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RESEARCH ARTICLE

VEGETATIONAL DIVERSITY ALONG ALTITUDINAL GRADIENTS IN THE UPPER YAMUNA FOREST DIVISION OF UTTARAKHAND, INDIA

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ABSTRACT

The present paper deals with the study conducted in the Upper Yamuna Forest Division of Uttarkashi district in Uttarakhand, India. The different altitudinal ranges varied from 1000-1500m, 1500-2000m, 2000-2500m were covered in this study. A total of 40 common tree species were recorded in 1000 to 1500m of elevation covering 26 families, 26 species in 1500 to 2000m covering 20 families and 14 common tree species in 2000 to 2500m of elevation belonging to 10 families. The decreasing trend of tree species was recorded from lower to higher elevation. The 19 herbs and 21 shrubs species reported in 1000 to 1500m elevation belonging 24 families, 7 herbs and 5 shrubs were observed in the elevation 1500 to 2000m in 11 families and 14 common herbs and 9 shrubs comprising 15 families were recorded in 2000 to 2500m of elevation. The herbal population increased as compare to shrub population from lower to higher elevation.

Key words: Altitudinal gradient, Tree, Shrub, Herb, Floral diversity, Garhwal Himalaya.

INTRODUCTION

Garhwal Himalaya has been centre for ecological investigation from time immemorial. The series of studies have been described the vegetation of Garhwal Himalaya (Kumar and Bhatt, 2006; Nautiyal *et al.*, 2004). It is complex in nature, structure, composition and differs from place to place. Species diversity and its distribution along the altitudinal ranges had been a subject of ecosystem (Hubbell *et al.*, 1999). Variation in forest tree species along the altitudinal gradient is also a major topic for the ecological exploration. Hilly ecosystems around the globe have distinct floral and faunal communities and high level of diversity due to the variation in climatic conditions (Gentry, 1993). Hence these changes in biological diversity are also indicates the changes in soil conditions and other climatic factors. Plant community of a region is a function of time as it is affected by the rainfall, temperature, humidity, slope, altitude and aspect at a given time. All these abiotic factors play an important role in the formation of plant community and their composition and to reach a plant species in climax condition (Kharkwal *et al.*, 2005).

Forest is most valuable gift by the nature to us which fulfils the human requirement in the form of food, fuel, fodder, timber, resin, oil, medicines etc. Though the studies on change of vegetation along altitudinal gradient have been conducted by many scientists in the Garhwal Himalayan region (Saxena *et al.*, 1985; Adhikari *et al.*, 1992) the Present study particularly focuses on Upper Yamuna forest

division of Uttarakhand, India. Moreover the documentation of existing vegetation with their diversity along altitudinal gradient is essentially required to estimate the depletion of forest vegetation in future prospect (Singh *et al.*, 2011). The studies conducted on these aspects revealed that vegetation cover is greatly influenced by the geology of that area then that of altitudinal gradient and other environmental conditions (Puri *et al.*, 1983). No such studies have been conducted in the Upper Yamuna forest division so far therefore, this study was planned to identify the change in vegetation diversity and plant species along the altitudinal gradient in upper Yamuna forest division in Uttarakhand region of India.

MATERIALS AND METHODS

The present study was carried out in the Upper Yamuna Forest Division including Badkot region of Uttarkashi district of Uttarakhand, India. The different altitudinal ranges varied from 1000-1500m, 1500-2000m, 2000-2500m were covered in the study. The area basically represents four seasons namely cooled winter season from December to February, mild hot weather season from March to May, monsoon season from July to September and post monsoon season from October to November. The high Himalayan region of the study area is covered with snow cap during winter season. Rainfall is highly variable and largely depends upon the altitude. The major tree species in the area are chir pine in the lower elevation and devdar, fir and various Quercus species in the higher elevation, beyond this the alpine pastures are found. The area is rich in medicinal plants and herbs which are naturally found in the valley having great commercial value.

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In the present study the inventory of vegetation was made by randomly laying sample plots of 20 x 20 m during October and November, 2012. The number of sample plots varied according to size and variation existing in the strata. In each sample plot, the trees, shrubs and herbs were enumerated.

RESULTS AND DISCUSSION

In the present study Table 1 shows that a total of 40 common tree species were recorded in 1000 to 1500m of elevation covering 26 families. The maximum 5 number of species were recorded in moraceae family followed by 4 each in caesalpiniaceae and mimosaceae. In an elevation 1500 to 2000m, a total of 26 common tree species were reported covering 20 families (Table 2). Similarly 14 common tree species were reported in 2000 to 2500m of elevation belonging to 10 families (Table 3). The general trend seen that the number of tree species found to be decreased from lower elevation to the higher elevation. Some of the species are found commonly in all the altitudinal ranges. Most of the species are timber, fuel wood and fodder species and some are also the fruit species. It was noticed that the forest resources

are limited and their wide utilization is continuously increasing due to constantly increasing population pressure particularly upto 2000m of elevation. Forest vegetation along the Upper Yamuna Forest Division has importance for sustaining the livelihood of local peoples. In the lower elevation between 1000 to 1500m the *Pinus roxburghii* is a very common tree in the forest for timber and fuelwood purposes. The *Grewia optiva* and *Celtis australis* are common fodder providing tree species. As we reach to the altitudinal zone 1500 to 2000m there is occurrence of *Quercus leucotricophora* which is one of the multipurpose species and most important species for fuel, fodder and making agriculture implements. This species governs the hydrological cycle of the Garhwal Himalayan region, hence have got the soil binding property. The altitudinal zone of 1500 to 2000m is the initial belt for occurrence of the tree species like *Rhododendron arboreum* and *Cedrus deodara*. The higher altitude (2000 to 2500m) is mainly comprised of coniferous species like *Abies pindrow*, *Cedrus deodara* and *Picea smithiana*. The important broad leaved species of *Quercus floribunda* and *Quercus semicarpifolia* commonly known as moru and kharsu oak are also used for fuel and fodder purposes in this region.

Table 1: Tree species found in the altitudinal ranges between 1000-1500m

Sl. No.	Scientific Name	Local name	Family	Uses
1	<i>Acacia pseudoeburnea</i>	Pahadi Kikar	Mimosaceae	Medicinal, fodder
2	<i>Acacia catechu</i>	Khair	Mimosaceae	Catechu, Agriculture Implements, Medicinal, Fuel
3	<i>Acer oblongum</i>	Putli	Acereaceae	Agriculture Implements, Bio-fertilizer, Bee-forage
4	<i>Aegle marmelos</i>	Bel Patra	Rutaceae	Edible, Medicinal
5	<i>Albizia chinensis</i>	Black sirus	Mimosaceae	Fodder, Industrial, Fuel wood
6	<i>Albizia lebbeck</i>	Sirus	Mimosaceae	Timber, Fodder, Medicinal
7	<i>Alnus nepalensis</i>	Utis/Alder	Betulaceae	Fodder, Soil stabilization, Timber
8	<i>Bauhinia purpurea</i>	Guriyal	Caesalpiniaceae	Fodder, Vegetables
9	<i>Bauhinia semala</i>	Semal	Caesalpiniaceae	Fuel, Fodder, Timber
10	<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae	Fodder, Fibre, Vegetables, Agriculture implements
11	<i>Bombex ceiba</i>	Semal	Bombacaceae	Commercial, Vegetables, Match box
12	<i>Boehmeria regulosa</i>	Genthi	Utriculaceae	Fodder, Medicinal, Box making
13	<i>Casearia graveolens</i>	Chilla	Flacourtaceae	Fuel, Fodder, fruits used to poison fishes
14	<i>Casearia tomentosa</i>	Cheela	Flacourtaceae	Fuel, Fodder
15	<i>Cassia fistula</i>	Amaltash	Caesalpiniaceae	Medicinal, fuelwood
16	<i>Cassine glauca</i>	Dhebri	Celastraceae	Reddish coloured wood often used in cabinet work
17	<i>Castanopsis tribuloides</i>	Kataonj	Fagaceae	Edible, Construction
18	<i>Celtis australis</i>	Khadik	Ulmaceae	Fodder, Fuel
19	<i>Citrus aurantium</i>	Narangi	Rutaceae	Fruit, Medicinal
20	<i>Cocculus laurifoliosus</i>	Tilpharya	Menispermaceae	Fuel, Manure, Livestock medicine
21	<i>Cordia vestita</i>	Bairulu	Boraginaceae	Agriculture Implements, Edible, Fodder, Construction
22	<i>Ficus roxburghii</i>	Timla	Moraceae	Fuel, Fodder, Edible, Vegetables, leaves used in making Cup and plates
23	<i>Ficus hispida</i>	Tomila/Daduri	Moraceae	Fibre, Fodder, Edible
24	<i>Engelhardtia spicata</i>	Gadh-mauha	Jugalandaceae	Fuel, Medicinal
25	<i>Dalbergia sissoo</i>	Shisham	Fabaceae	Timber, Fodder, Insecticidal use
26	<i>Erythrina suberosa</i>	Dhaua dhak	Fabaceae	Insecticidal, Medicinal
27	<i>Emblica officinalis</i>	Amla	Euphorbiaceae	Edible, Medicinal
28	<i>Sapindus mukorossis</i>	Ritha	Sapindaceae	Soap making, bee-forage
29	<i>Ficus religiosa</i>	Pipal	Moraceae	Medicinal, Fodder, Industrial
30	<i>Ficus palmata</i>	Bedu/Anjir	Moraceae	Fruit, Fodder, Medicinal
31	<i>Grewia optiva</i>	Bhimal	Tiliaceae	Fodder, Fuel, Fibre, Edible
32	<i>Adina cordifolia</i>	Haldu	Rubiaceae	Fodder, Construction, Timber, Medicinal, Agriculture Implements, toys making
33	<i>Flacourtia indica</i>	Bilangra	Flacourtaceae	Edible, Fodder, Medicinal, Bee-forage
34	<i>Ficus rumpii</i>	Kobar	Moraceae	Fodder for cattle and elephant, act as host for lac-insect
35	<i>Kydia calycina</i>	Pulao	Malvaceae	Fodder, Fibre, Construction, Medicinal
36	<i>Lyonia ovalifolia</i>	Aiyaar	Ericaceae	Fuel, young leaves are poisonous to cattle
37	<i>Mallotus philippensis</i>	Rohini	Euphorbiaceae	Industrial (mainly in Tannin and match box industry).Fuel
38	<i>Moringa oleifera</i>	Sainjna	Moringaceae	Edible, vegetables, Medicinal, roots and fruit power purify the polluted water
39	<i>Pinus roxburghii</i>	Pine/chir	Pineaceae	Timber, Industrial, Construction, Resin
40	<i>Pyrus pashia</i>	Mehal	Roseaceae	Edible, Medicinal, Fodder, Soil stabilization

Table 2: Tree species found in the altitudinal range between the 1500-2000m

Sl. No.	Scientific Name	Local name	Family	Uses
1	<i>Acer oblongum</i>	Putli/Kirmoli	Acereaceae	agriculture Implements, Bio-fertilizer
2	<i>Aesculus indica</i>	Pangar	Hippocastanaceae	Medicinal, Fodder, Manure, making pots, fruit are eaten by cattle and goats
3	<i>Alangium chinensis</i>	Kimu	Alangiaceae	Fodder, Agriculture Implements
4	<i>Albizia julibrissin</i>	Pink Siris	Mimosaceae	Fodder, fuel
5	<i>Alnus nepalensis</i>	Utis/Alder	Betulaceae	Fodder, Soil stabilization, Timber
6	<i>Bauhinia purpurea</i>	Guriyal	Caesalpinaceae	Fodder, Vegetables
7	<i>Carpinus viminea</i>	Chamkharik	Corylaceae	Timber, Fodder
8	<i>Cedrus deodara</i>	Deodar	Pinaceae	Timber, Construction, Medicinal
9	<i>Cupressus torulosa</i>	Surai	Cupressaceae	Industrial, Timber, Construction, Ornamental
10	<i>Euonymus pendulus</i>	Bhambheli	Celestraceae	Fuel, Fodder, Agriculture Implements
11	<i>Juglans regia</i>	Akhroat	Juglandaceae	Edible Fruit, Medicinal, Industrial, Timber
12	<i>Lyonia ovalifolia</i>	Aiyaar	Ericaceae	Fuel, young leaves are poisonous to cattle
13	<i>Pinus roxburghii</i>	Pine/chir	Pinaceae	Timber, Industrial, Construction, Resin
14	<i>Pinus walllichiana</i>	Kail/Blue Pine	Pinaceae	Timber, Construction, Industrial
15	<i>Prunus armeniaca</i>	Chulu	Roseaceae	Fruit, Medicinal
16	<i>Prunus cerasoides</i>	Padam/Painya	Roseaceae	Medicinal, Fruit, Fodder
17	<i>Pyrus pashia</i>	Mehal	Roseaceae	Edible, Medicinal, Fodder, Soil stabilization
18	<i>Quercus leucotrichophora</i>	Banj/White Oak	Fagaceae	Fodder, Fuel, Manure, Construction, Soil binder
19	<i>Rhododendron arboreum</i>	Burans	Ericaceae	Medicinal, Fuel wood, ornamental
20	<i>Myrica esculenta</i>	Kafal	Myricaceae	Fruits edible, dye, fuelwood
21	<i>Salix babylonica</i>	Majnu	Saliaceae	Ornamental, used for mainly cricket bat
22	<i>Ficus roxburghii</i>	Timla	Moraceae	Fuel, Fodder, Edible, Vegetables, leaves used in making Cup and plates
23	<i>Grewia optiva</i>	Bhimal	Tiliaceae	Fodder, Fuel, Fibre, Edible
24	<i>Celtis australis</i>	Khadik	Ulmaceae	Fodder, Fuel
25	<i>Quercus floribunda</i>	Moru oak	Fagaceae	Fuel, fodder, household articles, soil binder
26	<i>Populus ciliata</i>	Pahari pipal	Saliaceae	Fodder, various industrial uses

Table 3: Tree species found in the altitudinal range between the 2000-2500m

Sl. No.	Scientific Name	Local name	Family	Uses
1	<i>Abies pindrow</i>	Murenda/Fir	Pinaceae	Timber, Medicinal
2	<i>Cedrus deodara</i>	Deodar	Pinaceae	Timber, Construction, Medicinal
3	<i>Juglans regia</i>	Akhroat	Juglandaceae	Edible Fruit, Medicinal, Industrial, Timber
4	<i>Lyonia ovalifolia</i>	Aiyaar	Ericaceae	Fuel, young leaves are poisonous to cattle
5	<i>Myrica esculenta</i>	Kafal	Myricaceae	Fruits edible, dye, fuelwood
6	<i>Pyrus pashia</i>	Mehal	Roseaceae	Edible, Medicinal, Fodder, Soil stabilization
7	<i>Picea smithiana</i>	Rai/spruce	Pinaceae	Construction, packaging, medicinal
8	<i>Prunus cerasoides</i>	Padam/Painya	Roseaceae	Medicinal, Fruit, Fodder
9	<i>Taxus baccata</i>	Thuner	Taxaceae	Medicinal, Timber, Industrial
10	<i>Toona serrata</i>	Pahari tun	Meliaceae	Timber, Fodder, Medicinal
11	<i>Quercus floribunda</i>	Moru oak	Fagaceae	Fuel, fodder, household articles, soil binder
12	<i>Quercus semicarpifolia</i>	Kharsu	Fagaceae	Fodder, Fuel, Construction
13	<i>Acer oblongum</i>	Putli/Kirmoli	Acereaceae	agriculture Implements, Bio-fertilizer
14	<i>Swida macrophylla</i>	Khagsi	Cornaceae	Agricultural implements, fodder, fruits edible

Table 4: Shrubs and Herbs found in the altitudinal range between the 1000-1500m

Sl. No.	Scientific Name	Local name	Nature	Family	Uses
1	<i>Acorus calamus</i>	Bach	Herb	Araceae	Industrial, Medicinal (Jaundice, Bronchitis, Gastric problems)
2	<i>Adhatoda zeylanica</i>	Basing	Shrub	Acanthaceae	Vegetables, Medicinal (Cough and cold, pulmonary affections, bronchitis, fever), bee-forage
3	<i>Aerva sanguinolenta</i>	Safedfulia	Herb	Amranthaceae	Medicinal (diuretic, demulcent)
4	<i>Aechmanthera gossypina</i>	Latghan	Shrub	Acanthaceae	Bark fibres for making rope and net, bee-forage
5	<i>Ageratum conyzoides</i>	Goat weed	Herb	Asteraceae	Medicinal (skin ailments)
6	<i>Alternanthera sessilis</i>	Gudre-saag	Herb	Amranthaceae	Vegetables
7	<i>Amaranthus hybridus</i>	Chaulai	Herb	Amranthaceae	Industrial, Organic manure
8	<i>Corchorus olitorius</i>	Juite	Herb	Tiliaceae	Medicinal (Fever)
9	<i>Costus speciosus</i>	Kemuk	Herb	Zingiberaceae	Edible, Stimulant, Snake biting
10	<i>Cotoneaster acuminatus</i>	Chamruins	Shrub	Rosaceae	Fuel, bee-forage, Walking sticks
11	<i>Desmodium elegans</i>	Chamlai	Shrub	Fabaceae	Medicinal (Epilepsy, carminatives)
12	<i>Callicarpa macrophylla</i>	Daiya	Shrub	Verbanaceae	Edible, bee-forage, medicinal (rheumatic pain)
13	<i>Calotropis procera</i>	Aak	Herb	Asclepiadaceae	In stuffing the pillows and cushions, Fibres for making net, Medicinal (cold, cough, asthma)
14	<i>Campylotropis eriocarpa</i>	Khunju	Shrub	Fabaceae	Fodder, soil binder
15	<i>Cannabis sativa</i>	Bhang	Shrub	Cannabaceae	Edible, fuel, in making ropes, sacs, as condiment and intoxicating agent
16	<i>Carissa opaca</i>	Karaunda	Shrub	Apocyanaceae	Edible, fodder, bee-forage, soil stabilization
17	<i>Catunaregam spinosa</i>	Mainfal	Shrub	Rubiaceae	Medicinal (dyspepsia, asthma, cough), bee-forage, detergent
18	<i>Catunaregam uliginosa</i>	Pindru	Shrub	Rubiaceae	Fodder, bee-forage, medicinal (skin treatment)
19	<i>Centella asiatica</i>	Brahmi	Herb	Apiaceae	Medicinal (mental disorders, blood purifier, diuretic, skin diseases including leprosy)
20	<i>Datura stramonium</i>	Dhatura	Herb	Solanaceae	Medicinal (toxicant)
21	<i>Eclipta prostrata</i>	Bhringraj	Herb	Asteraceae	Medicinal (throat pain, asthma, fever, constipation)
22	<i>Euphorbia hirta</i>	Saptala/Dudhhi	Herb	Euphorbiaceae	Medicinal (bronchial infection, asthma)

23	<i>Evolvulus alsinoides</i>	Sankhpuspi	Herb	Convolvulaceae	Medicinal (cough and cold, chronic bronchitis, asthma, brain tonic)
24	<i>Holmskioldia sanguinea</i>	Katuri ka phool	Shrub	Verbeneaceae	Medicinal (body swelling), Ornamental
25	<i>Jasminum multiflorum</i>	Chameli	Shrub	Oleaceae	Bee-forage, medicinal (eczema, ulcer, pimples)
26	<i>Jasminum arborescens</i>	Kutmanibel	Shrub	Oleaceae	Bee forage, medicinal (bronchial ailments)
27	<i>Lindenbergia indica</i>	Makria Jhar	Herb	Scrophulariaceae	Medicinal (bronchitis, cuts, wounds)
28	<i>Maoutia puya</i>	Safed Khagsa	Shrub	Urticaceae	Fodder, fibre used for nets and ropes
29	<i>Mimosa pudica</i>	Chhuimui		Mimosaceae	
30	<i>Murraya koenigii</i>	Gandela	Shrub	Rutaceae	in flavouring the curries and cutlets, Bee-forage, insecticide, piscicide,
31	<i>Murraya paniculata</i>	Kamini	Shrub	Rutaceae	Ornamental, edible, bee-forage, medicinal (cold and cough)
32	<i>Parthenium hysterophorus</i>	Gajar Ghas	Herb	Asteraceae	Non medicinal, cause skin allergies
33	<i>Pupalia lappacea</i>	Nagdaminee	Shrub	Amranthaceae	Medicinal (cough, fever, skin diseases)
34	<i>Ricinus communis</i>	Arandi		Euphorbiaceae	Medicinal, soil stabilization
35	<i>Solanum anguivi</i>	Ban bhatt	Shrub	Solanaceae	Medicinal (cough, asthma, fever, skin treatment, febrifuge)
36	<i>Solanum erianthum</i>	Ban Tambakhu	Shrub	Solanaceae	Edible, medicinal (burning treatment, skin diseases, urinary troubles)
37	<i>Oxalis corniculata</i>	Bhilmori	Herb	Oxalidaceae	Vegetables, salad, medicinal (cataract, conjunctivitis)
38	<i>Phyla nodiflora</i>	Jal butti	Herb	Verbenaceae	Medicinal (fever, menstrual complaints)
39	<i>Trichodesma indicum</i>	Aundhi	Herb	Boraginaceae	Medicinal (stomachache, pyorrhoea and toothache, swelling of joints)
40	<i>Tridax procumbens</i>	Kumra	Herb	Asteraceae	Vegetables, medicinal (wounds, cuts)

Table 5: Shrubs and Herbs found in the altitudinal range between the 1500-2000m

Sl. No.	Scientific Name	Local name	Nature	Family	Uses
1	<i>Emilia sonchifolia</i>	Hirankuri/ Dudhi	Herb	Asteraceae	Vegetables, medicinal (eye inflammation, night blindness)
2	<i>Gentiana aprica</i>	Chirotu	Herb	Gentianaceae	Medicinal (headache, intermittent fever)
3	<i>Habenaria marginata</i>	Haldia jadi	Herb	Orchidaceae	Medicinal (flatulence)
4	<i>Micromeria biflora</i>	Ban Ajvayan	Herb	Lamiaceae	Medicinal (cold, sinusitis, gastroenteritis)
5	<i>Myrsine africana</i>	Chupra	Shrub	Myrsinaceae	Bee-forage, medicinal (colic diseases)
6	<i>Pilea scripta</i>	Chaul	Herb	Urticaceae	Pot herb
7	<i>Polygala arvensis</i>	Sanjivani	Herb	Polygalaceae	Medicinal (paralysis), febrifuge
8	<i>Rhus parviflora</i>	Tungla	Shrub	Anacardiaceae	Edible, fuel, medicinal (cholera), bee-forage, fencing
9	<i>Rosa macrophylla</i>	Ban Gulab	Shrub	Rosaceae	Edible, fuel, bee-forage, medicinal (skin ailments)
10	<i>Urtica dioica</i>	Kandali/ Bicchu Ghas	Herb	Urticaceae	Fibre for making sacs, ropes and mats, as a pot herb, Medicinal (sciatica, rheumatism, skin diseases)
11	<i>Uraria lagopus</i>	Pithrain/ Daula	Shrub	Fabaceae	Medicinal (fever, dropsy)
12	<i>Sinarundinaria falcata</i>	Gad Ringal	Shrub	Poaceae	Fodder, widely used in cottage, mats, baskets

Table 6: Shrubs and Herbs found in an altitudinal range between the 2000-2500m asl

Sl. No.	Scientific Name	Local name	Nature	Family	Uses
1	<i>Achyranthus aspera</i>	Latjiri	Herb	Amranthaceae	Medicinal (malaria, dropsy, bronchitis)
2	<i>Agrimonia pilosa</i>	Lesukuriya	Herb	Agavaceae	Medicinal (cough, diarrhoea, urinary disorders)
3	<i>Amaranthus hybridus</i>	Chaulai	Herb	Amranthaceae	Industrial, Organic manure
4	<i>Excoecaria acerifolia</i>	Dudhila/Phutkiya	Shrub	Euphorbiaceae	Ornamental, Medicinal (skin diseases, wounds)
5	<i>Galium acutum</i>	Kutub/Kura	Herb	Rubiaceae	Medicinal (urinary disorders)
6	<i>Gerbera gossypina</i>	Kapasee	Herb	Asteraceae	Fibre, medicinal (bone fracture, cuts, wounds)
7	<i>Hedyotis corymbosa</i>	Daman Pappar	Herb	Rubiaceae	Medicinal (fever, liver diseases)
8	<i>Inula cappa</i>	Tamagiri	Shrub	Asteraceae	Medicinal (urinary disorders)
9	<i>Nicandra physalodes</i>	Tambukya	Herb	Solanaceae	Ornamental, insecticide
10	<i>Persicaria capitata</i>	Kafalya	Herb	Polygonaceae	Medicinal
11	<i>Plumbago zeylanica</i>	Chitrak	Herb	Plumbaginaceae	Medicinal (skin diseases, wounds, abortion)
12	<i>Prinsepia utilis</i>	Bhenkuli	Shrub	Rosaceae	Detergent, edible, medicinal (rheumatic pains, diarrhoea), fencing
13	<i>Rhamnus purpureus</i>	Gaunta/Luish	Shrub	Rhamnaceae	Fodder, manure, agriculture implements, bee-forage, medicinal (digestive disorders)
14	<i>Reinwardtia indica</i>	Phiuuli	Herb	Linaceae	Bee-forage, tongue washing, Medicinal
15	<i>Himalrandia tetrasperma</i>	Ghingaru	Shrub	Rubiaceae	fuel, in making walking sticks
16	<i>Pteracanthus angustifrons</i>	Pathora	Shrub	Acanthaceae	Leaves and flowers occasionally cooked as vegetables
17	<i>Rubus biflorus</i>	Hinsara	Shrub	Rosaceae	Edible, medicinal (diarrhoea)
18	<i>Rubus niveus</i>	Anchu	Shrub	Rosaceae	Edible, medicinal (snake biting, dysmenorrhoea), Industrial, Fencing
19	<i>Scutellaria scandens</i>	Kutla phul	Herb	Lamiaceae	Bee-forage, medicinal (dysentery, vomiting)
20	<i>Solanum nigrum</i>	Makoi	Herb	Solanaceae	Edible, medicinal (liver piles, dysentery, fever, diarrhoea, eye ailments), beverages
21	<i>Veronica anagallis-aquatica</i>	Sadevi	Herb	Scrophulariaceae	Medicinal (cuts, sores, burns)
22	<i>Viburnum cylindricum</i>	Lampatya	Shrub	Caprifoliaceae	Fuel, fodder, bee-forage
23	<i>Vervascum thapsus</i>	Kakri Tamakhu	Herb	Scrophulariaceae	Industrial, medicinal (bronchitis, asthma)

Table 4 represents that 19 herbs and 21 shrubs were reported in 1000 to 1500m elevation comprising 24 families. 7 herbs and 5 shrubs were noted in the elevation 1500 to 2000m belonging to 11 families (Table 5). In the higher altitude of 2000 to 2500m of elevation a total of 14 common herbs and 9 shrubs were reported covering 15 families (Table 6). The number of herbal species was increased from lower to higher elevation. The Indian Himalayas are characterized by strong changes related to, differences in altitudinal gradient (Suyal *et al.*, 2010). Species often adapt these environmental conditions in contrasting way and their diversity depends upon their characteristics and the environmental condition that is suitable for a particular plant species (Young *et al.*, 2002). Many other workers has been worked in the Garhwal Himalayan forest as Gairola *et al.*, 2009 recorded that 10 families namely Asteraceae, Lamiaceae, Poaceae, Rosaceae, Orchidaceae, Utriacae, Euphorbiaceae, Fabaceae, Ranunculaceae, Polygonaceae are dominantly found in the Mandal-Chopta region of Garhwal Himalaya. In the present study the Upper Yamuna Forest Division is found one of the richest sources for the various floral biodiversity. Wide altitudinal ranges, rapid changes in biodiversity even at the small distances make it interesting for ecological study (Singh and Singh., 1992; Zobel and Singh., 1997). Vegetation diversity of the forest division is severely affected by many natural as well as anthropogenic disturbances. There are various environmental conditions which are primarily responsible for the vegetation diversity separately at different altitudinal ranges. These vegetation diversity and biological richness add the ecological significance of the forest division. Composition of different medicinal, edible- fruit plants substantially increases the ecological and economical value of the region.

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REFERENCES

Adhikari, B.S., Joshi, M., Rikhari, H.C. and Rawat, Y.S. (1992). Cluster Analysis (Dendrogram) of high altitude (2150-2500 m) forest vegetation around Pindari glacier in Kumaun Himalaya. *Journal of Environmental Biology* 13: 101-105.

- Gairola S., Sharma C. M., Ghildiyal S. K., Suyal S., Rana C. S., Butola D.S. (2009). "Biodiversity conservation and sustainable rural development in the Garhwal Himalaya." *Report Opin.* 1 (4)-6-12
- Gentry A. H. (1993). "Pattern and floristic composition in neotropical montane forest." *Proceeding of neotropical montane ecosystem symposium, New York*
- Hubbell, S.P., R.B. Foster., S.T. O'Brien., K.E. Harms., R. Condit (1999). "Light- gaps disturbances, recruitment limitation and tree diversity in a Neotropical forest." *Science*, 283: 554-557.
- Kharkwal G., Mehrotra P., Rawat Y. S., Pangety Y. P. S. (2005). "Phytodiversity and growth form in relation to altitudinal gradient in the central himalya (Kumaun) region of India" *Current science* 89 (5):873-878
- Kumar M., Bhatt V (2006). "Plant biodiversity and conservation of forests in foot hills of Garhwal Himalaya" *Lyoina* 11:43-59
- Nautiyal M. C., Nautiyal B. P., Prakash V (2004). "Effect of grazing and climate changes in Alpine vegetation of Tungnath, Garhwal Himalaya India." *The environmentalist* 24:125-134
- Puri G. S., Mehar-Homji V., Gupta R. K., Puri S. (1983). "Phytogeographical ecology pp 115-210 In forest ecology 2nd edn Oxford and IBH Publishing company
- Saxena A., Pandey T., Singh J. S. (1985). "Altitudinal variation in the vegetation of Kumaun Himalaya" pp 43-66. In D N Rao; K J Ahmad; M Yunus; S N Singh (eds) *Perpesticves in environmental botany*. Print house Lucknow
- singh J. S., Sing S. P., (1992). "Pattern of soil and vegetation and factors determining forms and hydrologic cycles in Nanda Devi Biosphere Reserve." *Final technical report submitted to the Ministry of Environment & Forest, New Delhi* pp: 176
- Singh V., Dasgupta S., Jhaldiyal V., Chauhan DS., Todaria NP (2011). "Diversity pattern of vegetation in and around proposed Kotlibhel hydroelectric project along the Alaknanda River in Garhwal Himalaya (India)" *Forest biogeoscience and Forestry*. Vol 4 pp 38-43
- Suyal S., Sharma C. M., Gairola S., Ghildiyal S. K., Rana C. S., Butola D.S. (2010) Phytodiversity (Angiosperms and Gymnosperms) in Chaurngikhal forest of Garhwal Himalaya, Uttarakhand Area. *Indian Journal of Science & Technology* vol. 3 No. 3
- Young K. R., Ulloa C., Luteyn J. L., Knapp S (2002). Plant evaluation and endemism in Andean South America: An Introduction. *Bot. Rev.* (68):4-21
- Zobel D. B., Singh S P (1997). "Himalayan forest and Ecological generalization". *Bio Sci.* 47 (11): 735-745
