast might be due to non availability of fodder and special adaptations of the animals to such plants.

Overgrazing sometime forces livestock to eat a harmful amount of poisonous plants. On a good grazing land, poisonous and less palatable plants are subjected to intense competition form vigorous high producing forage plants as many of the plant species are available as forage (Vallentine,1990). In the present case non-palatable species do not face much competition as the vegetation is poor and sparse, which further decreases by constant removal of palatable species by livestock. This has facilitated spread and growth of undesirable vegetation cover.

Fruits and flowers are seasonally important in animal diet (Pfister and Malecheck, 1986). In the present study, follower/fruits of 16% species were prefered by livestock. *Rosa macrophylla* and *Rosa webiana* were preferred only at flowering stage. The reason might be that fruits and flowers of forbs and shrubs generally have a much higher level of cell soluble and protein than leaves. Similarly, vegetative buds of shrubs are particularly high in cell soluble and crude protein (Holechek et al. 1998). Similar trend for grazing preference of flowers and fruits was reported by Hussain and Mustafa (1995) for other plants in the pasture of Nasirabad valley.

The leaves of 30 % species were preferred by livestock in the area. While the shoot/ whole plant were consumed 24% (especially annuals).A number of plant morphological characteristi s, such as spines, hair, stickiness, coarse texture and unfavorable odour reduce palatability, as do the growth habit or position of various plants parts. Palatability is a relative factor and depends on the availability of the plan pecies and the type of range animals. An absolute value in this respect is meaningful only when a wide variety of plant species are available.

When few species are available, as in spring, the animals have to depend on them for their survival. Goat and cow accept a lower level of palatability than sheep and cattle. Sheep and cattle have definite preferences. The palatability of plant communities also varies by seasons. Leaves from forbs and shrubs are more digestible than grasses. Many grasses accumulate silica which reduces digestibility (Holechek *et al.* 1998). For this reason many grasses such as *Elymus*, *Phalris* and *Arundo* with high silica content and woody culms were non-palatable in the area. However, grass, leaves and stems are higher in cellulose and lower in lignin. Leaves of nearly all forage have higher crude protein and phosphorus and low fiber and lignin than stems. Stems of woody species are low in quality due to high level of lignifications (Holechek *et al.* 1998). Similarly, green herbaceous components are easily digestible than dried or mature plants. Sheep prefer fresh foliage than dried forage. There is a deliberate preference of feed, which could be eaten faster. The preference for dried feed decreases because of taste, odour and feel.

Green and Kauffman (1995) reported that in ungrazed dry and moist meadow communities had significantly lower species richness and diversity as compared with grazed communities. In the most heavily grazed communities, ruderal and competitive ruderal species were increased by grazing disturbances. They concluded that influence of herbivory on species diversity and evenness vary from one community to another and that basing management recommendation on one component ignores the inherent complexity of riparian ecosystem Atamov and Ponomarenko (1994) reported 165 plant species in Baku which were the major components in 3 plant communities where *Bothriochloa, Festuca* and *Stipa* were present. Grazing pressure reduced the contribution of grasses to the swards. The proportion of most palatable species decreased in response to overgrazing while the proportion of unpalatable species increased. The number of seedlings decreased from 312 – 102 /m2 under light and severe grazing. Effective vegetation cover was reduced by about 50% by severe grazing. In our case ***Phalaris minor*, *Sorghum halepense*,** and ***Polypogon monspeliensis*** were present as non–palatable. *Festuca modesta, Elymus repens, Imperata cylindrica*, *Koeleria macrantha, Sorghum halepense* and *Urochloa panicoide*s were present as palatable grasses. But the grazing pressure reduced the contribution of these grasses to the swards. Here too, the proportion of most palatable species decreased due to overgrazing.

General Conclusion and Recommendations

1. The study of the investigated area was conducted during 1998-2000 to elucidate the vegetation-habitat and biotic relationship of the area.

2. The study revealed that the flora was composed of 206 species that belong to 10 pteridiophytes, 4 gymnosperms, 35 monocots and 157 dicots.

3. Based on the number of species Asteraceae, Rosaceae, Poaceae, Pinaceae and Lamiaceae, were the important families in spring, while in monsoon Poaceae, Rosaceae, Ranunculaceae, Leguminosae and Caryophyllaceae were most prevalent. Quantitatively, based on FIV the situation drastically changed. Pinaceae, Ranunculaceae, Asteraceae, Polygonaceae, Rosaceae, Leguminosae, Ranunculaceae, Rubiaceae, Salicaceae and Lamiaceae were important families.

4. The flora was dominated by hemicryptophytic, therophytic, microphyllous, nanophyllous and aggregated species. This is well in accordance with the climate of the area.

5. There were two flowering spells. First from May to June and the second from July to November with the peak flowering in June. The flowering was related to moist nature of the season.

6. The major utility of the area was rangeland, (46.20%). The species were used as fodder/forage. They were followed by medicinal plants (28.62%). It was found that the area initially a rangeland with some potential for medicinal plants.

7. There is a severe shortage of fuel and timber wood species that has enhanced deforestation and erosion pressure on the existing shrubby as well as woody species.

8. Different phytosociological parameters and ordination showed that the vegetation had 4 main associations; woodland temperate, woodland alpine, shrubland alpine and alpine grassland associations.

9. The physico-chemical analysis of habitat features revealed that the flora, vegetation structure and its productivity are governed by altitude, soil pH and nitrate.

10. The area is basically a subtropical in lower reaches which change to moist temperate, subalpinme to alpine type in the upper reaches. *Pinus roxburghii, P.wallichiana, Abies pindrow, Picea, smithiana, Quercus dilatata, Ficus palmata, Pyrus pashia, Salix denticulata* and

Prunus persica is being removed for fuelwood. The area had potential to regenerate as there were seedlings, young to mature plants of *Pinus wallichiana* and *Abies pindrow*. There is an urgent need for complete restriction on the deforestation and collection of young trees and shrubs.

11. Of the 115 palatable species, 16.5% were highly palatable and 28.6% were mostly palatable. Thus 45% of palatable plants were preferred species. This indicate non-availability of sufficient forage and high grazing pressure in the area. The grazing must be ecologically correlated to reduce the grazing pressure on vegetation. The herd size must be kept in accordance with the carrying capacity of this rangeland.

12. The preference of livestock differs by species, by parts, by phenological stage of plants and the most important by availability of forage. There is a great need to allow mixture of livestock so that grazing pressure on few preferred species might be relaxed. Rotational grazing particularly during non-flowering seasons might give a chance for the vegetation to produce foliage and seeds.

13. The productivity of the range depends upon the season, phenological stage of vegetation and amount of rainfall. The rainfall appeared to be more decisive as compared than any other factor of the environment.

Based on the above conclusions, it is recommended that:

1. Moderate and rotational grazing management be enforced to enhance the rangeland primary productivity.

2. There is severe deforestation pressure for fuel and timber wood. Alternate source of fuel/timber could be provided and the area should be closed for a period 20 years to promote shrub and tree cover.

3. Retrogression of climax community to disclimax is widespread. It can be managed by regulating grazing and deforestation with participation of local communities.

4. There is an urgent need to promote ethics that conservation and improvement of natural vegetation is critical for soil and land management. Soil is being eroded very rapidly due to low vegetation cover.

5. There are more avenues such as exploration of research activity for knowing the germination, seed production and growth pattern for successful propagation and reintroduction of fodder, fuelwood and medicinal plants in the investigated area.

6. Marketing policies for livestock and medicinal plants should be regulated and upgraded as at present there is no such facility.

7. Cooperation and participation of local people is essential to enforce effective management plan which might be possible with the help of influential of the area.

8. A balance between the food and feed supply, nutrient input, livestock population and human influences will be critical for long term sustainability of rangeland.

9. Strong linkages among international programme. Regional and sub-regional research and developmental programme are required to devise an integrated management plan so that the ecological and socio-economic problems could be addressed properly.

10. To improve and ensure overall sustainable biological productivity from this ecosystem, long tern plans are needed which might include rehabilitation of degraded habitats by introducing fast growing fodder species, replacement of low yielding livestock with high yielding breeds, rotational and mix grazing, provision of alternate source of fuel wood and livelihood. Such long term efforts might reduce pressure and allow the flora and fauna to revert to its natural original position.

11. The rangeland can be used as a game reserve for income regeneration that can be used for its development.

12. There is strong positive hope to promote ecotourism in the area. This will be an additional source of income.

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APPENDIX

Appendix 1. Phytosociological attributes of different plant communities based on importance values in Ganga and Bedori hills during monsoon, 1999.

Altitude(m)	1700	1800	1900	2000	2400	2500	2600	2800	2900	3000	3050	3200	3350	3505	3550	3750
Abies pindrow Royle	-	-	-	-	47.77	-	102.59	65.80	-	38.73	-	-	-	-	-	-
Ficus palmata Forssk	-	-	-	4.36	-	-	-	-	-	-	-	-	-	-	-	-
Picea smithiana (Wallich)Boiss																
Pinus wallichiana A.B. *Jackson*	47.20	35.67	23.88	18.77	-	99.00	-	-	-	-	-	-	-	-	-	-
Prunus persica Buch	-	-	-	1.98	-	-	-	-	-	-	-	-	-	-	-	-
Pyrus pashia Buch	-	1.68	10.88	-	-	-	-	-	-	-	-	-	-	-	-	-
Quercus dilatata Lindley																
Salix denticulata Anderson	-	-	-	-	-	-	-	-	-	41.31	-	-	-	-	-	-
Total	47.20	37.35	34.76	25.11	47.77	99.00	102.59	65.80	-	80.04	-	-	-	-	-	-
Shrub layer																
Berberis lycium Royle	9.61	22.02	35.23	33.71	-	1.27	-	-	-	-	-	-	-	-	-	-
Desmodium multiflorum DC	8.13	39.68	34.52	36.05	-	7.14	-	-	-	-	-	-	-	-	-	-
Ficus palmata Forssk	-	-	-	1.21	-											
Jasminum officinale L.	-	-	6.88	-	-	-	-	-	-	-	-	-	-	-	-	-
Juniperus communis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	25.74	18.08	37.84
Machilus odoratissima (Nees) Kostern	17.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pinus wallichiana A.B *Jackson*	2.28	1.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrus pashia Buch	-	-	5.33													
Rosa macrophylla Lindley	2.28	1.68	4.66	5.97	-	-	-	-	-	-	-	2.88	27.35	-	-	20.60
Salix denticulata Anderson	-	-	-	-	-	-	--	-	-	18.88	23.44	-	-	-	15.23	20.60 -
Sarcococca saligna (D. Don)*Muell Arg*	2.70	-	-	-	4.33	6.37	-	-	-	-	-	-	-	-	-	-

Spirea canescens D.Don	-	-	3.22	-	-	-	-	-	-	-	-	-	-	-	-	-
Viburnum grandiflorum Wallich ex DC	-	-	-	2.23	47.05	3.11	29.89	43.57	-	7.07						
Total																
Herblayer																
Abies pindrow Royle	-	-	-	-	-	-	1.03	-	-	-						
Acer cesium Wall	-	-	-	-	-	-	-	-	-	-	-	31.35	31.55	31.85	35.42	-
Achillea millefolium L.	3.86	0.91	2.45	11.58	-											
Adiantum venustum D. *Don*	5.72	4.28	-	-	9.30	2.42	-	0.87	-	2.34						
Agrostis canina auct	-	-	28.97	-	16.57											
Agrostis viridis auct.	-	-	-	-	-	-	-	-	-	-	-	47.17	-	-	-	-
Allium humile Kunth.															28.48	
Alopecurus myrosuroides Huds	-	-	-	-	-	-	-	-	-	-	11.36	-	-	-	-	-
Anaphalis margaritacea L.	-	-	-	-	-	-	-	-	-	-	-	-	-	31.66	-	-
Androsace rotumdifolia Hardw	1.47	-	-	-	-	-	-	-	-	-	-	-	-	-	48.12	-
Angelica cyclocarpa Lin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.32	-
Arabidopsis himalaica Edgew	-	-	-	-	0.88											
Arenaria neel. Wight Arn	-	-	2.25	-	-											
Arenaria orbiculata Royle	-	-	-	-	-	1.18	-	8.92	-	-						
Arisaema intermedium Blume	-	-	-	-	0.88	-	1.28	5.3	7.54							
Arisaema jacquemontii Blume	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.41	-
Artemisia herba alba Asso	-	-	-	-	-	-	-	-	-	-	30.36	30.36	-	-	-	-
Asplenium adiantum nigrum L.	-	-	-	-	11.01	-	-	.91	1.37	-						
*Aster alpinus(Clarke)*Hutch	-	-	-	-	-	-	-	-	-	-	-	-	22.26	-	-	-
Athyrium mackinnoni	-	-	-	-	-	-	1.07	-	-	-						

(Hope) C.chr																
Berberis lycium Royle	3.56	1.88	-	-	-											
Bergenia ligulata (Str) Hot	-	-	-	-	-	-	-	-	-	1.04	33.80				23.51	
Bistorta amplexicaulis D.Don	-	-	-	-	-	-	-	-	-	-	-	28.72	-	-	-	-
Brunella vulgaris L.	3.08	11.51	-	-	-	-	9.90	-	-	-	-	-	-	-	-	22.29
Bupleurum longicaul Wall	-	-	-	-	-	-	-	-	-	-	-	-	40..30	33.28	-	-
Caltha palustris L.	-	-	-	-	-	-	-	-	-	4.04	-	-	-	-	30.89	-
Cenchrus biflorus Roxb	-	-	-	-	-	33.93	27.85	34.09	-	-						
Cenchrus unciflous Her	-	-	-	-	-	-	-	13.77	-	-						
Conyza canadensis L.	-	-	2.25	2.45	-											
Corydalis govaniana Wallich	-	23.61	6.64	5.63	-											
Cotoneaster acuminatus Lindley	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Cynodon dactylon (L) Pers	-	-	-	-	-	-	-	-	-	4.70						
Cyperus niveus Retz	-	10.10	3.92	30.49	-											
Cyperus panicoides L.	-	-	-	-	-	-	1.28	-	19.17	-						
Cypripedium cordigerum D. Don	1.77	-	-	-	-	-	-	-	-	-	-	-				
Cystopteris fragalis(L) Bth	-	-	-	-	-	-	-	7.58	-	-						
Desmodium gangeticum DC	-	-	-	-	-	-	-	-	-	2.56						
Dipsacus inermis Wall	-	-	-	2.65												
Dryopteris stewartii Fress	-	-	-	-	-	-	-	-	21.03	-						
Elymus repens L Gould.	-	-	-	-	-	-	4.12	-	01.37	1.26						
Euphorbia wallichii HK.f	-	-	-	-	-	-	-	-	-		-	-	31.85	-	-	-
Festuca modesta Nees															20.70	
Ficus palmata Forssk	-	-	22.91	19.98	-											
Fragaria nubicola lindl	-	-	0.73	-	-											
Fritillaria roylei HK..f	1.47	17.69	17.10	-	24.88	36.11	14.36	17.95	42.46	13.02	28.41	-	-	-	-	-
Galium elegan L.															29.13	
Gallium aparine L.	-	11.46	--	-	-	-	5.95	-	-	-						

*Gentiana decumbens(non)*L.F. Clarke	27.45	11.46	4.73	13.65	15.60	17.52	8.82	17.70	-	-						
Geranium rotundifolium L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.00	-
Geranium wallichianum D.Don	-	14.74	-	15.21	-											
Hedra helix auct	-	-	-	-	4.27	-	9.33	11.26	8.43	37.05	-	36.51	-	-	-	-
Impatiens edgeworthii Hook	-	-	-	-	1.64	-	2.17	-	-	-						
Imperata cylindrica (L)Raeuschel	-	-	-	-	-	1.18	-	-	-	-	-	-	21.27	-	-	-
Iris lacteal	66.20	-	-	-	-	-	-	-	-	-						
Jasminum officinale L.																18.04
*Koeleria macrantha(Ledb)*Schult	-	-	3.21	-	-											
Lactuca dissecta L.	-	-	-	-	-	-		-	-	-	-	-	34.23	-	-	-
Lavaetra kashmiriana Camb	-	-	-	-	-	-	-	-	8.12	1.26						
Leontopodium alpinum Cass	-	-	-	-	-	-	-	-	-	-	-	-	-	57.93	-	-
Lespedeza Sericea (Thumb) Miq	-	-	-	-	-	7.29	-	-	1.72	-	-	-	-	-	-	27.57
Leucas lanata Bth	13.50	-	-	-	-	-	5.25	-	48.05	-						33.40
Malva verticillata L.	-	-	-	-	-	-	-	-	-	-	-	-	-	27.83		-
Melilotus indica (L) All	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35.60
Mentha longifolia (L.) Hudson	-	-	-	-	15.56	-	7.04	-	-	-						
*Micromeria biflora (*Ham) Bth	-	-	-	-	4.96	16.17	-	-	-	-						
Nepeta podostachys Bth	-	-	7.41	-	-											
Oenothera rosea (L). Her	-	3.03	-	-	-	-	1.03	-	-	-						
Oxalis corniculata Linn	1.47	0.93	-	15.93	-											
Parnassia cabulica Planch	5.00	6.54	14.78	17.40	4.55										20.60	
Pedicularis siphonantha	-	-	-	-	-	-	-	-	-	-	-	50.83	-	-	-	-

Bow																
Phlaris minor Retz	-	-	-	-	-	-	-	-	-	-	42.62	-	-	34.64	-	-
Phleum alpinum L.	-	12.09	14.64	-	-											
Phlomis bracteosa Royle ex Bth	-	-	-	-	-	-	-	-	-		-	-	-	-	35.43	22.51
Plantago lanceolata L.	-	-	-	-	-	-	3.22	-	-	-						
Plectranthus rugosus Wall	1.47	17.43	3.25	11.56	6.40	-	1.28	-	6.00	-						
Poa annua L.	-	-	7.56	-	-											
Poa bactriana Rozhev	-	-	-	-	3.26	-	-	-	43.03	48.65						
Poa infirma H. Bk	-	-	-	-	-	-	-	-	33.76	-						
Podophyllum emodi Royle	-	-	-	-	27.18											
Polypogan monspeliensis(L).*Desf*															10.50	
Potentilla atrasanguinea Lold													40.01			
Potentilla cuneata Pall.														19.09		
Potentilla eriocarpa Wallich											45.85					
Potentilla gelida C.A. Meyer	-	-	-	-	-	-	-	1.08	-	-	-	-	-	-	-	-
Primula denticulata Smith.	-	-	-	-	1.50											
Pteris cretica L.	-	-	-	-	-		-	-	-	-	57.56	40.06	-	-	-	-
Pyrus pashia Buch	-	-	-	-	-	-	6.32	-	-	-						
R.anunculus repens L.	-	-	3.38	-	-											
Ranunculus laetus Wallich	-	9.47	-		10.41	4.74	19.82	-	-	27.22		32.12		37.87		
Rosa maerophylla Lindley	-	-	2.45	-	4.98	0.81	-	23.53	7.95	-						
Rubia tinctorum L.	-	-	-	-	1.64											
Rumex hastatus D.Don	-	-	-	-	-	-	-	-	3.59	21.00						
Rumex nepalensis D.Don	27.39	3.40	-	-	-	-	3.09	-	-	-						
Saccharum spontaneum L.	-	-	-	-	5.31	-	-	-	-	4.94						22.32
Saussurea lappa Clarke	-	-	4.13	-	-											

Senecio chrysanthemoides DC															15.28	
Senecio graciliflorus DC													48.09			
Sibbaldia cuneata Hornum													42.84			
Sonchus arvense L.	38.44	-	-	-	-	-	-	9.31	-	14.13						
Sonchus asper Hill	-	12.62	-	-	-											
Sorghum halepense (L) Pers	-	1.88	-	-	-											
Stellaria media (L.) Vill	-	-	-	6.98	-											
Stellaria monosperma Buch	-	-	-	-	-	9.85	3.32	-	-	-						
Taraxacum officinale Weber	-	-	-	-	-	-	-	-	-	8.12						
Thymus serphyllum L.		9.77														
Trifolium repens L.																32.81
Trifolium resupinatum L.	-	-	11.01	9.99	-	-	11.31	9.82	6.9	-						
Trillidium govanianum (D. Don) Kunth	-	-	-	-	-	-	-	-	-	1.26						
Urochloa panicoides P.Beauv	-	-	-	-	-	-	-	-	-	2.32						
Urtica dioica L.	-	-	-	18.10	-											
Veronica melissaefolia Royle	-	-	-	-	-	-	1.52	-	-	-						
Vetiveria zizanioides (L.) Nash	-	-	-		14.40	-	13.27	2.36	4.67	-	26.47					
Viburnum grandiflorum Wallich ex DC															20.40	
Viola serpen Wall	-	-	-	-	-	-	4.79	2.19	32.7	-						

Key is the same as in Table 9

Appendix 2. Phytosociological attributes of different plant communities based on importance values in GangaChoti and Bedori hills during spring, 1999.

	Ganga									Bedori					
	TCP 1700	TPD 1800	APB 1900	PCG 2000	APV 2400	AVM 2600	PEB 2800	VSP 2900	SAR 3000	EPA 3050	PGA 3250	PJP 3350	PPA 3505	PAP 3650	PPL 3750
A. Tree layer															
Abies pindrow Royle	-	-	-	-	75.54	92.24	-	-	-	-	-	-	-	-	-
Picea smithiana (Wallich) Boiss	-	-	-	-	-	-	64.11	-	-	-	-	-	-	-	-
Pinus wallichiana A.B.Jackson	41.0	52.97	50.22	78.89	43.49	10.46	-	-	-	-	-	-	-	-	-
Pyrus pashia Buch	21.6	19.62	10.51	-	-	-	-	-	-	-	-	-	-	-	-
B. Shrub layer															
Berberis lycium Royle	19.1	43.10	32.53	34.57	-	-	-	-	-						
Desmodium multiflorum DC	23.1	20.24	17.75	-	-	-	-	-	-						
Juniperus communis L.										3.45	8.09	52.64	-	-	-
Myrsine africana L.	-	4.67	-	-	-	-	-	-	-						
Rosa webbiana Wallich	7.19	15.47	8.64	9.99	41.29	-	-	-	-						
Rosa macrophylla Lindley										4.12					
Salix denticulata Anderson	4.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sarcococca saligna(D.Don) Muell	5.37	7.26	16.43	6.19	13.41	12.38									
Viburnum grandiflorum Wallich ex DC	-	-	-	-		33.56	12.54	8.55	-						
Zanthoxylum alatum DC	7.19	4.23	-	-	-	-	-	-	-						

C.Herb layer															
Andropogon munroi C.B. Clarke	-	60.7	-	-	-	-	-	-	-						
Avena barbata Pott	-	-	-	-	-	-	-	-	27.86						
Bromus tectorum L	-	-	-	-	-	-	31.64	-	-						
Cynodon dactylon(L.)Pers.	38.8	34.8	28.22	-	-	-	-	-	-						
Dichanthium annulatum (Forssk) Stapf	-	-	-	-	-	31.34	-	-	-						
Lolium perenne										7.16	-	-	-	-	-
Poa annua L.	-	-	-	-	-	-	-	34.58	-						
Phleum alpinum L.										32.54	19.61	48.16	48.88	41.08	61.31
Poa bactriana Rozhev.	-	-	-	-	-	7.51	-	-	-	-	-	-	-	-	-
Themeda anathera Nees .	47.5	17.3	-	-	11.19	-	-	-	-	-	-	-	-	-	-
Hypericum perforatum L.	-	-	-	-	-	-	-	-	-	-	-	8.92	-	-	-
Trigonella emodi Bth										-	-	-	3.59	-	-
Wulfenia amherotiana Bth.	-	-	-	-	-	-	10.27	-	-	-	-	-	-	-	-
Bupleurum longicaule Wall	-	-	-	-	-	-	26.22	6.87	19.51	13.40	-	1.75	-	-	-
Pleurospermum govanianum DC.										-	-	-	-	-	-
Achillea millefolium L.	-	-	9.62	-	-	-	-	-	-	31.77	36.16	32.42	-	-	-
Anaphalis margaritacea (L.) Bth	-	-	-	-	-	-	8.38	-	-	-	-	-	-	-	-
Anaphalis nepalensis (Spreng) Hand.							12.73			-	-	-	-	39.39	19.51
Anaphalis timmua D.Don	-	-	-	-	5.30	-	-	-	-						
Artemisia wallichiana Besser										27.77	-	-	-	-	-
Artemisia scoparia Waldst and										4.12	-	-	-	-	-

Aster alpinus (Clarke) Hutch	-	-	-	-	-	-	-	-	19.51	-	-	-	-	-	-
Gerbera gossypina Royle	-	-	44.68	-	-	-	-	-	-						
Leontopodium alpinum Cass										12.35	23.89	3.29	-	34.18	46.44
Myriactus nepalensis Bth	-	-	-	-	2.24	-	-	-	-	-	-	-	-	-	-
Senecio chrysanthemoides DC								11.27	-	14.98	15.10	-	3.70	-	-
Senecio ligularia Hook										-	-	-	25.32	-	-
Senecio nudicaulis DC	-	-	-	-	-	-	-	13.32	-		10.86				
Sonchus asper Hill	3.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*Circium arvense(L.)*Scope	-	-	-	-	13.35	8.53	-	-	-	-	-	-	-	-	-
Clinopodium alpinum Cass	--	-	-	-	-	-	6.13	6.69	-	-	-	-	-	-	-
Pseudomertensia echioides (Bth) Reidl										3.58	12.22	-	-	-	
P. moltkioides (Royle) Kazmi											11.83	-	-	-	-
Cyprus panicoides L.	42.1	7.04	46.35	-	-	-	-	-	-	-	-	26.04	-	-	-
Euphorbia wallichii HK.f										1.58	-	-	-	-	-
Gentiana cachemirica DC	-	-	-	-	-	-	-	19.34	15.02	-	3.89	-	3.39	-	-
Geranium wallichianum D.Don			5.25				6.48			5.53	38.29	-	19.30		
Nepeta podostachys Bth										42.05	-	-	-	-	-
Salvia hians Royle											7.21	1.47	-	-	-
Scutellaria chamaedrifolea Bth										-	7.21	-	-	-	-
Thymus serphyllum L.												1.46		7.49	15.92
Medicago leciniata(L.) Mill	17.5	13.20	-	30.44	16.07	35.84	-	-	-	-	-	-	-	-	-
Elsholtzia strobilifera Bth	-	-	-	-	-	-	-	17.74	-	-	-	-	-	-	-
Epilobium cylindricum D. Don	-	-	-	-	-	-	45.38	31.04	19.82	-	6.63	-	-	-	-
Plantago lanceolota L.	-	-	-	13.92	-	18.45	12.44	-	-	-	-	-	-	-	-
Plantago ovata Forssk	10.7	-	9.62	5.37	17.94	-	-	-	-	-	-	-	-	-	-

Polygonum amplexicaulis D.Don										25.86	19.56	34.10	16.50	47.15	79.09
Rumex dentatus L.	-	-	-	-	14.67	11.33	-	-	72.46	-	-	-	-	-	-
Androsace rotundifolia Hardw										-	-	-	-	51.43	33.01
Primula denticulata Smith					3.53					-	-	-	-	-	-
Cystopteris fragilis(L.) Bth														2.47	
Dryopteris stewartii Fress										-	-	-	-	2.14	-
Aconitum laeve Royle										-	-	-	7.41	-	-
Aconitum violaceum Jacquem ex Stapf										3.00	-	27.73	-	-	-
Ranunculus laetus Wallich										9.44	5.37	9.98	-	-	-
Cotoneaster acuminatus Lindley	-	-	-	-	-	-	31.00	-	34.03						
Fragaria nubicola Lindley	-	4.07	11.48	14.25	9.47	13.60	-	13.65	-	25.40	5.12	-	-	-	-
Geum elatum Wall															
Potentilla eriocarpa Wallich										27.77	56.57	63.86	-	57.16	37.20
*Potentilla gelida C.A.*Meyar										23.24	-	-	-	-	-
Brunella vulgaris L.	-	-	-	-	-	-	17.82	-	-	-	-	-	-	-	-
Sibbaldea cuneata Hornum	-	-	-	-	-	6.28	-	47.94	72.82	-	-	-	-	-	-
Galium elegan Wall	-	-	-	7.34	7.94	4.81	-	-	-	-	-	-	-	-	-
Galium boreale L. Wall										-	-	-	1.65	15.54	4.99
Pedicularis pectinata Wallich.										16.48	10.86	-	80.41	1.81	-
Pedicularis siphonantha D.Don										-	-	-	14.36	-	-
Veronica melissaefolia Royle	-	-	-	-	9.49	-	-	4.19	-	-	-	-	-	-	-
Oenanthe Javanica (Blume) DC	-	-	-	-	-	-	14.65	-	-	-	-	-	-	-	-
Urtica dioica L.	-	-	-	-	-	13.89	-	-	-	-	-	-	-	-	-

Viola odorata L.	-	-	8.62	-	-	-	-	-	-	-	-	-	-	-	-
Viola serpen Wallich	-	-	-	-	-	9.25	-	-		-	-	-	-	-	-

Key: 1=*Themeda-Cyperus-Pinus* Community (TCP)
2=*Themeda-Pinus-Desmodium* Community (TPD)
3= *Andropogon-Pinus-Berberis* Community (APB)
4= *Pinus-Cyperus-Gerbera* Community (PCG)
5=*Abies-Pinus-Viburnum* Community (APV)
6=*Abies-Viburnum-Medicago* Community (AVM)
7=*Picea-Epilobium-Bromus* Community (PEB)
8=*Veronica-Sibbaldia-Poa* Community (VSP)
9= *Sibbaldia-Aster-Rumex* Community (SAR)
10=*Euphorbia-Phleum-Artemisia* Community (EPA)
11=*Potentilla-Geranium-Achillea* Community (PGA)
12= *Potentilla-Juniperus-Phleum* Community (PJP)
13= *Potentilla-Phleum-Achillea* Community (PPA)
14= *Potentilla-Androsace-Polygonum* Community (PAP)
15= *Polygonum-Phleum-Leontopodium* Community (PPL)

Appendix 3 . Classification of plants of Ganga Choti and Bedori Hills in various economics uses in the area.
Key: M= Medicinal, F= Forage/Fodder, FW= Fuel wood, TW= Timber wood,
VED/EF= Vegetable/Edible Fruit, P= Poisonous, RT= Roof Thatching, TD= Tannin/Dying,
RY= Resin Yielding, HT= Herbal Tea and ER= Evil Repellant

S. No	Species	M	F	FW	TW	Veg /EF	P	TD	RY	HT
1	*Abies pindrow* Royle	-	+	-	+	-	-	-	+	-
2	*Achillea millefolium* L.	+	+	-	-	-	-	-	-	-
3	*Aconitum chasmenthum* Stapf	+	-	-	-	-	+	-	-	-
4	*Aconitium laeve* Royle	+	-	-	-	-	+	-	-	-
5	*Aconitum violaceum Jacquem* Stapf	+	-	-	-	-	+	-	-	-
6	*Adiantum venustum* D.Don	+	-	-	-	-	-	-	-	-
7	*Adiantum capilus veneris* L.	+	+	-	-	-	-	-	-	-
8	*Agrostis alba auct*	-	+	+	-	-	-	-	-	-
9	*Agrostis canina* auct.	-	+	-	-	-	-	-	-	-
10	*Agrostis gigantea* Roth	-	+	-	-	-	-	-	-	-
11	*Ajuga bracteosa* Wallich	+	+	-	-	-	-	-	-	-
12	*Allium humile* Kunth	-	-	-	-	-	-	-	-	-
13	*Amaranthus viridus* L.	+	+	-	-	-	-	-	-	-
14	*Anaphalis margaritacea* (L.)Bth	-	-	-	-	-	-	-	-	-
15	*Anaphalis nepalensis* (Spreng.) Hand	-	-	-	-	-	-	-		-
16	*Anaphalis timmua* D. Don	-	-	-	-	-	-	-	-	
17	*Andropogon munroi* C.B.Clarke	-	+	-	-	-	--	-	-	-
18	*Androsace rotundifolia* Hardw	-	+	-	-	+	-	-	-	-

19	*Arenaria neel.* Wight Arn	-	+	-	-	-	-	-	-	-
20	*Arenaria orbiculata* Royle	-	+	-	-	-	-	-	-	-
21	*Arisaema intermedium* Blume	+	-	-	-	-	+	-	-	-
22	*Arisaema jacquemontii* Blume	+	-	-	-	-	+	-	-	-
24	*Artemisia wallichiana* Besser	+	+	-	-	-	-	-	-	-
25	*Artemisa scoparia* Waldst and Kit	+	+	-	-	-	-	-	-	-
26	*Artemisia herba- alba* Asso.	+	+	-	-	-	-	-	-	-
27	*Arundo donax* L.	-	+	+	-	-	-	-	-	-
28	*Asplenium adiantum nigrum* L.	-	+	-	-	-	-	-	-	-
29	*Aster alpinus*(Clarke) Hutch	+	-	-	-	-	-	-	-	-
30	*Astragalus floridus* L	+	+	-	-	-	-	-	-	-
31	*Athyrium mackinnoni* (Hope) C. Chr	-	+	-	-	-	-	-	-	-
32	*Avena barbata* Pott ex Link	-	+	-	-	-	-	-	-	-
33	*Berberis lycium* Royle	+	+	-	+	+	-	-	-	-
34	*Bergenia ciliata* (Haw) Sternb	+	+	-	-	-	-	-	-	-
35	*Bergenia ligulata* (Str) Hot	+	+	-	-	-	-	-	-	-
36	*Biden bipinnata* L.	-	+	-	-	-	-	-	-	-
37	*Bistorta amplexicaulis*(D.Don) Greene	-	+	-	-	-	-	-	-	-
38	*Brachiaria ramosa* (L) Stapf	-	+	-	-	-	-	-	-	-
39	*Bromus tectorum* L.	-	+	-	-	-	-	-	-	-
40	*Brunella vulgaris.*L	-	+	-	-	-	-	-	-	-
41	*Bupleurum longicaule* Wall Ex DC	-	-	-	-	-	-	-	-	-
42	*Calamintha umbros* (M.Bieb)K.koch	+	-	-	-	-	-	-	-	-
43	*Caltha palustris* L.	-	+	-	-	-	-	-	-	-
44	*Cannabis sativa* L.	+	-	-	-	-	-	-	-	-
45	*Cenchrus biflorus* Roxb	-	+	-	-	-	-	-	-	-
46	*Cenchrus uniflorus* Ehr	-	+	-	-	-	-	-	-	-
47	*Chenopodium ambrosides* L.	-	+	-	-	-	-	-	-	-
48	*Chrysopogon aucheri* (Boiss) Stapf	-	+	-	-	-	-	-	-	-
49	*Circaea alpina* Asch&Mag	-	-	-	-	-	-	-	-	-
50	*Circium arvense* (L).Scope	-	+	-	-	-	-	-	-	-
51	*Clematis grata* Wallich	-	-	-	-	-	-	-	-	-

52	*Clinopodium alpinum* Cass	-	+	-	-	-	-	-	-	-
53	*Codonopsis ovata* Bth	+	-	-	-	-	+	-	-	-
54	*Convolvulus arvensis* *Var.linearifolius* Choisy	+	+	-	-	-	-	--	+	-
55	*Conyza canadensis* L.	-	-	-	-	-	-	-	-	-
56	*Cotoneaster acuminatus* Lindley	-	-	+	-	-	-	-	-	-
57	*Cynodon dactylon* (L.) Pers	+	+	-	-	-	-	-	-	-
58	*Cynoglossum lanceolatum* Forssk	-	+	-	-	-	-		-	-
59	*Cynoglossum* wallichii G.Don.	-	+	-	-	-	-	-	-	-
60	*Cyperus niveus* Retz	+	+	-	-	-	-	-	-	-
61	*Cyperus panicoides* L.	+	+	-	-	-	-	-	-	-
62	*Cypripedium cordigerum* D.Don. Prod.	-	+	-	-	-	-	-	-	-
63	*Cystopteris fragilis* (L) Bth	-	-	-	-	-	-	-	-	-
64	*Dactylis glomerata* L.	-	+	-	-	-	-	-	-	-
65	*Desmodium multiflorum* DC	-	+	-	-	-		-	-	-
66	*Desmostachya bipinnata* (L) Stapf	-	+	-	-	-	-	-		-
67	*Dichanthium annulatum* (Forssk).Stapf	-	+	-	-	-	-		-	-
68	*Dipsacus inermis* Wall	-	+	-	-	-	-	-	-	-
69	*Dryopteris stewartii* Fress	-	+	-	-	-	-	-	-	
70	*Elsholtzia strobilifera* Bth	-	+	-	-	-	-	-	-	
71	*Elymus repens* L.Gould	-	+	-	-	-	-	-		-
72	*Epilobium cylindricum* D.Don	-	+	-	-	-	-	-	-	-
73	*Epilobium hirsutum* L.	-	+	-	-	-	-		-	-
74	*Erigeron alpinus* L.	-	+	-	-	-	-	-	-	--
75	*Erigeron bellidioides* Buch	-	+	-	-	-	-	-	-	-
76	*Euphorbia helioscopia* L.	+	-	-	-	-	+	-	-	-
77	*Euphorbia wallichii* H.K.f	+	-	-	-	-	+	-	-	-
78	*Eurphobia prostrata* Ait	+	-	-	-	-	+	-	-	-
79	*Festuca modesta* Nees	-	+	-	-	-	-	-	-	-
80	*Ficus palmata* Forssk	+	+	+	+	-	-	+	-	-
81	*Fragaria nubicola* Lindl	+	+	-	-	+	-	-	-	-
82	*Fritillaria roylei* Hook.	+	+	-	-	-	-	-	-	-

83	*Gallium elegan* Wall	+	+	-	-	-	-	-	-	-
84	*Gentiana cachmerica* DC	-	+	-	-	-	-	-	-	-
85	*Gentiana decumbens* L.P Clarke	-	+	-	-	-	-	-	-	-
86	*Gentiana kurroo* Royle	-	+	-	-	-	-	-	-	-
87	*Geranium rotundifolium* L.	+	+	-	-	-	-	-	-	-
88	*Geranium wallichianum* D.Don	+	+	-	-	-	-	-	-	-
89	*Gerbera gossypina* Royle	-	+	-	-	-	-	-	-	-
90	*Geum elatum* Wall	-	+	-	-	-	-	-	-	-
91	*Hedra helix Auct*	-	-	-	-	-	-	-	-	-
92	*Impatiens edgeworthii* H.K.f	-	+	-	-	-	-	-	-	-
93	*Impatiens glandulifera* Royle	-	+	-	-	+	-	-	-	-
94	*Imperata cylindrica* (L) *Raeuschel*	-	+	-	-	-	-	-	-	-
95	*Indigofera heterantha* Wall	+	+	-	-	-	-	-	-	-
96	*Ipomoea perforatum* L.	+	+	-	-	+	-	-	-	-
97	*Iris lactea* L.	-	-	-	-	-	-	-	-	
98	*Jasminum officinale* L.	-	+	-	-	-	-	-	-	-
99	*Juniperus communis* L.	+	-	-	-	+	-	-	-	-
100	*Koeleria macrantha* (Ledb) Schult	-	+	-	-	-	-	-	-	-
101	*Lactuca dissecta* L.	+	+	-	-	+	-	-	-	-
102	*Lavaetra cachmiriana* Camb	-	-	-	-	-	-	-	-	-
103	*Leontopodium alpinum* Cass	-	+	-	-	+	-	-	-	-
104	*Lepidium sativum* L.	-	+	-	-	-	-	-	-	-
105	*Lespedeza sericea* (Thunb) Miq	-	+	-	-	-	-	-	-	-
106	*Machilus odoratissima* Nees.	-	+	-	-	-	-	-	-	-
107	*Malva sylvestris* L.	+	+	-	-	+	-	-	-	-
108	*Malva verticillata* L.	+	+			+				
109	*Medicago falcata* L.	-	+-	-	-	-	-	-	-	-
110	*Medicago leciniata* (L) Mill	-	+	-	-	-	-	-		-
111	*Melilotus indica* (L) All	-	+	-	-	-	-	-	-	
112	*Menta longifolia* (L)Hudson	+	+	-	-	-	-	-	-	-
113	*Micromeria biflora* (Ham) Bth	-	+	-	-	-	-	-	-	-
114	*Minuartia kashmirica* (Edgew) Mattf	-	-	-	-	-	-	-	-	-
115	*Morina coulteriana* Royle	-	-	-	-	-	-	-	-	-

116	*Myriactus nepalensis* Bth	-	-	-	-	-	-	-	-	-
117	*Myrsine africana* L.	-	+	-	-	-	-	-	-	-
118	*Nepeta podostachys* Bth	-	-	-	-	-	-	-	-	-
119	*Oenanthe javanica* (Blume) DC									
120	*Oenothera rosea* (L).Her	-	+	-	-	-	-	-	-	-
121	*Onychium japonicum* (Kunze) Wall	-	+	-	-	-	-	-	-	-
122	*Oxalis corniculata* L.	+	-	-	-	+	+	-	-	-
123	*Phalaris minor* Retz	-	+	-	-	-	-	-	-	-
124	*Phlomis bracteosa* Royle ex Bth									
125	*Phleum alpinum* L.	-	+	-	-	-	-	-	-	-
126	*Picea smithiana*(Wallich) Bois	-	-	+	+	-	-	-	-	-
127	*Pinus roxburghii* sargent	-	-	+	+	-	-	-	+	-
128	*Pinus wallichiana* A.B.Jackson	-	-	+	+	-	-	-	+	-
129	*Plantago lanceolata* L.	+	+	-	-	-	-	-	-	-
130	*Plantago major* L	+	+	-	-	-	-	-	-	-
131	*Plantago ovata* Forssk	+	+	-	-	-	-	-	-	-
132	*Plectranthus rugosus* Wall	-	-	-	-	-	-	-	-	-
133	*Pleurospermun govanianum* (DC) Clarke	-	-	-	-	-	-	-	-	-
134	*Poa annua* L.	-	+	-	-	-	-	-	-	-
135	*Poa bactriana* Rozhev	-	+	-	-	-	-	-	-	-
136	*Poa infirma* H.Bk	-	+	-	-	-	-	-	-	-
137	*Podophyllum hexandrum* Royle	+	+	-	-	-	+	-	-	-
138	*Polygonum album* Ham	+	+	-	-	-	-	+	-	-
139	*Polygonum amplexicaulis* D.Don	+	+	-	-	+	-	+	-	-
140	*Polygonum alpinum* All.	+	+	-	-	-	-	+	-	-
141	*Polypogon monspeliensis* (L.Desf)	-	+	-	-	-	-	-	-	-
142	*Potentilla cuneata* Wallich	+	-	-	-	-	-	-	-	-
143	*Potentilla eriocarpa* Wallich	+	-	-	-	-	-	-	-	-
144	*Potentilla gelida* C.A. Meyer	+	-	-	-	-	-	-	-	-
145	*Potentilla geradiana* L.	+	-	-	-	-	-	-	-	-
146	*Primula denticulata* Smith	-	+	-	-	-	-	-	-	-
147	*Pseudomertensia echioides* (Bth)									

	Riedl									
148	*Pteris cretica* L.	-	+							
149	*Pteris vitata* L.	-	+							
150	*Punica granatum* L.	-	-	+	-	+	-	-	-	-
151	*Pyrus pashia* Buch	+	-	-	-	-	-	-	-	-
152	*Quercus dilatata* Royle	-	-	-	-	-	--	-	-	-
153	*Ranunculus repens* L.	+	+	-	-	-	-	-	+	-
154	*Ranunculus laetus* Wallich	+	+	-	-	-	-	-	-	-
155	*Rosa ellipticus* Smith	+	+	-	-	-	-	-	-	-
156	*Rosa macrophylla* Lindley	+	+	-	-	-	-	-	-	-
157	*Rosa webbiana* Wallich ex Royle	+	+	-	-	-	-	-	-	-
158	*Rubia tinctorum* L.	+	+	-	-	-	-	+	-	-
159	*Rubus niveus* Wallich	-	-	-	-	-	-	-	-	-
160	*Rumex hastatus* D. Don	-	+	-	-	-	-	-	-	-
161	*Rumex dentatus* L.	-	+	-	-	-	-	+	-	-
162	*Rumex nepalensis* D.Don	+	+	-	-	-	-	-	-	-
163	*Saccharum spontaneum* L.	-	+	-	-	-	-	-	-	-
164	*Salix albeda* Anderson.	-	-	-	-	-	-	-	-	-
165	*Salix denticulata* Anderson	+	-	-	-	-	-	-	-	-
166	*Salix grandiflorum* L.	+	+	-	-	-	-	-	-	-
167	*Saussurea lappa* Clark	+	+	-	-	-	-	-	-	-
168	*Saxifraga ciliata* Royle	+	+	-	-	-	-	-	-	-
169	*Scutellaria chamaedrifolea* Bth	-	-	-	-	-	-	-	-	-
170	*Senecio ligularia* Hook	+	-	-	-	-	-	-	-	+
171	*Senecio chrysanthemoides* DC	+	-	-	-	-	-	-	-	+
172	*Senecio graciliforus* DC	+	-	-	-	-	-	-	-	+
173	*Senecio nudicaulis* DC	+	-	-	-	-	-	-	-	+
174	*Senecio quadriflorum* Pall	+	-	-	-	-	-	-	-	+
175	*Selinum teniufolium* Wall	-	-	-	-	-	-	-	-	-
176	*Sibbaldia cuneata* Hornum	-	-	-	-	-	-	-	+	+
177	*Solanum nigrum* L.	+	+	-	-	+	-	-	-	-
178	*Sonchus arvense L.*	+	+	-	-	-	-	-	-	-
179	*Sonchus asper* Hill	+	+	-	-	-	-	-	-	-

180	*Sorghum halepense* (L)Pers	-	+	-	-	-	-	-	-	-
181	*Spiraea canescens* D.Don	-	+	-	-	-	-	-	-	-
182	*Stellaria media* (L) Vill	-	+	-	-	+	-	-	-	-
183	*Stellaria monosperma* Buch	-	+	-	-	+	-	-	-	-
184	*Strobilanthes attenuata* Nees	+	-	-	-	-	-	-	-	-
185	*Swertia petiolata* D.Don	-	-	-	-	-	-	-	-	-
186	*Tagetes minuta* L.	-	-	-	-	-	-	-	-	-
187	*Taraxacum officinales* Weber	+	+	-	-	+	-	-	-	-
188	*Themeda anathera* Ness ex Steud	-	+	-	-	-	-	-	-	-
189	*Thymus serphyllum* L.	+	+	-	-	-	-	-	-	-
190	*Trifolium repens* L.	-	+	-	-	-	-	-	-	-
191	*Trifolium resupinatum* L	-	+	-	-	-	-	+	-	-
192	*Urtica dioica* L.	+	-	-	+	-	+	-	-	+
193	*Valeriana pyrolifolia* Decne	+	-	-	-	-	-	-	-	-
194	*Veronica melissaefolia* Royle	+	+	-	-	+	-	-	-	-
195	*Viburnum grandiflorum* Wallich ex DC.	+	+	-	-	+	-	-	-	-
196	*Viola odorata* L.	+	+	-	-	-	-	-	-	-
197	*Viola serpen* Wallich	+	+	-	-	-	-	-	-	-
198	*Zanthoxylum armatum* DC	+	+	+	-	-	-	-	-	-
		83	134	15	04	20	12	07	06	07

Appendix 4. Classification of plants of Ganga Chotti and Bedori Hills on the basis of their palatability, part used condition of freshness/ dryness and livestock during 1999-2000.

		Palatability Class						Parts used			Condition			Livestock		
	Species	Np	P	H	M	L	R	W	L	I	F	D	B	C	G	S
S.No	Tree															
1	*Abies pindrow* Royle	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	*Ficus palmata* Forssk	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+
3	*Picea smithiana* (Wallich) Bois	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	*Pinus roxburghii* Sargent	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	*Pinus wallichiana* A.B.Jackson	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	*Punica granatum* L.	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-
7	*Pyrus pashia* Buch	-	+	+	-	-	-	-	+	+	+	-	-	+	+	+
8	*Quercus dilatata* Lind	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
9	*Machilus odoratissima* Nees	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	*Astragalus floridus* L	-	+	-	-	+	-	-	+	-	-	+	-	-	+	+
	Shrub															
11	*Berberis lycium* Royle	-	+	-	+	-	-	-	+	+	+	-	-	-	+	-
12	*Cotoneaster acuminatus* Lindley	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	*Desmodium multiflorum* DC	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
14	*Indigofera heterantha* Wall	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
15	*Jasminum officinale* L.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
16	*Juniperus communis* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+
17	*Myrsine africana* L.	-	+	-	-	-	-	-	+	-	+	-	-	-	+	-
18	*Rosa macrophylla* Lindley	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-
19	*Rosa webbiana* Wallich ex Royle	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-
20	*Rubus fruticosus* Wallich	-	+	-	+	-	-	-	+	-	+	-	-	+	+	-
21	*Salix denticulata* Anderson	-	+	-	-	-	+	-	+	-	+	-	-	+	+	-
22	*Salix grandiflorum* L.	-	+	-	-	+	-	-	+	+	+	-	-	+	+	+

23	*Sarcococca saligna* (D.Don) Muel	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	*Viburnum grandiflorum* Wallich ex DC	-	+	-	-	-	+	-	+	+	-	-	-	+	+	+
25	*Zanthoxylum armatum* DC	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-
	Herb Layer															
26	*Achillea millefolium* L.Yarrow	-	+	-	+	-	-	+	-	-	+	-	-	+	+	-
27	*Aconitum chasmenthum* Stapf	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	*Aconitium laeve* Royle	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	*Aconitum violaceum* Jacquem	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	*Ajuga bracteosa* Wallich	-	+	-	-	+	-	+	-	-	+	-	-	-	+	-
31	*Allium humile* Kunth	-	+	-	-	-	-	+	+	+	+	+	+	+	+	+
32	*Amaranthus viridus* L.	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-
33	*Anaphalis margaritacea* (L) Bth	-	+	-	-	-	+	-	+	-	+	-	-	+	-	+
34	*Anaphalis nepalensis* (Spreng) Hand	-	+	-	-	+	-	-	+	+	+	-	-	-	+	+
35	*Anaphalis timmua* D.Don	-	+	-	-	-	+	-	+	+	+	-	-	-	+	+
36	*Androsace rotundifolia* Hardw	-	+	-	-	-	+	+	-	-	+	-	-	-	+	-
37	*Aquilegia pubiflora* Wallich	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	*Arenaria neel* Wight & Arn	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	*Arenaria orbiculata* Royle	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	*Arisaema intermedium* Blume	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	*Arisaema jacquemontii* Blume	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	*Artemisia wallichiana* Besser	-	+	-	-	+	+	+	+	+	-	-	-	-	+	-
43	*Artemisia scoparia* Waldst and Kit	-	+	-	-	-	+	-	+	-	+	-	-	+	+	+
44	*Artemisia herba* alba Asso	-	+	-	+	-	-	+	+	+	-	+	+	+	+	+
45	*Aster alpinus* (Clarke) Hutch	-	+	-	-	-	+	-	+	+	+	-	-	-	+	-
46	*Bergenia ciliata* (Haw) Sternb	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47	*Bergenia ligulata* (Str) Hot	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	*Biden bipinnata* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	*Bistorta amplexicaulis* (D.Don) Greene	-	+	-	-	+	-	-	+	+	-	-	+	+	+	-

50	*Brunella vulgaris*.L	-	+	-	+	-	-	-	+	+	+	-	-	-	+	-
51	*Bupleurum longicaule* Wall Ex DC	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-
52	*Calamintha umbrosum* (M.Bieb) K.Koch	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	*Caltha palustris* L.	-	+	-	-	-	+	-	+	-	+	-	-	+	-	+
54	*Cannabis sativa* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	*Chenopodium umbrosum* M.(Bich). K.bich	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-
56	*Circaea alpina* Asch&Mag	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	*Circium arvense* (L).Scop	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	*Clematis grata* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	*Clinopodium alpinum* Cass	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	*Codonopsis ovata* Bth	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	*Convolvulus arvensis* Var. linerarifolius Choisy	-	+	+	-	-	-	+	-	-	+	-	-	+	+	+
62	*Conyza canadensis* L.	-	+	-	+	-	-	-	+	+	+	-	-	+	+	-
63	*Cotoneaster acuminatus* Lindley	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	*Cynoglossum lanceolatum* Forssk	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	*Cynoglossum* glochidiatum. Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	*Cyperus niveus* Retz	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+
67	*Cyperus panicoides* L.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+
68	*Cypripedium cordigerum* D.Don.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	*Dipsacus inermis* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	*Elsholtzia strobilifera* Bth	-	+	-	-	+	-	-	+	-	-	+	-	-	-	+
71	*Epilobium cylindricum* D.Don	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-
72	*Epilobium hirsutum* L.	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-
73	*Erigeron alpinus* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	*Erigeron bellidioides* Buch	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	*Euphorbia helioscopia* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	*Euphorbia wallichii* H.K.f	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

77	*Eurphobia prostrata* Ait	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	*Fragaria nubicola* Lindl.	-	+	-	+	-	-	+	-	-	-	+	-	+	+	+
79	*Fritillaria roylei* H.K.f	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	*Gallium elegan* Wall	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
81	*Gentiana cachmerica* DC	-	+	-	-	-	+	-	+	-	+	-	-	-	-	+
82	*Gentiana decumbens* L.P Clarke	-	+	-	-	-	+	-	+	-	+	-	-	-	-	+
83	*Gentiana kurroo* Royle	-	+	-	-	-	+	-	+	-	+	-	-	-	-	+
84	*Geranium rotundifolium* L.	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
85	*Geranium wallichianum* D.Don	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
86	*Gerbera gossypina* Royle	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87	*Geum elatum* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
88	*Hedra nepalensis* K.koch	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
89	*Impatiens edgeworthii* H.K.f	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+
90	*Impatiens glandulifera* Royle	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+
91	*Ipomoea perforatum* L.	-	+	-	-	+	-	-	+	-	-	+	-	-	+	+
92	*Iris lactea* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
93	*Lactuca dissecta* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
94	*Lavaetra cachemiriana* Camb	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95	*Leontopodium alpinum* Cass	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
96	*Lepidium sativum* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97	*Lespedeza sericea* (Thunb) Miq	-	+	-	-	+	-	-	+	-	-	-	-	-	-	+
98	*Malva sylvestris* L.	-	+	-	-	+	-	-	+	+	+	-	-	-	+	-
99	*Malva verticillata* L.	-	+	-	-	+	-	-	+	+	+	-	-	-	+	-
100	*Medicago falcata* L.	-	+	-	-	-	-	+	+	+	+	+	+	+	+	+
101	*Medicago leciniata* (L) Mill	-	+	-	+	-	-	-	+	+	+	+	+	+	+	+
102	*Melilotus indica* (L) All	-	+	-	+	-	-	-	+	+	+	+	+	+	+	+
103	*Mentha longifolia* (L)Hudson	-	+	-	-	-	+	+	-	-	+	+	+	-	+	-
104	*Micromeria biflora* (Ham) Bth	-	+	+	-	-	-	+	-	-	+	+	+	-	+	+
105	*Minuartia kashmirica* (Edgew) Mattf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

106	*Morina coulteriana* Royle	-	+	-	-	+	-	-	+	+	-	-	-	+	+	+
107	*Myriactus nepalensis* Bth	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
108	*Nepeta podostachys* Bth	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
109	*Oenanthe javanica* (Blume) DC	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
110	*Oenothera rosea* (L).Her	-	+	-	+	-	-	+	-	-	+	-	-	+	-	-
111	*Oxalis corniculata* L.	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
112	*Phlomis bracteosa* Royle ex Bth	-	+	-	-	+	-	-	+	-	+	-	-	+	+	+
113	*Plantago lanceolata* L.	-	+	-	-	-	+	-	+	+	+	-	-	+	+	-
114	*Plantago major* L.	-	+	-	-	-	+	-	+	+	+	-	-	+	+	-
115	*Plantago ovata* Forssk	-	+	-	-	-	+	-	+	+	+	-	-	+	+	-
116	*Plectranthus rugosus* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
117	*Pleurospermum govanianum* (DC) Clarke	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118	*Podophyllum emodi* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119	*Polygonum album* Ham	-	+	-	+	-	-	-	+	-	+	-	-	+	+	+
120	*Polygonum amplexicaulis* D.Don Green	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
121	*Polygonum monspeliensis* (L).	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
122	*Potentilla cuneata* Wallich	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
123	*Potentilla eriocarpa* Wallich	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
124	*Potentilla gelida* C.A. Meyer	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
125	*Potentilla geradiana* L.	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-
126	*Primula denticulata* Smith	-	+	-	+	-	-	-	+	+	+	-	-	+	+	+
127	*Pseudomertensia echioides* (Bth) Riedl	-	+	-	-	-	+	+	+	-	-	-	-	-	-	+
128	*Pseudomertensia moltkioides* (Royle) Kazmi	-	+	-	-	-	+	+	+	-	-	-	-	-	-	+
129	*Ranunculus repens* L.	-	+	-	-	-	+	+	-	-	+	-	-	+	+	-
130	*Ranunculus laetus* Wallich	-	+	-	-	-	+	+	-	-	+	-	-	+	+	-
131	*Rubia tinctorum* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

132	*Rumex hastatus* D. Don	-	+	-	-	+	-	+	-	-	+	-	-	+	+	-
133	*Rumex dentatus* L.	-	+	-	-	-	+	-	+	-	+	-	-	+	+	-
134	*Rumex nepalensis* D.Don	-	+	-	-	+	-	+	-	-	+	-	-	+	+	-
135	*Saussurea lappa* Clark	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
136	*Saxifraga moorcroftiana* Sternb	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-
137	*Scutellaria chamaedrifolea* Bth	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
138	*Senecio ligularia* Hook	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
139	*Senecio chrysanthemoides* DC	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
140	*Senecio graciliflorus* DC	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141	*Senecio nudicaulis* DC	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
142	*Senecio quadriflorum* Pall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
143	*Selinum tenifolium* Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
144	*Sibbaldia cuneata* Hornum	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+
145	*Solanum nigrum* L.	-	+	-	-	+	-	+	-	-	+	-	-	-	-	+
146	*Sonchus arvense* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
147	*Sonchus asper* Hill	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
148	*Spiraea canescens* D.Don	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
149	*Stellaria media* (L) Vill	-	+	-	+	-	-	-	-	+	-	-	-	-	-	-
150	*Stellaria monosperma* Buch	-	+	-	+	-	-	-	-	+	-	-	-	-	-	-
151	*Strobilanthes attenuata* Nees	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
152	*Swertia petiolata* D.Don	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
153	*Tagetes minuta* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
154	*Taraxacum officinales* Weber	-	+	-	+	-	-	+	-	-	+	-	-	+	+	-
155	*Thlaspi arvense* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
156	*Thymus serphyllum* L.	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-
157	*Trifolium repens* L.	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
158	*Trifolium resupinatum* L.	-	+	-	+	-	-	+	-	-	+	+	+	+	+	+
159	*Trillidium repen* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	*Trillidium govanianum*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	(D.Don)Kunth															
161	*Tussilogo farfara* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162	*Urtica dioica* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
163	*Valeriana pyrolifolia* DCNe	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
164	*Verbascum thapsus* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
165	*Veronica melissaefolia* Royle	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
166	*Viola odorata* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
167	*Viola serpen* Wallich	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Grasses															
168	*Agrostis alba* auct	-	+	-	+	-	-	-	+	+	+	-	-	+	+	-
169	*Agrostis canina* auct.	-	+	-	+	-	-	-	+	+	+	-	-	+	+	-
170	*Agrostis gigantea* Roth	-	+	-	-	+	-	-	+	-	+	-	-	+	+	-
171	*Andropogon munroi* C.B. Clarke	-	+	-	-	+	-	-	+	-	-	-	-	+	-	-
172	*Arundo donax* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
173	*Avena barbata* Pott ex Link	-	+	-	+	-	-	-	+	-	+	-	-	+	+	+
174	*Brachiaria ramosa* (L) Stapf	-	+	-	-	+	-	-	+	-	+	-	-	+	-	-
175	*Bromus tectorum* L.	-	+	-	+	-	-	-	+	-	-	-	-	+	-	-
176	*Cenchrus biflorus* Roxb	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+
177	*Cenchrus uniflorus* Ehr	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+
178	*Chrysopogon aucheri* (Boiss) Stapf	-	+	-	-	-	+	-	+	+	+	-	-	-	+	+
179	*Cynodon dactylon* (L.) Pers	-	+	+	-	-	-	+	-	-	+	+	+	+	+	+
180	*Dactylis glomerata* L.	-	+	-	-	-	+	-	+	-	+	-	-	+	+	+
181	*Desmostachya bipinnata* (L) Stapf	-	+	-	-	+	-	-	+	-	+	-	-	+	-	-
182	*Dichanthium annulatum* (Forssk).Stapf	-	+	-	+	-	-	+	-	-	+	-	-	+	-	-
183	*Elymus repens* L.Gould	-	+	-	-	+	-	+	-	-	+	-	-	+	+	-
184	*Festuca modesta* Nees	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-
185	*Imperata cylindrica* (L) Raeuschel	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-
186	*Koeleria macrantha* (Ledb) Schult	-	+	+	-	+	-	-	-	+	-	+	-	-	+	-

187	*Phalaris minor* Retz	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	*Phleum alpinum* L.	-	+	+	-	-	+	-	-	+	-	-	-	-	-	+
189	*Poa annua* L.	-	+	+	-	-	-	+	-	-	+	+	+	+	+	+
190	*Poa bactriana* Rozhev	-	+	+	-	-	-	+	-	-	+	+	+	+	+	+
191	*Poa infirma* H.Bk	-	+	+	-	-	-	+	-	-	+	+	+	+	+	+
192	*Polypogon monspeliensis* (L)Desf	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193	*Sorghum halepense* (L) Pers	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	*Themeda anathera (*Ness ex Steud) Hack	-	+	+	-	-	-	-	-	+	+	+	+	+	-	-
195	*Urochloa panicoides* P.Beauv	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	*Vetiveria zizanioides* (L) Nash	-	+	-	-	+	-	+	-	+	-	-	-	-	+	+
	Ferns															
197	*Adiantum venustum* D. Don	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
198	*Adiantum capilus veneris* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
199	*Aspelenium adiantum* nigrum L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	*Athyrium mackinnoni* (Hope) C. Chr	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201	*Cystopteris fragilis* (L) Bth	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	*Dryopteris stewartii* Fress	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203	*Onychium japonicum* (Kunze) Wall	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	*Pteris cretica* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
205	*Pteris vitata* L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206	*Thelypteris levinger* Clark	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total															

Key Np=not palatable, P= palatable. H= highly palatable, M= most palatable,
L= less palatable. R= rarely palatable, W= whole plant, L= leaf, I= inflorescence,
F= freshness, D= dryness, B= both, C= cow, G= goat, S= sheep

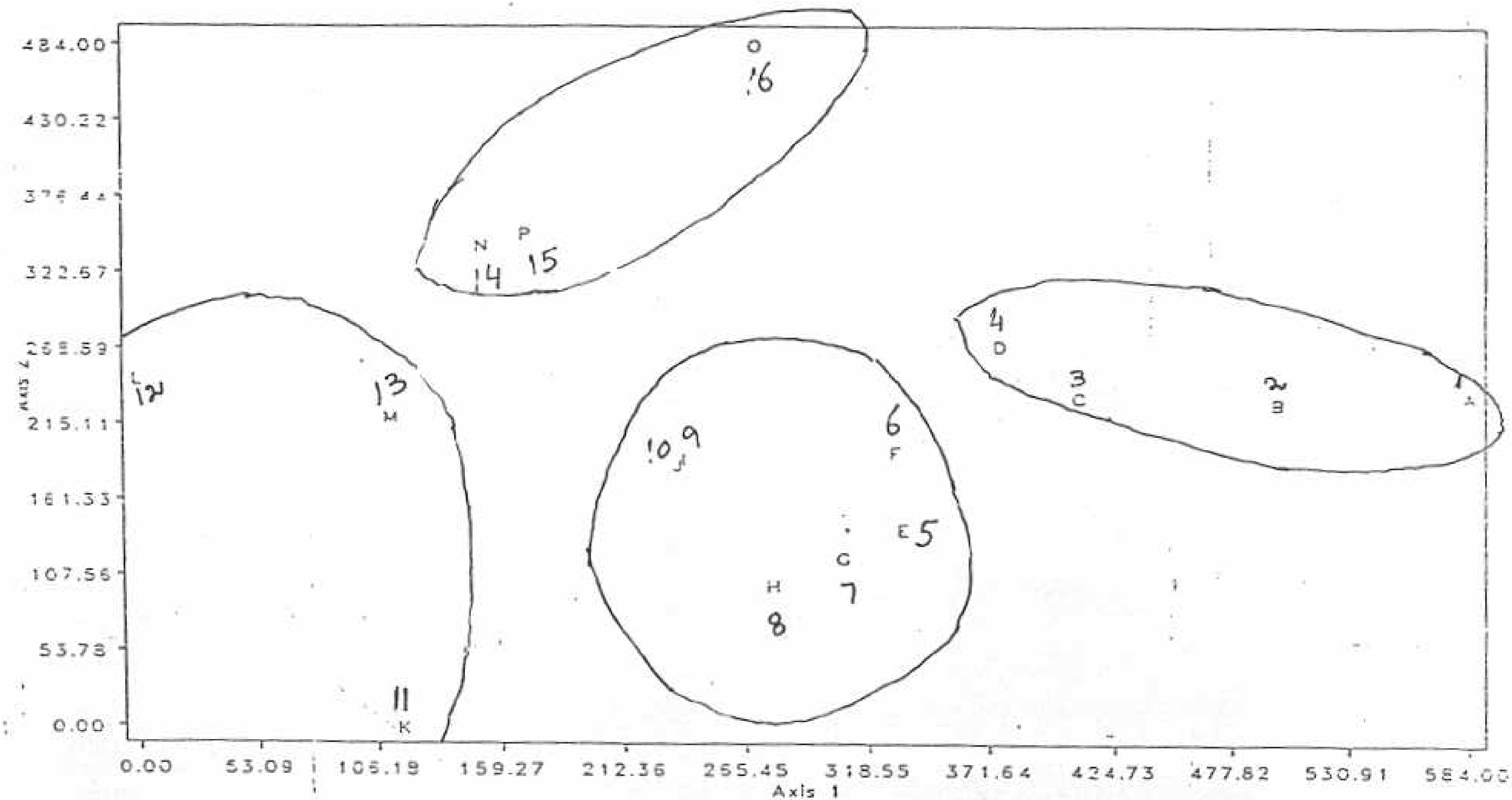


Fig- 5: DCA stand ordination of qualitative data of Ganga and Bedori Hill.

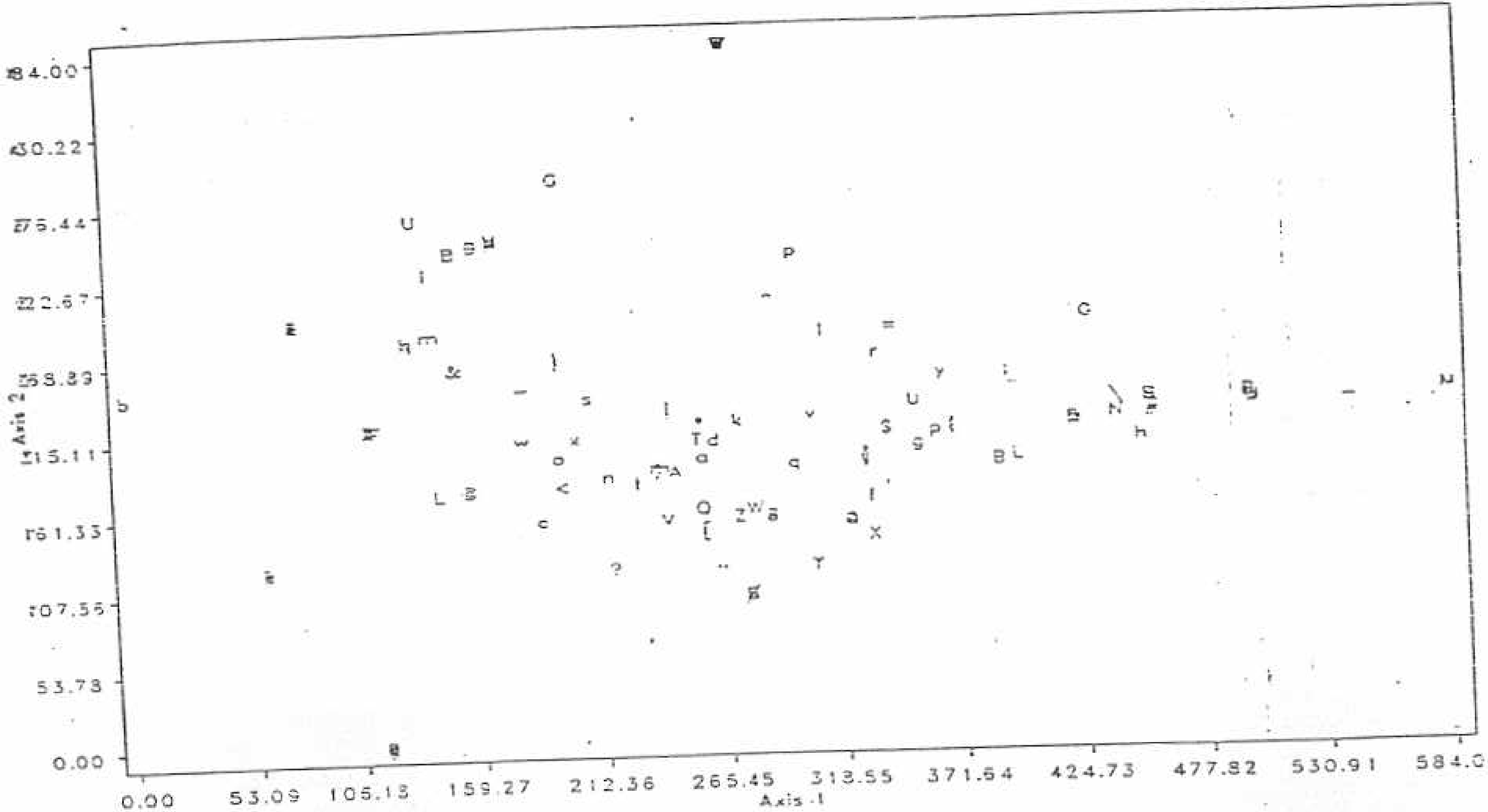
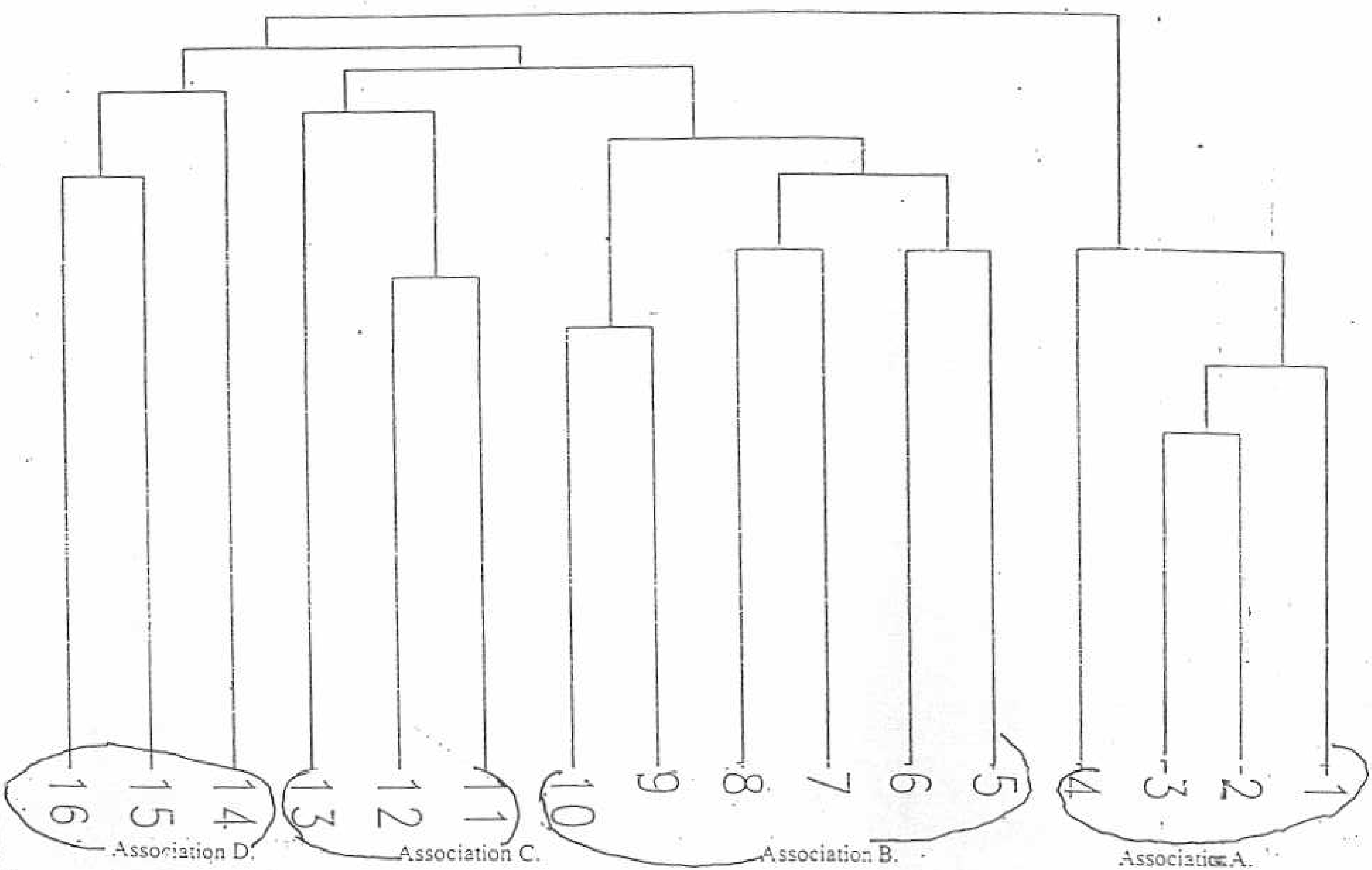


Fig- 6. DetrendaCorrespondence Analysis, species of the Qualitative data of Ganga Chotti and Bedori Hill.



Appendix 7: Cluster Analysis of Vegetation recorded from Ganga Chotti and Bedori Hills.

Fig 5- DETRENDED CORRESPONDENCE ANALYSIS

AXIS	EIGEN VALUE	PERCENT OF TOTAL	EIGEN VALUE PERCENT
1	0.616	15.40	15.40
2	0.405	10.12	25.52
3	0.257	6.43	31.95
4	0.206	5.14	37.10

Correlation (Pearson)

	Axis 1	Axis 2	Alt	pH	Ec	No3	P	K
Axis 2	-0.019							
Alt	-0.888	-0.301						
pH	0.729	-0.135	-0.533					
Ec	-0.405	-0.526	0.521	-0.206				
No3	-0.556	-0.720	0.694	-0.320	0.703			
P	-0.157	-0.174	0.388	0.310	0.380	0.235		
K	-0.152	0.135	0.004	-0.159	0.390	0.182	-0.093	
TSS	-0.502	-0.448	0.589	-0.266	0.988	0.697	0.390	0.410

Key. Alt= Altitude Ec= Electrical conductivity, p= Phosphorus, K= Potassium, TSS=Total soluble salts

Species Score DCA Axis 1-4

Plotaxis Stand	Axis 1	Axis 2	Axis 3	Axis 4
A	504	237	211	235
B	500	231	298	205
C	410	235	180	147
D	378	272	143	112
E	334	141	277	46
F	331	196	251	220
G	308	121	205	39
H	278	101	235	260
I	239	191	129	407
J	236	187	196	297
K	118	0	119	130
L	0	248	152	228
M	113	221	432	209
N	152	343	0	136
O	272	484	285	257
P	171	351	247	0

Key. A-D = Woodland Temperate Association, E-J= Woodland Alpine Association K-M= Shrubland Alpine Association, N-P= Alpine Grassland Association.