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A preliminary checklist of the vascular flora of Kalam valley, Swat, Pakistan

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Abstract

The floristic survey of Kalam valley, Swat was carried out during 2012 to 2014 and a total of 529 species belonging to 312 genera and 85 families were identified. Of them, 14 species of pteridophytes, 11 species of Gymnosperms and 504 species of angiosperms (57 species of Monocotyledons and 447 species of Dicotyledons) were recognized. Asteraceae was the largest family which contributed 52 species (9.82%), followed by Lamiaceae (37 spp., 6.99%), while 14 largest families represented by 10 or more species accounted for 60.90% of the species. The largest genera were: Ranunculus (7spp. each), *Berberis, Nepeta, Veronica and Polygonum* (6 spp. each), *Impatiens*, *Prunus*, *Allium, Astragalus, Vicia, Salix, Geranium, Salvia, Papaver, Potentilla,* Lathyrus and *Rosa* (5 spp. each). This checklist will provide a useful starting point for further ecological and bio prospective research of the area.

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Introduction

Kalam valley is located in the North of District Swat at a distance of about 100Km from Saidu Sharif (the capital city of district swat) Khyber Pakhtunkhwa, Pakistan. The area lies between: 35° 22 to 35° 53 North latitudes and 72°28 to 72°49 East longitudes (as revealed from the map) in Swat district. The average elevation of the area varies from 1980 to 5000 meters from the mean sea level. The valley is open on southern side and splits in to a series of rocky patches as one go from the start of study area at Kalam town up to the north of Loi pand ghalay which is the last station of the study area. The study area is surrounded by Behrain and Mankyal on the south, Utror valley on the west, Chitral and Ghizar districts on the North and Indus kohistan on the East. Major landforms of the study area comprises rocky slopes along stream beds with some rocky sub alpine and alpine pastures on high elevations. Kalam is the main town of the study area and the point of origin of River swat. Inhabitants of the area include Yousafzai Pakhtuns who depend mainly on their agricultural lands and royalty from forests, non-local population mainly attached with hotels business whereas nomads called "Gujars" and "Ajars" visit the area for grazing their livestock during warmer season of the year. Growth season in the area starts from April and ends in September, double cropping system is limited only to the lower plain patches of Kalam town. Turnip, potato and Cabbage are the main crops cultivated in the area. Maximum annual temperature doesn't go beyond 20C°, winters are severe with heavy snow fall resulting in huge land sliding and destruction of vegetation. In winter the temperature drops even to –6C°, severity of the winter season increases towards the north of the study area almost compelling the local inhabitants to migrate along with their livestock to the low lying areas in the south of Kalam. Socio-economic index of the population is very low, tourism and forest products are the two main sources of subsistence for the local population. Excepting the lower plain patch at Kalam town, there are hills in different shapes, elevations and aspects. The series of hills are offshoots of the Hindu Kush mountain range (Ahmed & Sirajuddin, 1996).

The low lying areas of the valley are alluvial plains traversed by seasonal streams. The soils of hills are of the mountain type and are residual as well as transported (Hussain & Ilahi, 1991). Total area of Kalam valley up to northern paloga and adjoining hilly tracts (research area) is 840 sqkm of which 23.52 sqkm (2.8%) is cultivated and 816.48 sqkm (97.2%) is uncultivated (MRDP 2003). The human population of the area in the year 2011 was 35,586 with yearly growth rate of 3%.

Phytogeography and Plant Bio diversity

The study area representing north-eastern belt of swat is a hilly area as minimum altitude of the area is 2000 meters whereas the maximum altitude at the high elevations reaches up to 5000 meters. Mean maximum temperature of the low lying parts is 20°c reducing up to 15°C in the upper high altitude belts whereas the mean winter temperature during the months of January and February may drop much bellow - 6°C creating very extreme climate due to frequent snow fall, this area is perhaps the coldest part of Pakistan. Rain fall is much more common during the months of July and August crossing 1800mm/year, which often results in landslides and glaciers falling blocking roads and destroying vegetation. Geologically, the area has some similarity with indo Chinese region. The soil is well aerated and light to moderate in texture, light sandy and shallow in some areas, suitable for the growth of coniferous forests, turnips, potato etc. Normally there is only one growth season stretching from May to September due to a very prolonged winter coupled with severely low temperature. On the basis of altitudinal and phytogeographical differences, the study area is divided in to the following vegetational zones, with in these broad zones there are further differences based on microclimatic and edaphic factors.

Cool temperate zone

The altitude for this zone is from 1500m to 2000m and the typical examples are the sub-valleys e.g. some lower basin depressions with in Kalam Oshoo areas. The weather is very cold in winter and a considerable snowfall is a common occurrence although the summer is very short, a double cropping system still prevails.

The common crops are: potato, maize and wheat. Keeping livestock is a common profession here, while the people are dependent on forest products to a great extent. The indicator species are Pinus wallichiana and Quercus dilatata (Ahmad and Ahmad, 2004).

Cold temperate zone

This is very densely forested zone in Swat Valley, with an altitude range of 2000-2500m. The summer here is short and the snowfall is heavier in winter, remaining for up to four months. Potato and beans are grown mixed with maize. Livestock is the major part of the economy. This zone includes areas like Boyon, Top of Gaheel Gudar and areas adjacent to kalam. Abies pindrow and Picea smithiana are the indicator species (Ahmad and Ahmad, 2004).

Subalpine zone

These are the areas covered with snow for more than five months and demarcate the tree line from 2500-3500m. These are the stomachs of the livestock of Swat districts and are grazed by herds of sheep and goats in the summer months. Normally, agriculture is not a common practice in these areas and the products are usually the medicinal herbs growing here. Betula utilis and Q. semecarpifolia are the indicator tree species of the zone e.g Beyon, Ashoran , gorkin areas (Ahmad and Ahmad, 2004).

Alpine zone

The highest points of the Kalam Valley consist of glacial lakes and streams. The altitude is 3500 - 4500m with extremely harsh weather, intense UV radiation and strong winds, all characteristics of this zone. Badar Bateen Dara, Upper Desan, Upper Kalasher and areas above Mahodand lake up to Hilly Tracts of Deshai and Loi Pand Ghalay share the same zonal conditions. Medicinal plants are collected from the region in summer, from the limited resources available (Ahmad and Ahmad, 2004).

Cold desert zone

These are the extreme high peaks of the Kalam Valley and are covered by snow and glaciers all year long. The mountains range from 4500 to 6000m, Falakser and Mingo Pass are the representative areas of this zone (Ahmad and Ahmad, 2004).

Some threatened endemic fauna of the region is present, including snow leopards and snow cocks, but no obvious macro flora is present. It is very obvious that the presence of these different ecological zones provide micro-climates and ecological niches to a wide variety of flora and fauna, contributing to the complexity of biodiversity of Kalam Valley.

Floristic checklists are often the only source of botanical information for a particular area and may serve as a useful starting point for more detailed study (Keith, 1988). Because of their conciseness, the listing of species is easy to handle and less time consuming (Saima *et al*., 2010) that aids in the identification and correct naming of species, essential resources for biodiversity estimates and biogeographic studies. Furthermore, this information provides important public outreach and fundamental information used in addressing the biodiversity crisis (Funk *et al*., 2007).

Many workers have contributed comprehensive checklists to the local floras. These include Qureshi (2008), Jafari & Akhani (2008), Djaha *et al*., (2008), Saima *et al*., (2009), Saima *et al.,* (2010), Fazal *et al.,* (2010), Qureshi & Bhatti (2010), Haq *et al*., (2010), Qureshi *et al*., (2011a,b) and Yalcin *et al*., (2011). Related works from adjoining areas include Stewart (1967) and Rashid *et al*., (1987). Because of the diverse topographic features and micro-habitats, the study area has a great potential for flourishing a rich plant biodiversity. Keeping these considerations in view, The aims and objectives of the present study was to identify and enlist the vascular flora of the area as well as focus on conservation issues of plant under the prevalence of many factors including the attack of invasive species, excessive tourism, severe grazing, deforestation, land sliding, over harvesting of important plant species and other anthropogenic activities which can reduce species diversity and alter the structure of vegetation in Kalam valley. The present study will provide a baseline for further ecological investigations and conservation measures.

Need and Justification for the Present Research

Although northern Pakistan sustains a rich diversity of vascular plant species (Shinwari *et al.* 2010) and constitute major part of the vascular Flora of Pakistan, still there are some areas which are considered as potential hotspot of biodiversity but due to non-accessibility and extremely harsh environmental conditions, these areas have not been explored, Kalam Valley in upper swat district is one of these areas which needs special attention for phytosociological and conservation based exploration. the only research study which was conducted on a very minute part of the study site was done by Sheerin, Z. 2002, an M.Sc thesis submitted to Govt Jehanzeb College Siadu Sharif Swat enlisting only 73 species of plants used by local people, but this study is of very low level and restricted to a very small belt of land providing no knowledge about any parameters related to plant biodiversity of the proposed study area. Summarizing all the relevant facts and authentic data in mind, it can be safely concluded that this area is totally unexplored from vegetational and plant biodiversity point of view and hence the present study will be a pioneer work in this direction having multifaceted scope nationally as well as internationally for the overall betterment of humanity.

Aims and objectives of the present study

The present study is focused on the following objectives to be achieved: Preparing a complete list of the vascular flora of the study area. To analyze plant communities of the area along different environmental variables especially altitudinal variation which has a significant role in shaping the patterns of plant biodiversity. Compilation of data relating to indigenous uses of important plants and hence providing a launching pad for exploring ways and means how to enhance plant uses on major scale for uplifting of the socio-economic status of the society and combat poverty.

Identifying the threats to the sustainability of the terrestrial ecosystems of the study area and to determine various practicable measures how to increase plants biodiversity as well as restore natural habitats of the area.

Providing a preliminary solid data about the vascular plants diversity of Kalam valley to be used by conservationists in their quest to stop erosion of valuable species. Association indices of the plant communities prevailing in the area. Determination and documentation of plants species which may be a new contribution to the flora of Pakistan or new to science. Identification of the important plants which can play a pivotal role in the regional economy as well as national economy.

Materials and methods

Design for phytosociological studies

Preliminary information about the area including geographical and topographical maps were obtained from Pakistan geological survey and forest departments, the area was divided into transect lines taking base line of transect as Ushu river which dissect the research area from the north to south, transects were designed on both sides of Ushu river after five to eight kilometer interval. For vegetation sampling, quadrates of different sizes were taken along each transect line keeping in view the physiognomic features, habitat type, soil conditions, aspect and slope.

Collection of plant specimens

The collection of plant specimens of vascular flora of Kalam valley was made during 2012-2014. For this purpose, the whole study area was thoroughly visited covering each season by quadrat sampling in all stands and research sites. During the survey, plant specimens were collected in triplicate. For observation of habitat type, life form and other Phytosociological studies, plant specimens were photographed, large specimens were cut by pruners whereas small plant species were dugout with roots intact using digging tools.

Soil analysis.

Soil samples were collected from different research sites keeping in view the slope, aspect, habitat and climatic conditions. Digging tools were used to collect soil samples 10 centimeters deep by following standard protocol of Hussain, F. 1989.

The collected soil samples were analyzed for soil texture, soil structure as well as water holding capacity, soil pH and other parameters.

Preparation of Voucher Specimens

The collected plant specimens were pressed in plant pressers, dried in newspapers and blotting papers for nearly 25 days, poisoned with solution of mercuric chloride and then mounted on standard herbarium sheets. (17x11inches).

Identification of plant specimen

Angiosperms and Gymnosperms were identified with the help of *Flora of Pakistan* (Nasir & Ali, 1970-1989; Ali & Nasir, 1989-1991; Ali & Qaiser, 1995-2012), while Pteridophytes were identified with the help of Cryptogamic Flora of Pakistan (Nakaiki & Malik, 1992, 1993). Nomenclature for taxa basically follows the above mentioned Floras but the accepted names were further validated from The Plant List and The International Plant Names Index (Anon., 2012a,b). All plant names were family-wise alphabetically arranged and provided in the result.

Documentation of field data

Field data comprising habit, habitat, life form, frequency of occurrence, locality, geographic coordinates, aspect, local name and other parameters relating to plant specimen were incorporated to the tagged herbarium sheets. The prepared voucher specimens were deposited in the herbarium of Department of Botany Hazara University Mansehra Pakistan for record.

Results

During the survey a total of 529 vascular plant species belonging to 312 genera and 85 families were recorded. It also includes 14 species of Pteridophytes and 11 gymnosperm species. (Fig. 1) Amongst angiosperms, monocotyledons consisted of 57 species of 38 genera and 10 families, while dicotyledons group belonged 447 species of 259 genera and 65 families. Asteraceae was the largest family represented by 52 species (9.82%), followed by Lamiacea (37 spp., 6.99%), Fabaceae (34 spp., 6.42%, Rosaceae (34 spp., 6.42%), Poaceae (28 spp., 5.29%) and Brassicaceae (26 spp., 4.91%). Other larger families represented by 10 or more species are Brassicaceae (22 spp.), Cyperaceae (18 spp.), Solanaceae (15 spp.), Polygonaceae (14 spp.), Amaranthaceae (12 spp.), Ranunculaceae, Boraginaceae and Euphorbiaceae (10 spp. each). All these larger families collectively contributed 61.24% of the total species (Fig. 4). The families and plants in each group of vascular plants are arranged in alphabetical order. The numbers in parenthesis, with prefix BN are voucher numbers of the collected specimens, while the bold letters are the abbreviations of the major habitat types of the species.

Abbreviations for habitat types

A- Alpine, B– Bush land, DRB-Disturbed Road Bank, DRS-Dry Rocky Slope, F-Forest, FM-Field Margin, GL-Grass Land, HT-Hill Top, M-Marshes, MRS-Moist Rocky Slope, NS- Near Snow, SB-Stream Bed Cultivated Species are marked with asterisk (*).

Among the 529 collected plant species from research area there were 412 herb species (77.88%), 80 shrubs species (15.12%) whereas the total number of trees was 37 (6.99%) (Fig. 2). The life form data according to Raunkiaer 1939 reveled that therophytes was the dominant class represented by 193 plant species (36%) followed by Phanerophytes 113 (21%), Hemicryptophytes 70 (13%) & Helophytes 54 (10%) whereas epiphytes & parasitic plant species were in least number 2 (0.37%) & 1 (0.18%) respectively (Fig. 3). Abbreviation for different life form classes are Panerophytes - Phan, Chamaephytes-Cham, Therophytes - Thero, Hemicryptophytes - Hemi, Geophytes - Geo, Helophytes - Helo, Hydrophytes - Hydro, Epiphytes - Epi & Parasites - P.

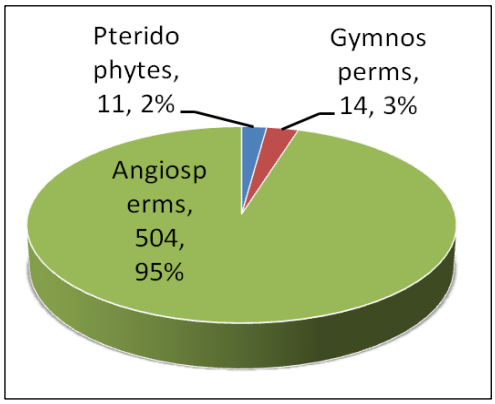


Fig. 1. Group Wise Spectrum of Plant Species from Kalam Valley.

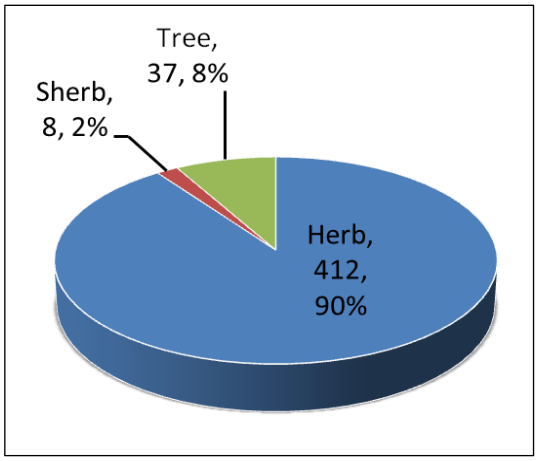


Fig. 2. Pie Chart showing habit of plant species.

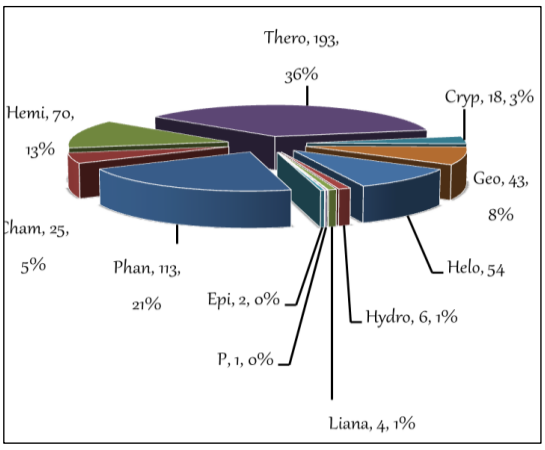


Fig. 3. Graphical Representation of Different Life Forms of Total 529 Plant Species.

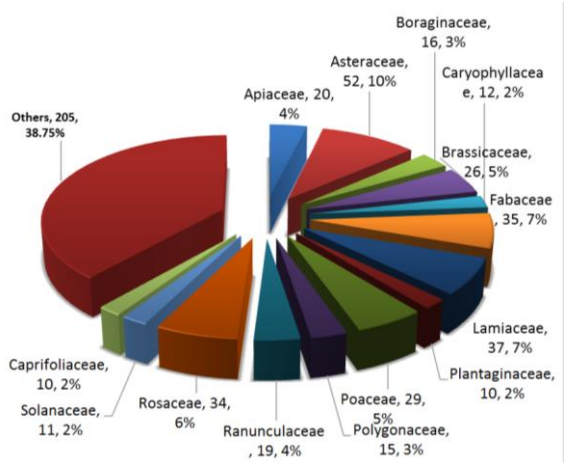


Fig. 4. Spectra of families in Kalam Valley, Swat.

Pteridophytes

Aspleniaceae

Asplenium ceterach L. (BN-500/MRS)

Asplenium trichomanes L. (BN-361/DRB)

Asplenium septentrionale (L.) Hoffm.(BN-1353/HT)

Dryopteridaceae

Dryopteris juxtaposita Christ (BN-909/HT)

Dryopteris linearis Copel. (BN-1470/F)

Dryopteris serratodentata (Bedd.) Hayata (BN-213/FM)

Polystichum lachenense (HK.) Bedd. (BN-82/NS)

Polystichum lonchitis (L.) *Roth.* (BN-23/SB)

Equisetaceae

Equisetum debile Roxb. ex Vaucher (BN-1191/A)

Pteridaceae

Adiantum capillus-veneris L. (BN-355/HT)

Pteris cretica L. (BN-219/MRS)

Pteris vittata L. (BN-387/SB)

Selaginellaceae

Selaginella sanguinolenta (L.) Spring (BN-231/FM)

Tectariaceae

Aspidium filix mas (BN-352/HT)

Gymnosperms

Cupressaceae

Juniperus communis L. (BN-30/BL)

Juniperus macropoda Boiss. (BN-1177/HT)

Ephedraceae

Ephedra gerardiana Wall.ex Stapf. (BN-61/BL)

Pinaceae

Abies Pindrow Royle. (BN-66/SB)

Cedrus deodara (Roxb. ex D. Don) G. Don (BN-1512/F)

Picea smithiana (Wall.) Boiss. (BN-135/F)

Pinus gerardiana Wall. Ex D. Don (BN-1525/BL)

Pinus roxburghii Sarg. (BN-304/SB)

Pinus wallichiana A.B. Jacks. (BN-1540/MRS)

Taxaceae

Taxus wallichiana Zucc. (BN-398/F)

Taxus baccata L. (BN-1429.MRS)

Monocot

Amaryllidaceae

Allium cepa L. (BN-1451/MRS)*

Allium humile Kunth. (BN-268/MRS)

Allium sativum L. (BN-1479/F)*

Allium stracheyi Baker. (BN-269/MRS)

Allium griffithianum Boiss. (BN-171/SB)

Asparagaceae

Polygonatum verticillatum (L.) All. (BN-1529/BL)

Scilla griffithii Hochr. (BN-192/DRB)

Cyperaceae
Carex cumulata (L. H. Bailey.) Mackenzie (BN-779/SB)
Carex plectobasis Krecz. (BN-687/SB)
Carex psychrophila Nees. (BN-776/SB)
Carex cardiolepis Nees (BN-372/GL)
Carex sanguinea Boott (BN-373/GL)
Cyperus glomeratus L. (BN-1236/MRS)
Cyperus rotundus L. (BN-308/F)

Dioscoreaceae
Dioscorea deltoidea Wall. Ex Griseb. (BN-323/BL)

Iridaceae
Iris hookeriana Foster (BN-280/SB)
Iris germanica L. (BN-384/SB)
Iris florentina L. (BN-383/SB)

Ixiolirionaceae
Ixiolirion tataricum (Pall.) Schult. & Schult.f. (BN-751/FM)

Juncaceae
Juncus articulatus L. (BN-865/GL)
Juncus membranaceus Royle.ex D.Don. (BN-234/BL)

Liliaceae
Gagea pseudoreticulata Vved (BN-275/A)
Lilium polyphyllum D. Don. (BN-771-GL)
Notholirion thomsonianum (Royle) Stapf (BN-216/FM)
Tulipa clusiana DC. (BN-439/A)
Tulipa stellata Hook. (BN-364/DRB)

Orchidaceae
Cypripedium cordigerum D.Don (BN-1520/MRS)
Dactylorhiza hatagirea (D.Don.) Soo.(BN-33/BL)
Spiranthes sinensis (Pers.) Ames (BN-1510/F)

Poaceae
Alopecurus myosuroides Huds. (BN-1284/A)
Aristida adscensionis L. (BN-133/DRB)
Aristida cyanantha Steud. (BN-164/FM)
Arundo donax L. (BN-1057/SB)
Avena sativa L. (BN-516/SB)
Bothrio chloaischaemum (L.) Keng (BN-1334/DRB)
Bromus pectinatus Thunb (BN-281/SB)
Chrysopogon gryllus (L.) *Trin.* (BN-286/A)
Cynodon dactylon (L.) Pers. (BN-1410/MRS)
Dactylis glomerata L. (BN-118/BL)
Digitaria ciliaris (Retz.) Koeler (BN-1337/DRB)
Echinochloa colona (L.) Link (BN-1285/MRS)
Eleusine indica (L.) Gaertn (BN-366/RSB)
Eragrostis cilianensis (All.) Mosher (BN-1399/RB)
Imperata cylindrica (L.) Raeusch ((BN-274/A)
Pennisetum orientale L. C. Rich. (BN-640/FM)
Poa annua L. (BN-648/GL)
Poa bulbosa L. (BN-692/A)
Poa infirma Kunth (BN-1383/GL)
Poa pratensis L. (BN-87/NS)
Polypogon fugax Neesex. Steud. (BN-107/FM)
Polypogon monspeliensis (L.) Desf (BN-331/MRS)
Rostraria cristata (L.) Tzvelev (BN-690SB)
Sclerochloa dura P. Beauv. (BN-1436/MRS)
Setaria viridis (L.) P. Beauv. (BN-689/SB)
Setaria pumila (Poir.) Roem. & Schult.(BN-1446/SB)
Sorghum halepense (L.) Pers. (BN-143/M)
Triticum aestivum L. (BN-1445/MRS)*

Dicot
Acanthaceae
Dicliptera bupleuroides Nees.(BN-963/NS)
Justicia adhatoda L.(BN-994/SB)
Peristrophe bicalyculata (Retz.) Nees (BN-340/MRS)
Pteracanthus urticifolius (Wall. ex Kuntze) Bremek. (BN-1538/SB)
Ruellia tuberosa L. (BN-451/DRB)
Strobilanthes urticifolia Wall. ex Kuntze (BN-622/HT)

Adoxaceae
Sambucus wightiana Wall. ex wight. & Arn. (BN-773/SB)
Viburnum cotinifolium D. Don. (BN-1172/HT)
Viburnum grandiflorum Wall. ex DC. (BN-1365/SB)

Amaranthaceae
Achyranthes aspera L. (BN-141/GL)
Amaranthus caudatus L. (BN-239/BL)
Amaranthus viridis L. (BN-330/BL)
Celosia argentea L. (BN-533/SB)
Chenopodium album L. (BN1461/MRS)
Chenopodium botrys L. (BN-1166/BL)

Apiaceae
Aegopodium burtii E. Nasir. (BN-81/NS)
Aegopodium alpestre Ledeb.(BN-320/DRB)
Aegopodium podagraria L.(BN-505/DRB)
Anthriscus nemorosa (M. Bieb.) Spreng. (BN-1346/DRB)
Bunium persicum (Boiss.) Fedtsch. (BN-734/NS)
Bupleurum falcatum L. (BN-884/BL)
Bupleurum gilesii H.Wolff (BN-22/SB)
Carum copticum (L.) Benth. & Hook. F. (BN-937/NS)
Chaerophyllum reflexum Lindley. (BN-12/F)
Chaerophyllum villosum Wall. ex DC. (BN-71/SB)
Coriandrum sativum L. (BN-314/DRB)

Foeniculum vulgare Mill. (BN-1432/ MRS)
Heracleum canescens Lindl. (BN-196/DRB)
Pimpinella diversifolia DC. (BN-468/MRS)
Pleurospermum stylosum Clarke. (BN-755/FM)
Psammogeton canescens Vatke (BN-209/SB)
Scandix pecten-veneris L. (BN-349/HT)
Seseli libanotis (L.) Koch. (BN-774/SB)
Torilis japonica (Houtt.) DC. (BN-318/DRB)
Torilis leptophylla (L.) Rchb.f. (BN-460/MRS)

Apocynaceae
Vinca major L. (BN-541/A)

Asteraceae
Achillea millefolium L. (BN-1521/MRS)
Anaphalis triplinervis (Sims.) C.B. Clarke. (BN-247/MRS)
Artemisia persica Boiss. (BN-724/NS)
Artemisia vulgaris L. (BN-1425/MRS)
Artemisia indica Willd. (BN-509/DRB)
Artemisia scoparia Waldst. & Kitam. (BN-1475/F)
Aster altaicus Willd. (BN-933/NS)
Aster flaccidus Bunge. (BN-319/DRB)
Aster molliusculus (Lindl. ex DC.) C.B. Clarke. (BN-316/DRB)
Bidens cernua L. (BN-757/FM)
Calendula arvensis M. Bieb. (BN-429/NS)
Calendula officinalis L. (BN-432/A)
Caltha alba Camb. (BN-662/BL)
Carpesium cernuum var, *Glandulosa* Hook. F. & Thomson ex C.B. Clarke (BN-531/SB)
Centaurea cyanus L. (BN-913/HT)
Chrysanthemum griffithii Clarke. (BN-1171/HT)
Cichorium intybus L. (BN-138/MRS)
Cirsium falconeri (HK.t) Petrak. (BN-665/BL)
Cirsium arvense (L.) Scop. (BN-1129/SB)
Cnicus benedictus L. (BN-510/SB)
Conyza bonariensis (L.) (BN-309/F)
Conyza canadensis (L.) Cronquist. (BN-744/SB)
Conyza stricta Willd. (BN-752/FM)
Crepis multicaulis Ledeb. (BN-140/MRS)
Duhaldea cuspidata (Wall. ex DC.) Anderb (BN-210/SB)
Erigeron multiradiatus (Lind. ex Dc.) C.B. Clarke. (BN-777/SB)
Erigeron canadensis L. (BN-825/BL)
Galinsoga parviflora Cav. (BN-868/GL)
Gnaphalium affine D.Don (BN-415/MRS)
Inula cappa DC. (BN-1154/MRS)
Lactuca dissecta D. Don (BN-119/BL)
Lactuca brunoniana (DC.) Wall. ex C.B.Clarke (BN-1231/MRS)
Lactuca serriola L. (BN-1395/HT)
Launaea secunda (C.B.Clarke) Hook.f. (BN-1274/A)
Onopordum acanthium L. (BN-1514/F)
Parthenium hysterophorus L. (BN-1128/SB)
)*Phagnalon niveum* Edgew. (BN-217/FM
Pulicaria salviifolia Bunge (BN-1349/HT)
Saussurea albescens (DC.) Sch. Bip. (BN-930/NS)
Scorzonera virgata DC. (BN-167/FM)
Senecio nudicaulis Buch.-Ham. ex D. Don (BN-899/SB)
Senecio chrysanthemoides DC. (BN-1176/HT)
Senecio kraschenninnikovii Schischk. (BN-1330/DRB)
Serratula pallida DC. (BN-912/HT)
Silybum marianum (L.) Gaertn. (BN-1426/MRS)
Solidago virgaurea subsp. *Leiocarga* (Benth.) Hultén (BN-924/A)
Sonchus asper (L.) Hill. (BN-100/MRS)
Sonchus arvensis L. (BN-339/MRS)
Sonchus oleraceus (L.) L. (BN-675/A)
Tagetes patula L. (BN-328/BL)
Taraxacum officinale (L.) Weber. ex F.H. Wigg. (BN-412/SB).
Youngia japonica (L.) DC. (BN-419/MRS)

Balsaminaceae
Impatiens brachycentra Kar. & Kir. (BN-310/F)
Impatiens bicolor Royle. (BN-666/BL)
Impatiens thomsonii Hook. f. (BN-1342/DRB)
Impatiens brachycentra Kar. & Kir. (BN-310/F)
Impatiens edgeworthii Hook. F. (BN-311/F)

Berberidaceae
Berberis calliobotrys Bien. ex Koehne (BN-1167/BL)
Berberis orthobotrys Bien. ex Aitch. (BN-58/GL)
Berberis pseudumbellata Parker. (BN-1501/DRS)
Berberis vulgaris L. (BN-15607/F)
Berberis jaeschkeana C.K. Schneid. (BN-1504/F)
Berberis lycium Royle. (BN-522/MRS)
Epimedium elatum C. Morren & Decne. (BN-1522/MRS)
Podophyllum emodi Royle. (BN-250/MRS)

Betulaceae
Alnus nitida (Spach) Endl. (BN-496/MRS)
Corylus jacquemontii Decne. (BN-733/NS)

Boraginaceae
Arnebia euchroma (Royle.) I.M.J. (BN-1127/SB)
Cynoglossum glochidiatum Wall. ex Benth. (BN-322/BL)
Cynoglossum lanceolatum Forssk. (BN-338/MRS)
Eritrichium strictum Decne. (BN-646/GL)
Heliotropium bacciferum Forssk. (BN-1271/A)
Lindelofia anchusoides (Lindl.) Lehm. (BN-78/GL)
Lindelofia longiflora (Benth.) Baill. (BN-421/NS)
Lithospermum arvense L. (BN-430/NS)
Myosotis alpestris F.W. Schmidt. (BN-444/DRB)
Myosotis arvensis K.F. Schultz (BN-716/HT)
Myosotis caespitosa K.F. Schultz (BN-764/GL)
Nonea edgeworthii A. DC. (BN-497/MRS)

Onosma dichroantha Boiss. (BN-1233/MRS)
Onosma hispida Wall. ex G. Don. (BN-1267/NS)
Pseudomertensia *moltikiods* (Royle.) Kazmi. (BN-354/HT)
Pseudomertensia parvifolia (Decne.) Riedl in Rech. (BN-841/A)

Brassicaceae
Alliaria petiolata (M. Bieb.) Cavara & Grande (BN-333/MRS)
Arabidopsis pumila (Celak.) N. Busch. (BN-194/DRB)
Arabis pterosperma Edgew. (BN-780/MRS)
Arabis nova Vill. (BN-998/SB)
Barbarea vulgaris R.Br. (BN-1145/MRS)
Brassica nigra (L.) W.D.J. Koch (BN-1421/MRS)
Brassica campestris L. (BN-356/HT)
Capsella bursa-pastoris (L.) Medic. (BN-703/A)
Cardamine hirsuta L. (BN-923/A)
Cardamine loxostemonoides O.E. Schulz (BN 456/SB)
Cardamine pratensis L. (BN-925/A)
Coronopus didymus (L.) Sm. (BN-674/AP)
Descurainia sophia (L.) Webb. Ex Prantl (BN-747/SB)
Eruca sativa Mill. (BN-324/BL)
Lepidium ruderale L. (BN-375/F)
Matthiola incana (L.) R.Br. (BN-1295/MRS)
Nasturtium officinale R.Br. (BN-70/SB)
Rorippa islandica (Oeder.) Borbas. (BN-225/MRS)
Rorippa nasturtium (Moench) Beck (BN-382/F)
Sisymbrium irio L. (BN-603/SB)
Sisymbrium orientale L. (BN-633/SB)
Thlaspi andersonii (H & T) O.E.S. (BN-17/BL)
Thlaspi arvense L. (BN-725/NS)
Thlaspi griffithianum (Boiss.) Boiss. (BN-74/GL)
Thlaspi perfoliatum L. (BN-453/SB)
Turritis glabra L. (BN-715/HT)

Buxaceae
Buxus sempervirens L. (BN-1536/DRS)

Campanulaceae
Campanula tenuissima Dunn. (BN-693/A)
Campanula tenuissima Dunn. (BN-21/SB)
Campanula pallida Wall. (BN-515/SB)

Cannabaceae
Cannabis sativa L. (BN-661/BL)

Caprifoliaceae
Leycesteria formosa Wall. (BN-1060/SB)
Lonicera asperifolia (Dcne.) H & T. (BN-37/FM)
Lonicera myrtillus H. & T. (BN-267/MRS)
Morina longifolia Wall. ex DC. (BN-1203/F)
Morina coulteriana Royle (BN-1142/DRB)
Scabiosa canescens Waldst. & Kit. (BN-379/F)
Valeriana pyrolifolia Decne. (BN-760/FM)
Valeriana Wallichii Dc. (BN-1032/A)
Valeriana jatamansi Jones. (BN-485/SB)
Valerianella szovitsiana Fisch. & C.A. Mey. (BN-1149/MRS)

Caryophyllaceae
Arenaria serpyllifolia L. (BN-754/FM)
Cerastium fontanum Bau. Mg. (BN-901/SB)
Dianthus orientalis Adams (BN-1296/MRS)
Dianthus crinitus Sm. (BN-335/MRS)
Gypsophila cerastioides D. Don (BN-480/F)
Gypsophila ortegioides Boiss. (BN-313/F)
Sagina saginoides var. Hesperia Fernald (BN-1341/DRB)
Silene vulgaris (Moen.) Garke. (BN-1385/GL)
Silene conoidea L. (BN-357/DRB)
Silene gonosperma (Rupr.) Bocquet. (BN-351/HT)
Stellaria decumbens Edgew (BN-636/FM)
Stellaria media (L.) Vill. (BN-907/HT)

Celastraceae
Gymnosporia royleana Wall. ex M.A. Lawson (BN-532/SB)

Chenopodiaceae
Chenopodium foliosum (Moen.) A Sch. (BN-668/BL)

Convolvulaceae
Convolvulus arvensis L. (BN-28/SB)
Cuscuta erosa Yunck. (BN-1418/MRS)
Ipomoea purpurea (L.) Roth. (BN-1439/MRS)

Crassulaceae
Rhodiola wallichiana (Hook.) S.H.Fu. (BN-1473/F)
Sedum ewersii Ledeb. (BN-169/FM)
Sedum roseum (L.) Scop. (BN-77/GL)
Sedum hispanicum L. (BN-1230/A)

Cucurbitaceae
Melothria heterophylla (Lour.) Cogn. (BN-1518/MRS)

Elaeagnaceae
Elaeagnus parvifolia Wall. ex Royle. (BN-396/FM)

Euphorbiaceae
Ailanthus philippinensis Merr. (BN-486/SB)
Euphorbia clarkeana Hook. F. (BN-1352/HT)
Euphorbia heterophylla L. (BN-1505/F)
Euphorbia wallichii HK.t. (BN-112/GL)
Euphorbia helioscopia L. (BN-423/NS)

Fabaceae
Astragalus bakeri Eggleston ex A. Heller (BN-1150/MRS)

Astragalus grahamianus Benth. (BN-917/HT)
Astragalus laspurensis Ali (BN-1294/MRS)
Astragalus frigidus (L.) A. Gray. (BN-224/MRS)
Astragalus graveolens Benth. (BN-446/DRB)
Caesalpinia decapetala (Roth) Alston. (BN-511/SB)
Cicer macranthum M. Pop. (BN-770/GL)
Desmodium elegans DC. (BN-847/NS)
Indigofera gerardiana Wall. ex Baker. (BN-960/BL)
Indigofera heterantha Wall. ex Brand. (BN-965/NS)
Indigofera atropurpurea Hornem. (BN-1321/F)
Indigofera tinctoria L. (BN-458/SB)
Lathyrus laevigatus Arechav. (BN-920/A)
Lathyrus pratensis L. (BN-940/MRS)
Lathyrus aphaca L. (BN-190/MRS)
Lathyrus emodi (Fritsch) Ali. (BN-488/SB)
Lathyrus sphaericus Retz. (BN-491/MRS)
Lespedeza juncea (L.f.) Pers (BN-1137/DRB)
Lotus corniculatus L. (BN-495/MRS)
Medicago lupulina L. (BN-571/MRS)
Medicago minima (L.) L. (BN-887/BL)
Medicago polymorpha L. (BN-989/MRS)
Oxytropis lapponica (Wahl.) Gay. (BN-75/GL)
Pisum sativum L. (BN-326/BL)*
Robinia pseudoacacia L. (BN-471/MRS)
Trifolium repens L. (BN-854/NS)*
Trifolium resupinatum L. (BN-971/NS)
Trifolium hexanthum A. Heller (BN-325/BL)
Trigonella foenum-graecum L.(BN-1416/MRS)
Vicia faba var: Major L. (BN-205/SB)
Vicia bakeri Ali (BN-455/SB)
Vicia hirsuta (L.) Gray (BN-380/F)
Vicia monantha Retz. (BN-447/DRB)
Vicia montana Froel. ex W.D.J. Koch (BN-336/MRS)

Fagaceae
Quercus baloot Griff. (BN-397/F)
Quercus dilatata A. Kern. (BN-191/DRB)
Quercus incana Bartram. (BN-389/DRS)

Gentianaceae
Gentiana cachemirica Decne. (BN-1530/SB)
Gentianodes marginata (G. Don.) Omer, Ali & Qaisar (BN-255/NS)
Gentianopsis paludosa (Munro. HK.t.) (BN-517/SB)
Swertia ciliata (D. Don ex G. Don) B.L. Burtt (BN-910/HT)
Swertia cordata (Wall. ex G. Don) C.B. Clarke (BN-944/SB)
Swertia petiolata D. Don 9 (BN-1169/BL)

Geraniaceae
Erodium cicutarium (L.) L'Hér. (BN-220/MRS)
Geranium nepalense Sweet. (BN-293/MRS)
Geranium pusillum Burm. F. (BN-695/A)
Geranium wallichianum (D. Don.) ex Sweet. (BN-880/F)
Geranium collinum Stephan ex Willd. (BN-360/DRB)
Geranium sylvaticum L. (BN-176/SB)
Pelargonium zonale (L.) L'Hér. ex Aiton (BN-493/MRS)
Grossulariaceae
Ribes alpestre Decne. (BN-745/SB)
Ribes orientale Desf. (BN-1202/F)

Hamamelidaceae
Parrotiopsis jacquemontiana (Decne.) Rehder. (BN-156/DRB)

Hypericaceae
Hypericum perforatum L. (BN-301/SB)
Hypericum oblongifolium Choisy (BN-1467/MRS)

Juglandaceae
Juglans regia L. (BN-76/GL)

Lamiaceae
Ajuga bracteosa Wall. ex Benth. (BN-133/SB)
Ajuga parviflora Benth. (BN-342/MRS)
Calamintha umbrosa (M. Bieb.) Fisch & Mey. (BN-722/NS)
Clinopodium vulgare L. (BN-321/DRB)
Eremostachys superba Royle. ex Benth. (BN-403/F)
Hyssopus officinalis L. (BN-1175/HT)
Isodon rugosus (Wall. ex Benth.) Codd (BN-1358/SB)
Leucas mollissima Wall. ex Benth. (BN-1351/HT)
Lamium album L. (BN-475/F)
Lamium amplexicaule L. (BN-577/SB)
Lycopus europaeus L. (BN-148/SB)
Mentha arvensis L. (BN-1430/MRS)
Mentha longifolia(L.) Huds. (BN-1476/F)
Mentha aquatica L. (BN-502/DRB)
Micromeria biflora (Buch.-Ham. ex D. Don) Benth. (BN-753/FM)
Nepeta laevigata (D. Don) Hand.-Mazz. (BN-939/SB)
Nepeta clarkei Hook.f. (BN-484/SB)
Nepeta podostachys Benth. (BN-1174/HT)
Nepeta praetervisa Rech. f. (BN-1241/A)
Nepeta prattii H.Lév. (BN-1161/MRS)
Nepeta raphanorhiza Benth. (BN-183/MRS)
Origanum vulgare L. (BN-299/MRS)
Otostegia limbata (Benth.) Boiss. (BN-341/MRS)
Plectranthus rugosus Wall. ex Benth. (BN-1458/MRS)
Prunella vulgaris L. (BN-105/FM)
Salvia lanata Roxb. (BN-345/HT)
Salvia plebeia R. Br. (BN-916/HT)
Salvia moorcroftiana Wall. ex Benth. (BN-1042/A)
Salvia nubicola Wall. ex Sweet (BN-1143/DRB)
Salvia splendens Sellow. ex Schult. (BN-407/F)
Scutellaria edelbergii subsp. *Edelbergii* Rech. f. (BN-1345/DRB)
Scutellaria petiolata Hem. & Lace. (BN-3/SB)
Scutellaria heydei Hook. f. (BN-748/NS)
Stachys emodi Hedge. (BN-932/NS)

Stachys parviflora Benth. (BN-507/DRB)
Teucrium abutiloides L'Hér. (BN-238/BL)
Thymus linearis Benth. (BN-683/SB)

Lauraceae
Persea duthiei (King) Kosterm. (BN-1140/DRB)

Lythraceae
Lagerstroemia indica L. (BN-337/MRS)
Punica protopunica Balf. F. (BN-481/SB)

Malvaceae
Lavatera cashemiriana Cambess (BN-914/HT)
Malva neglecta Wallr. (BN-947/SB)
Malva sylvestris L. (BN-905/SB)
Malva parviflora L. (BN-418/MRS)

Melanthiaceae
Trillium govanianum Wall. ex D.Don (BN-1532/SB)

Moraceae
Broussonetia papyrifera (L.) L'Hér. ex Vent. (BN-184/MRS)
Ficus carica L. (BN-1437/MRS)

Oleaceae
Jasminum humile L. (BN-463/MRS)
Jasminum officinale L. (BN-619/HT)
Olea ferruginea Wall. ex Aitch. (BN-1417/DRS)

Onagraceae
Epilobium hirsutum L. (BN-1061/SB)
Epilobium laxum Royle. (BN-1186/A)
Epilobium angustifolium L. (BN-1247/HT)
Oenothera rosea L'Hér. ex Aiton. (BN-530/SB)

Orobanchaceae
Euphrasia himalayica wetts. (BN-139/MRS)
Pedicularis pectinata Wall. ex Genth. (BN-208/SB)
Pedicularis punctata Decne. (BN-1173/HT)

Oxalidaceae
Oxalis corniculata L. (BN-187/MRS)

Paeoniaceae
Paeonia emodi Wall. ex Royle. (BN-401/F)

Papaveraceae
Corydalis govaniana Wall. ex Tent. (BN-584/MRS)
Corydalis diphylla Wall. (BN-677/A)
Fumaria indica (Hausskn.) Pugsley (BN-808/FM)
Fumaria parviflora Lam. (BN-1012/SB)
Papaver dubium L. (BN-494/MRS)
Papaver hybridum L. (BN-566/NS)
Papaver pavoninum C.A. Mey. (BN-527/MRS)
Papaver rhoeas L. (BN-312/F)
Papaver somniferum L. (BN-919/A)

Phytolaccaceae
Phytolacca acinosa Roxb. (BN-1517/MRS)

Plantaginaceae
Gratiola officinalis L. (BN-503/DRB)
Plantago lanceolata L. (BN-590/MRS)
Plantago major L. (BN-685/SB)
Plantago ovata Forssk. (BN-374/GL)
Veronica lanuginose Benth. ex HK.F. (BN-576/SB)
Veronica laxa Benth. (BN-576/SB)
Veronica anagallis-aquatica L. (BN-593/SB)
Veronica beccabunga L. (BN-1235/MRS)
Veronica biloba schreb. ex L. (BN-528/MRS)
Veronica persica Poir. (BN-581/SB)

Platanaceae
Platanus orientalis L. (BN-821/SB)

Plumbaginaceae
Acantholimon lycopodioides (Girard.) Boiss. (BN-1144/MRS)

Polygonaceae
Aconogonon alpinum (All.) Schur. (BN-204/SB)
Bistorta affinis (D. Don.) Green. (BN-645/GL)
Oxyria digyna (L.) Hill. Hart. (BN-870/F)
Persicaria capitata (Buch.-Ham.) H.Gross (Bn-1003/H)
Polygonum aviculare L. (BN-1350/HT)
Polygonum barbatum L. (BN-1493/MRS)
Polygonum paronychioides C.A. Mey. (BN-32/BL)
Polygonum plebeium R. Br. (BN-1480/F)
Polygonum posumbu Ham. ex D. Don. (BN-9/MRS)
Polygonum hydropiper L. (BN-376/F)
Rheum australe D. Don (BN-1537/SB)
Rumex alpine Spring. (BN-153/MRS)
Rumex nepalensis Baker & C.H. Wright (BN1359/SB)
Rumex dentatus L. (BN-1376/GL)
Rumex hastatus D. Don (BN-52/A)

Primulaceae
Anagallis arvensis L. (BN-168/FM)
Androsace rotundifolia Hard. (BN-499/MRS)
Androsace sempervivoide Jacq. ex Duby. (BN-512/SB)
Androsace cordifolia Wall. (BN-582/RC)
Myrsine africana L. (BN-1469/F)

Primula denticulata Smith (BN-129/MRS)
Primula rosea Royle. (BN-1275/A)
Primula schlagintweitiana Pax (BN-233/BL)

Ranunculaceae
Aconitum heterophyllum Wall. ex Royle (BN-1516/MRS)
Aconitum violaceum Jacq.ex stpf. (BN-1535/SB)
Actaea spicata L. (BN-54/A)
Anemone obtusiloba D. Don. (BN-95/A)
Aquilegia nivalis Fak.ex Jackson. (BN-103/FM)
Aquilegia pubiflora Wall. ex Royle. (BN-408/F)
Clematis grata Wall. (BN-425/NS)
Clematis graveolens Lindl. (BN-1290/MRS)
Delphinium ajacis L. (BN-1424/MRS)
Delphinium denudatum Wall. ex Hook. F. & Thomson (BN-1442/SB)
Delphinium recurvatum Greene (BN-1428/MRS)
Ranunculus gramineus L. (BN-1448/SB)
Ranunculus aquatilis L. (BN-381/F)
Ranunculus arvensis L.(BN-524/MRS)
Ranunculus laetus Wall. Ex Hook. F. & J.W. Thomson (BN-763/GL)
Ranunculus munroanus J.R. Drumm. Ex Dunn (BN-24/SB)
Ranunculus muricatus L. (BN-368/GL)
Ranunculus sceleratus L. (BN-385/SB)
Trollius acaulis Lindley. (BN-94/A)

Rhamnaceae
Sageretia theezans (Vahl) Brongn. (BN-182/MRS)

Rosaceae
Cotoneaster racemiflorus (Desf.) K. Koch (BN-395/FM)
Cotoneaster integerrimus Medik. (BN-1375/GL)
Cotoneaster nummularius Fisch. & C.A. Mey. (BN-1178/HT)
Cotoneaster microphyllus Wall. Ex Lindl. (BN-394/FM)
Crataegus songarica C. Koch. (BN-1531/SB)
Duchesnea indica (Jacks.) Focke. (BN-243/SB)
Filipendula vestita (Wall. ex G. Don) Maxim. (BN-1528/BL)
Fragaria indica Andrews (BN-1419/MRS)
Fragaria vesca Lind.ex Hk. f. (BN-56/GL)
Fragaria nubicola (Lindl.Ex Hook.f.) Lacaita (BN-370/GL)
Potentilla anserina L. (BN-759/FM)
Potentilla atrosanguinea Lodd. (BN-246/SB)
Potentilla nepalensis Hk. (BN-707/A)
Potentilla reptans L. (BN-32/MRS)
Potentilla supina L. (BN-506/DRB)
Prunus cerasoides D. Don. (BN-701/A)
Prunus cornuta (Wall. ex Royle.) Steud. (BN-170/FM)
Prunus prostrata HK.t. (BN-175/SB)
Pyrus pashia var. *sikkimensis* Wenz. (BN-902/SB)
Prunus cerasus L. (BN-365/DRB)
Prunus domestica L. (BN-489/SB)
Pyrus communis L. (BN-452/SB)
Rosa canina L. (BN-904/SB)
Rosa moschata Mill. (BN-1481/F)
Rosa webbiana Wall. ex Royle. (BN-212/FM)
Rosa brunonii Lindl. (BN-257/A)
Rosa multiflora Thunb. (BN-279/SB)
Rubus ellipticus Sm. (BN-424/NS)
Rubus fruticosus Auct. (L.) (BN-504/DRB)
Rubus sanctus Schreb. (BN-1034/A)
Rubus ulmifolius Schott (BN-1146/MRS)
Sibbaldia cuneata Kunze (BN-1373/GL)
Sorbaria tomentosa (Lind.) Rehder (BN-68/SB) *Spiraea canescens* D.Don (BN-521/MRS)

Rubiaceae
Galium aparine L. (BN-831/A)
Galium elegans Wall. (BN-850/NS)

Rutaceae
Dictamnus albus L. (BN-46/A)
Skimmia laureola Franch. (BN-1502/F)
Zanthoxylum armatum D.C. (BN-426/NS)

Salicaceae
Populus alba L. (BN-711/F)
Populus nigra L. (BN-207/SB)
Salix alba L. (BN-713/HT)
Salix pycnostachya Anderson. (BN-731/NS)
Salix tetrasperma Roxb (BN-124/MRS)
Salix flabellaris Andersson (BN-616/HT)
Salix acmophylla Boiss. (BN-482/SB)

Santalaceae
Viscum album L. (BN-718/HT)

Sapindaceae
Acer cappadocicum Gled. (BN1138/DRB)
Acer caesium Wall. ex Brandis. (BN-96/A)

Saxifragaceae
Bergenia stracheyi (H&T.) Engl. (BN-125/MRS)
Bergenia ciliata (Haw.) Sternb. (BN-793/FM)
Saxifraga flagellaris Willd. (BN-266/MRS)

Scrophullariaceae
Buddleja crispa Benth. (BN-303/SB)
Buddleja asiatica Lour. (BN-431/A)
Scrophularia nodosa L. (BN-743/SB)
Verbascum thapsus L. (BN-1156/MRS)

Solanaceae
Atropa acuminata Royle (BN-1431/MRS)
Capsicum annuum L. (BN-1491/MRS)
Datura stramonium L. (BN-392/FM)
Hyoscyamus niger L. (BN-1058/SB)
Lycium edgeworthii Dunal. (BN-1141/DRB)

Lycopersicon esculentum Mill. (BN-1415/MRS)*
Petunia alba M.C. Ferguson & Ottley (BN-1450/SB)
Solanum nigrum var *nigrum* L. (BN-1273/A)
Solanum surattense Burm. F. (BN-1506/F)
Solanum pseudocapsicum L. (BN-1454/MRS)
Withania somnifera (L.) Dunal (BN-1482/F)

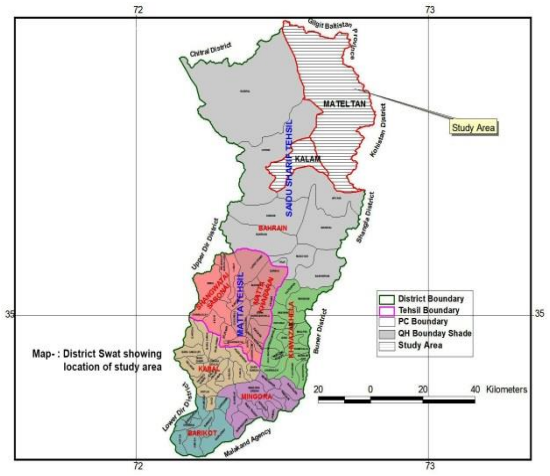
Tamaricaceae
Myricaria germanica (L.) Desv. (BN-244/SB)

Thymelaeaceae
Daphne mucronata Royle. (BN-404/F)
Daphne papyracea Wall. Ex G. Don (BN-936/NS)
Wikstroemia canescens Wall. Ex Meisn. (BN-329/BL)

Urticaceae
Debregeasia saeneb (Forssk.) Hepper & J.R.I. Wood (BN-362/DRB)
Urtica dioica L. (BN-1412/MRS)
Urtica urens L. (BN-1434.MRS)

Verbenaceae
Verbena officinalis L. (BN-1459/MRS)

Violaceae
Viola biflora L. (BN-122/BL)
Viola canescens Wall. ex Roxb. (BN-726/NS)
Viola tricolor L. (BN-1457/MRS)
Viola alba Besser (BN470/MRS)



Map 1: District Swat showing location of the study area (The area lies between: 35° 22 to 35° 53 North latitudes and 72°28 to 72°49 East longitudes)

Discussion

Study of floristic composition of vegetation is crucial for conservation management by providing habitats for wildlife and contributing to the ecologically sustainable management of natural resources (Ahmad & Ehsan, 2012).

Many researchers have worked on plant biodiversity especially in northern parts of Pakistan, among these Hussain and Shah, (1989) carried out phytosociolgial studies on Docut hills district Swat and found 5 main community types on different slopes.

Map 2: Prominent villages in the study area

They concluded that the original vegetation has changed to open grassland due to ecological factors like deforestation and overgrazing accompanied by soil erosion. Chaudhri and Qureshi (1991) indicated that as many as 709 species of the vascular plants of Pakistan, constituting about one tenth of the vascular flora is in danger of being gradually wiped out or exterminated altogether.

Haq (2011) reported 37 taxa including 14 critically endangered and 23 endangered species. Loss of habitat, unplanned collection, deforestation, overgrazing and erosion, attack of pathogens and effects of introduced taxa were the major threats to the vegetation. Alam & Ali (2010) determined conservation status of 19 taxa according to IUCN Red list categories and criteria, they stated that the rate of plant extinction has reached to one species per day as a result of anthropogenic activities and it is considered 1000–10,000 time faster than that would occur naturally (Hilton-Taylor, 2000; Akeroyd, 2002). If the trend remains constant, 60,000 to 100,000 plant species may disappear in the near future (Akeroyd, 2002; Bramwell, 2002).

During the present research endeavor 529 plant species were collected from research area, habit wise classification showed that there were 412 herb species (77.88%), 80 shrubs species (15.12%) and trees being 37 (6.99%) (Fig. 3). Life form analysis according to Raunkiaer 1939 revealed that therophytes was the most abundant class represented by 193 plant species (36%) followed by Phanerophytes 113 (21%), Hemicryptophytes 70 (13%) & Helophytes 54 (10%), the least abundant classes were epiphytes & parasitic plant species numbered 2 (0.37%) & 1 (0.18%) respectively (Fig. 4).

These 529 vascular plant species identified from the field, belonging to 312 genera and 85 families. It also includes 14 species of Pteridophytes and 11 species of gymnosperms (Fig. 2) the split of angiosperms showed that monocotyledons consisted of 57 species of 38 genera and 10 families, while dicotyledons group belonged 447 species of 259 genera and 65 families.

The spectral analysis of the families showed that Asteraceae was the largest family represented by 52 species (9.82%), followed by Lamiacea (37 spp., 6.99%), Fabaceae (34 spp., 6.42%, Rosaceae (34 spp., 6.42%), Poaceae (28 spp., 5.29%) and Brassicaceae (26 spp., 4.91%).

Other larger families represented by 10 or more species are Brassicaceae (22 spp.), Cyperaceae (18 spp.), Solanaceae (15 spp.), Polygonaceae (14 spp.), Amaranthaceae (12 spp.), Ranunculaceae, Boraginaceae and Euphorbiaceae (10 spp. each).

All these larger families collectively contributed 61.24% of the total species which reveals greater ecological adaptation of these species especially in the lower altitudinal ranges of the study area this fact is also evident from similar studies conducted by Hamayun *et al*. 2006 & Ilyas *et al*. 2013.

The present study revealed that the number of vascular plant species in Kalam valley is higher than many areas of comparable size (Table 1). The total area of Kalam valley is 84000 hectares (MRDP 2003) which constitute 0.105% of the total area of Pakistan (79.61mill. Hec.), but the present list has 529 species which constitute 9.14% of the total 5783 species as reported by Stewart (1972).

The area of Kalam Valley is 15.7% of the total Swat district (533700hec.) but the number of species is 34.32% of the total reported for the Swat state by Stewart (1967).

The number of gymnosperm species recorded in the present survey is more as compared to majority of the floristic studies conducted in rest of Pakistan and is in conformity with findings of Akhtar, N 2014 which suggest that climate and other topographical factors prevailing in the area supports thick forests abundant in gymnosperm species.

Majority of the plant species used for building and firewood purposes including *Abies pindrow, Picea smithiana, Pinus Willichiana, Cedrus deodara* are being cut ruthlessly by the local population whose population density has been considerably reduced compared to the last ten years, these findings match results obtained by Ahmad *et al*. 2014 from Chail valley swat. Similarly some of the most important medicinal plants including *Achyranthes aspera* (local name Geshkay), *Bunium persicum* (Local name Zeera), *Acorus calamus* (Skha waja), *Berberis lyceum* (Local name Hez, Kwaray), *Dioscorea deltoidea* (local name Kanis), *Ephedra gerardiana* (local name somani), *Corydalis govaniana* (Mamera), Colchicum luteum (local name chunar phund), *Paeonia emodi* (Mamaikh),

Podophyllum emodi (local name Banasher/ Kakora), *Rheum australe* (Khotial), Aconitum violaceum (Local name Zahar mora), *Aconitum heterophyllum,* (local name Sarba Zailay), *Valeriana pyrolifolia* (local name Mushke-bala) *Viola canescens* (local name Banafsha/ Kotan pel), are under severe biological stress which needs serious conservation measures to prevent possible extinction of these plants from the area, similar reports have also been recorded by (Shinwari, 2003, Hamayun *et al* 2006).

The species variation in plants from site to site may be due to the soil type, composition of soil, elevation of selected sites, moisture content of soil, nature of disturbance like grazing pressure, human interference, distance of study site from population area etc.

All these factors determine the category of species in which the species fall (Ahmad *et al.*, 2007). This paper provides a considerably up-to-date checklist for the kalam valley but still due to harsh environmental conditions including severe snow fall, unpredictable land sliding, non-accessibility and the like.

Some of the potential plant habitats have not been explored properly, It is intended that this can provide a springboard to future botanists and members of the conservation community to explore the diversity of this area and facilitate future plant diversity initiatives.

Table 1. Statistical evaluation of number of plant species in different groups and their comparison to number of plants in District Swat and Pakistan.

Plant group	Number of species			Percentage proportion of species compared to	
	Kalam valley (Area=84000hec.)	Swat District (Stewart, 1967) (Area=533700hec.)	Pakistan (Stewart, 1972) (Area=79.61mill. hec.)	Swat district (Area=15.7 %)	Pakistan (Area=0.105%)
Pteridophytes	14	55	128	25.5	10.9
Gymnosperms	11	13	23	84.6	47
Monocotyledons	57	306	1140	18.6	5
Dicotyledons	447	1167	4492	38.3	10
Total	529	1541	5783	34.32	9.14

Conclusions

The present research endeavor strongly reveals that Kalam valley due to its peculiar topography and edaphoclimatic features is home to some of the most valuable and rare ethno botanically important plants and highly favors the growth of tall coniferous trees. The study area is also unique regarding the occurrence of short lived small herbaceous plants which are found very close to snow line and most of which belongs to family Brassicaceae. As the area is located at the junction point of three big mountain chains *i.e.* Hindukush, Himalaya and Karakorum, so this blend is also expressed in vegetation but some species are specifically endemic to Kalam valley and cannot be found in other part of the country. The research area is under fierce biological stress in the form of deforestation, burning of forest for coal purposes, severe grazing, unplanned construction of infra-structure, frequent forest fires which is likely to reduce the biodiversity of vascular plants in the area. Illegal hunting of many valuable and threatened animals by the locals and outsiders is likely to disturb homeostatic process and productivity of the forest ecosystem. Population of many valuable medicinal plants identified by the author is likely to reduce with in few years to a very drastic level which needs strict conservational strategies on the part of provincial government and local community concerned.

Recommendations

Due to multiple anthropogenic activities, the vegetation cover over the years has been disproportionality reduced which can be replaced to some extent by afforestation and reforestation. Local community, social sector and other stack holders should be involved to manage and monitor important territories specified for ex-situ conservation of species. There is earnest need of effective legislation on the part of Government in the areas of town planning, over grazing, illegal cutting of trees and encroachment of forests by the local population. The present list could be an easy source of material to ethnopharmaco-botanical studies. The flora found in the area may be an interest model for future studies dealing with ecological, morphological, physiological, and reproductive aspects.

Additional research should be conducted to evaluate the intrinsic ecological values of the local flora and to incorporate characteristics of species composition with ecological functions (Zhao *et al*., 2010).

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Declaration of interest

The authors do not have any conflict of interest with people or any organization.

Authors agreement

The authors have read the article and agree with the contents of the article.

References

Ahmad H, Khan S, Hamayun M. 2004. Ethnobotanical resources of Manikhel forests, Orakzai Tirah, Pakistan Journal Ethno botany. Leaflets www.siu.edu/~ebl/.

Ahmad I, Ibrar M, Ullah B, Ali N. 2011. Ethnobotanical Study of Tehsil Kabal, Swat District, KPK, Pakistan. Pakistan Journal of Botany **43(1),** 1-9.

Ahmad KM, Hussain M, Ashraf ML, Uqman MY, Ashraf Khan ZI. 2007. Indigenous vegetation of Soone Valley at the risk of extinction. Pakistan Journal of Botany **39(3),** 679-690.

Ahmad MS, Sultana SF, Hadi TB, Hadda S, Rashid M, Zafar MA, Khan MPZ, Khan Yaseen G. 2014. An Ethnobotanical study of Medicinal Plants in high mountainous region of Chail valley (District Swat-Pakistan). Ahmad *et al.* Journal of Ethnobiology and Ethnomedicine **10**, 36.
www.ethnobiomed. com/content/10/1/36

Ahmad SS, Ehsan H. 2012. Analyzing the herbaceous flora of lohi bher wildlife park under variable environmental stress. Pakistan Journal of Botany **44(1),** 11-14.

Akeroyd J. 2002. A rational look at extinction.Plant Talk, **28**: 35-37.

Akhtar N, Bergmeier E. 2015. Species richness, alpha and beta diversity of trees, shrubs and herbaceous plants in the woodlands of Swat, Pakistan. Pakistan journal of botany. Volume **47,** Number 6 (2015:Dec.); 201512; 2107-2114 - Pakistan Botanical Society.

Alam J, Ali SL. 2010. Conservation status of AstraglusgilgitensisAli (Fabaceae): a critically endangered species in Gilgit district, Pakistan. Phyton (Horn, Austria) **48(2),** 211-223.

Ali SI, Nasir (Eds.) YJ. 1989-1992. Flora of Pakistan. Islamabad, Karachi.

Ali SI, Qaiser (Eds.) M. 1995-2012. Flora of Pakistan. Department of Botany, University of Karachi.

Ali SI, Qaiser (Eds.) M. 1995-2012. Flora of Pakistan. Department of Botany, University of Karachi.

Anon. 2012a. The International Plant Names Index (IPNI). < http://www.ipni.org>

Anon. 2012a. The International Plant Names Index (IPNI). <http://www.ipni.org>

Anon. 2012b. The Plant List; a working list of all plant species. http://www.theplantlist.org

Anon. 2012b. The Plant List; a working list of all plant species. http://www.theplantlist.org

Anonymous. 1999. District Census Report, Swat. Population census organization, Statistics Division, Government of Pakistan, Islamabad. p. 198- 201.

Balck MJ. (1996). "Transforming ethnobotany for the new millennium." Annals of the Missouri Botanical Garden, **83,** 58-66.

Begum. 2003. Marketing of medicinal plants of Utror-Gabral Valleys, Swat, Pakistan. Journal Ethno botany Leaflets.
www.siu.edu/~ebl/

Bramwell D. 2002. How many plant species are there? Plant Talk, **28,** 32-34.

Chaudhri and Qureshi. 1991. Indicated that as many as 709 species of the vasvular plasnts of Pakistan, constituting about one tenth of the vascular flora, are in danger of being gradually wiped or exterminated altogether.

District Census Report. 1998. Population census organization, Statistics Division, Government of Pakistan, Islamabad p. 198- 201.

Fazal H, Ahmad N, Rashid A, Farooq S. 2010. A checklist of phanerogamic flora of Haripur Hazara, Khyber Pakhtunkhwa, Pakistan. Pakistan Journal of botany **42(3),** 1511-1522.

Funk VT, Hollowell P, Berry C, Kelloff S, Alexander N. 2007. Checklist of the Plants of the Guiana Shield (Venezuela: Amazonas, Bolivar, Delta Amacuro; Guyana, Surinam, French Guiana). Contributions from the United States National Herbarium **55,** 1- 84.

Hamayun M. 2005. Studies on ethnobotany, conservation and plant diversity of Utror and Gabral valleys, District Swat, Pakistan. Ph.D Dissertation. pp. 79-81.

Hamayun M, Khan SA, Sohn EY, Lee I. 2006. Folk medicinal knowledge and conservation status of some economically valued medicinal plants of District Swat, Lyonia **11(2),** 101-113.

Haq F. 2011. Conservation status, threats and recommendations of the critically endangered and endangered species in Nandiar Khuwar catchment District Battagram, Pakistan. international journal of biological conservation **3(2),** 27-35.

Haq FU, Ahmad H, Alam M, Ahmad I, Ullah R. 2010. Species diversity of vascular plants of Nandiar Valley Western Himalaya, Pakistan. Pakistan Journal of Botany **42(S.I.),** 213-229.

Hilton-Taylor C. 2000. IUCN Red List of Threatened Species. IUCN Gland, Switzerland and Cambridge UK.

Hussain F, Aleem shah. 1989. Phytosociology of vanishing Subtropical Vegetation of swat with.

Hussain F. Field and laboratory manual of plant ecology. NAHE, UGC, Islamabad 1989.

Hussain F, Ilahi I. 1991. Ecology and Vegetation of Lesser Himalayas, Pakistan. Department of Botany, University of Peshawar p. 187.

Hussain F, Khaliq A, Durani MJ. 1996. Ethnobotanical studies on some plants of Dabargai hills, district Swat, Pakistan. Proc. First Train. Workshop Ethnob. Appl. Conser., PARC, Islamabad p. 207-215.

Ilahi I, Hussain F. Modern Trends of Plant Science Research in Pakistan Proc. 3rd National Conference Plant Scientists pp. 253-258.

Ilyas M, Qureshi R, Arshad M, Mirza SN. 2013. A preliminary checklist of the vascular flora of kabal valley, swat, Pakistan. Pakistan Journal of Botany **45(2),** 605-615.

Keith DA. 1988. Floristic lists of New South Wales (III). Cunninghamia **2(1),** 39-73.

Khan HA. Working plan for protected forests of Bahrain Tehsil (Swat District), 1995-96 to 2009-10. Peshawar Pakistan: NWFP Forest Department 1995.

Khan RS, Ahmad QS, Khan BA. 1996. Impact/Solution of fuel shortage on Conser. of Biodiversity of Hindu-Kush Himalayas region of Pakistan. Proc. First Train. Workshop Ethnob. Appl. Conser., PARC, Islamabad p.171-176. Text was searched but 1996 is missing with Khan *et al.*

Nakaike T, Malik (Eds.) S. 1992-1993. Cryptogrammic Flora of Pakistan. National Science Museum, Tokyo. Pakistan. Lyonia **11(2),** 101-113.
Nasir E, Ali (Eds.) SI. 1970-1989. *Flora of Pakistan*, Islamabad, Karachi.

Qureshi R. 2008. Preliminary floristic list of Chotiari wetland Complex, Nawab Shah, Sindh, Pakistan. Pakistan Journal of Botany **40(6),** 2281-2288.

Qureshi R, Bhatti GR. 2010. Floristic inventory of Pai forest, Nawab Shah, Sindh, Pakistan. Pakistan Journal of Botany **42(4),** 2215-2224.

Qureshi R, Bhatti GR, Shabbir G. 2011a. Floristic inventory of Pir Mehr Ali Shah Arid Agriculture University Research Farm at Koont and its surrounding areas. Pakistan Journal of Botany **43(3),** 1679-1684.

Qureshi R, Khan WA, Bhatti GR, Khan B, Iqbal S, Ahmad MS, Abid M. 2011b. First report on the biodiversity of Khunjerab National Park, Pakistan. Pakistan Journal of Botany **43(2),** 849-861.

Rashid A, Hussain F, Ilahi I. 1987. A checklist of the flora of Attock-Nizampur Valley, District Peshawar In (Eds.).

Raunkiaer C. 1934. The Life Forms of Plants and Statistical Plant Geography. Clarendon Press Oxford.

Saima S, Dasti AA, Hussain F, Wazir SM, Malik SA. 2009. Floristic compositions along an 18km long Transect in Ayubia National Park district Abbottabad, Pakistan. Pakistan Journal of Botany **41(5),** 2115-2127.

Saima S, Dasti AA, Abbas Q, Hussain F. 2010. Floristic diversity during monsoon in Ayubia National Park, District Abbottabad, Pakistan. Pakistan Journal of Plant Sciences **16(1),** 43-50.

Shah M, Hussain F. 2012. Conservation assessment of plant resources of Chakesar valley, district Shangla, KPK, Pakistan Pakistan Journal of Botany **44,** 179-186. Special Issue May 2012.

Sheerin, Z. 2002. Ethnobotanical plants of Kalam valley, Swat. M.Sc Thesis, Univ.Peshawar pp. 36-46.

Sirajuddin H, Ahmad M, Rahman & Ghafoor S. 2005. Floristics and natural resources of mount eelumsw a t international journal of chemical and pharmaceutical research Vol. **2(2),** pp. 27I-277.

Ullah A, Rashid A. 2014. Conservation status of threatened medicinal plants of Mankial Valley Hindukush Range, Pakistan international journal of biodiversity conservation Vol. **6(1),** pp. 59-70,
DOI: 10.5897/IJBC2012 .123 ISSN 2141-243X © 2014

Yalcin E, Kilinc M, Kutbay HG, Bilgin A, Korkmaz H. 2011. Floristic properties of lowland meadows in Central Black Sea Region of Turkey. EurAsian journal of BioSciences **5,** 54-63.