A Brief Overview of Vegetation of Pangi Valley (Chamba, Himachal Pradesh): A High Altitude Region of Northwest Himalaya, India

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Preliminary survey was conducted in the Pangi Valley which is an an high altitude region of Northwest Himalaya, India. Pangi Valley has been least studied for floristic studies except for few cytological and ethnobotanical studies. Pangi was excluded in Flora of Chamba District and there is not much information on the vegetation. With the ever increasing population and, stress on natural resources for human needs, Pangi is now headed to a road for development. This area which hold enormous potential of vast floral and faunal genetic diversity requires to be explored before it is too late. The current attempt aims to present a general overview of the vegetation and information about some important plants of this geographically important cold desert region of India.

Keywords: Chamba, Himalayas, medicinal plants.

Pangi valley lies in the north-western extremity of Himachal Pradesh in the Chamba district. This is a cold arid region in the Trans Himalayas where rough terrain, scanty rainfall, harsh weather conditions and heavy snowfall are prominent features. Pangi is a high altitudinal remote tribal area with an eye catching natural beauty. It is bordered by two mountain ranges i.e. the Great Himalayan Range and the Pir Panjal Range and drained by river Chandrabhaga. Geographically the area lies between 32º 12' 41" to 32º 47' 59" N latitude and 76º 13' 56" to 76º 47' 48" E longitude with an elevation ranges from 2006 to 6168m (average elevation 4008 m), spreading over an area of 1600 sq km.

Pangi valley is a part of Pangi tehsil of Chamba district with its headquarters at Killar. Killar can be reached by road from Chamba via Sach Pass, from Udaipur and from Dharwas. The high altitudinal passes remain close during most of the months of a year (October- June) due to heavy snowfall cutting the valley from rest of the country. Due to these geographical and climatic barriers Pangi has been remotely developed, culturally isolated and has preserved its untouched biological diversity. Chandrabhaga (Chennab) flows in the south north direction cutting the valley into two almost equal halves. The river on its due course through the valley forms deep narrow gorges and valleys with steep slopes. Number of small streams also called Nallas flow through the entire valley and some are major tributaries of Chennab (Sechu Nalla, Luj Nalla, Twan Nalla, etc). These small streams form a criss cross pattern in the valley which is life supporting system for faunal and floral elements of the valley.

Pangi lies in the semi arid zone of inner Himalayas. This is a rain shadow area as high mountain peaks do not allow the heavy monsoon winds to reach the valley making the climatic conditions harsh. Most of the precipitation here is in the form of snow fall along with avalanches. The temperature shows great fluctuation during the different months of the years. It takes a dip below mercury during the colder months of the year i.e. winters accompanied by strong winds. Summers are warmer with temperature rise of more than 25º C. Pangi valley comes under cold and dry zone as per agro climatic conditions.

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Pangi is sub divided into three major (Hudan, Sural, Saichu) and four minor valleys. The region is remotely habituated with villages at far distance. The region is habituated mostly by Bhot and Pangwal tribal people. The higher altitudinal sub valleys are called Bhatoris. Hinduism and Buddhism are the two major religions followed along with worship of local deities. Pangwali and Bhoti are the spoken languages. Saichu Tuan Nala Wild Life Sanctuary has been established in the valley for the protection and conservation of wildlife and plant wealth of the valley. The WLS is spread over a wide area 390.29 square kilometres, with an altitudinal range of 2500 to 6072 meters including glaciers and high alpine grasslands. This is home to endangered snow leopards. Some of them are Capra sibirica (Ibex), Hemitragus jemlahicus (himalayan thar), Ursus arctos (brown bear), Ursus thibetanus (black bear), Moschus chrysogaster (musk deer), Uncia uncia (snow leopard). The birds include the Monal and Cheer pheasants, Himalayan western tragopan, Snow peacock, Himalayan woodpecker, Snow pigeon, and Black beaded jay.

Pangi Valley has been least studied for floristic studies (Watt 1881); for cytological studies which remained confined to of dicot plants (Kumar et al., 2011; Rana et al., 2012, 2013; Singhal et al., 2009, 2011a, 2011b); for ethnobotanical studies (Rana et al. 2014; Dutt et al. 2014). Bhattacharya and Uniyal (1980) reported very few species from Pangi locality and more stress was laid on Trilokinath region. Pangi was excluded in Flora of Chamba District (Singh and Sharma 2006) and there is no comprehensive account of vegetation. With the ever increasing population and, stress on natural resources for human needs, Pangi is now headed to a road for development. This area which hold immense potential of vast floral and faunal genetic diversity needs to be accessed before it is too late. The study aims to present a general overview of the vegetation of this geographically important cold desert region of India.

Intensive field surveys and rapid sampling of vascular plants from different localities of Pangi Valley was done to explore the area from 2015-2016. A precise note was made on common plant species along with relevant details. Species identification was done consulting regional floras Flora of British India (Hooker 1872-1897), Flora of Lahaul-Spiti (Aswal and Mehrorta 1994), Flora of Cold Deserts of western Himalayas V-1 and V-2 (Murti 2001; Shrivastava and Shukla 2015), Flora of Kullu (Dhalwal and Sharma 1999), Flora of Himachal Pradesh (Chowdhery and Wadhwa 1984), Flora of Chamba (Singh and Sharma 2006). Further confirmation of the plant specimens has been done from Herbaria, Botanical Survey of India, Dehra Dun (BSD) and Forest Research Institute, Dehradun (DD). Photographs were taken for important plants.

Pangi is rich in terms of floral diversity and is home to some rare, endemic and endangered plant species. It is thickly forested at lower altitudes. Pinus, Cedrus, Picea, Abies, Taxus, Juniperus, Populus, Salix, Juglans, Betula and Acer are the dominant tree species in the valley area. The higher altitudes above 4500 meters remain snow bound and are a glacier region. Herbaceous elements are most frequently found in the moist forest slopes near streams or the untouched areas such as subalpine and alpine grass lands or the valley bottom i.e. deep gorges and river banks. The herbaceous flora is dominated by elements belonging to plant families Fabaceae, Asteraceae, Poaceae, Rosaceae etc.

The plants of the high altitudinal cold desert valley have gone under a number of morphological, ecological and physiological adaptations to survive in the harsh climatic conditions prevailing in valley. These are, development of a deep and strong extensive root system, underground modified stem i.e. rhizomes and bulbs, stunted growth with shrubby appearance, frost resistance, accumulation of starch grains in chloroplasts, vegetative reproduction with reduced sexual life cycle and an efficient seed dispersal mechanism.

The vegetational wealth of Pangi Valley can be categorized into the following types: Himalayan Temperate Vegetation

This type of vegetation occurs in an altitudinal range of 2000–2,800 m. The vegetation comprises of Himalayan temperate type. Abies spectabilis, Acer pentapomicum, Cedrus deodara, Juniperus macropoda, Picea smithiana, Pinus gerardiana, Pinus wallichiana and Taxus wallichiana form the tree canopy. Populus citata and Salix viminalis are the broad leaf planted tree species. Herbs and shrubs are constituted by Allium humile, Allaria officinalis, Arabidopsis...
thaliana, Berberis lycium, Caltha palustris, Daphne oleoides, Epilobium angustifolium, Geranium nepalense, Lonicera quinquelocularis, Prunus cornuta, Ribes orientale, R. nigrum, Rosa webbiana, Rubus saxatilis, R. foliolosus, R. maclentus, Sisymbrium orientale, Asplenium trichomanes and Sorbus foliosa. Many species of Artemisia such as Artemisia hishia, A. maritime and A. parviflora, A. vulgaris form dense scrubby vegetational cover over vast the slopes in the valley.

**Sub Alpine Vegetation**

This type of vegetation occurs in an altitudinal range of 2,800–3,800 m. The major floral taxa found are Aconitum ferox, Allium humile, Angelica glauca, Aralia cachemirica, Arnebia benthamii, Aesculus indica, Berberis pseudombellata, B. jaeschkeaana, Betula utilis, Bupleurum falcatum, Cardamine impatiens, C. macrophylla, Corylus jacquemontii, Elymus dahuricus, Ephedra Gerardiana, Eririchium canum, Erisimum melicentae, E. hieracifolium, Dactylis glomerata, Geranium wallichianum, Impatiens glandulifera, Juglans regia, Malus baccata, Oxyria digyna, Pedicularis pectinata, Pirochiza kurroa, Plantago depressa, Polygonatum multiflorum, P. verticillatum, Potentilla atrorubescens, Primula denticulata, P. macrophylla, Prunus cornuta, Ranunculus laetus, Rhododendron campanulatum, Ribes orientale, Saussurea costus, S. auriculata, Tanacetum gracile, T. tomentosum, Thalaspi alpestre and Verbascum thapsa.

**Alpine Vegetation**

This type of vegetation starts from 3,800 m onwards, the vegetation is mainly dominated by species of Aconitum heterophyllum, A. rotundifolium, Agrostis viridalis, Arnebia euhroma, Aquilegia pubiflora, Capparis himalayensis, Cassiope fastigiata, Cortia depressa, Delphinium cashmerianum, D. vestitum, Dracocephalum heterophyllum, Elymus nutans, E. dahuricus, Fritillaria roylei, Heracleum wallichii, Myricaria squamosa, Corydalis meifolia, Geranium wallichianum, Impatiens brachycentra, Inula royleana, Iris kumaonensis, Jurinea macrocephala, Meconopsis aculeate, Picrohiza kurroa, Polygonum affine, Primula macrophylla, Ranunculus hyperboreus, Rheum australe, R. moorecroftianum, R. spiciforme, Rhodiola imbricata, Rhododendron anthropogon, R. campanulatum, Saussurea graminifolia, S. obvallata, S. gossypiphora, Selinium tenuifolium and Trollius acaulis.

The entire Himalayan belt is known as treasure house for many medicinal, aromatic, edible and aesthetic plants from time immemorial. Tribal people of Pangi Valley mostly depend on the wild plants as medicines for various ailments. Rana et al. (2014) documented 67 ethno medicinally important plant species from the valley whereas Dutt et al. (2014) have documented 45 species as ethno medicinally important. Some important medicinal plants found in the valley like Aconitum heterophyllum (Patis, Ativisa), is a highly traded ayurvedic plant used as an anthelmintic,
| No. no. | Name of Species | Family | Locality | Latitude | Longitude | Altitude | Habitat | Morphology Notes |
|--------|----------------|--------|----------|----------|-----------|----------|---------|------------------|
| 1      | Plantago ovata Willd. | Plantaginaceae | Eco Sensitive Zone near Twan | 33° 01.821' N | 76° 37.150' E | 3006 m | On open slopes, Annual | tufted herb; leaves rosulate; inflorescence | Puneet Kumar |
| 2      | Euphorbia cyparissias L. | Euphorbiaceae | Eco Sensitive Zone near Twan | 33° 01.821' N | 76° 37.150' E | 3006 m | Annual branched herb; leaves opposite; capitulum with white toothed ray florets and yellow disc florets | Puneet Kumar |
| 3      | Chenopodium album L. | Chenopodiaceae | Eco Sensitive Zone near Twan | 33° 01.821' N | 76° 37.150' E | 3006 m | On open slopes, Annual; erect, branched herb; ribbed, green to purpl-red stem | Puneet Kumar |
| 4      | Geranium nepalense | Geraniaceae | Eco Sensitive Zone near Twan | 33° 01.821' N | 76° 37.150' E | 3006 m | Perennial trailing or ascending herb; white flower, violet anthers | Puneet Kumar |
| 5      | Malva verticillata L. | Malvaceae | Eco Sensitive Zone near Twan | 33° 01.821' N | 76° 37.150' E | 3006 m | On open slopes, Herb; rough to touch; leaves lobed, lobes rounded; light pink flower | Puneet Kumar |
| 6      | Erigeron canadensis L. | Asteraceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | River Bed, open places, Annual erect herb; branched above, hairy; | Puneet Kumar |
| 7      | Descurainia sophia (L.) Webb ex Prantl Brassicaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Dry open places, waste places; Annual herb; branched, erect; light yellow flower; fruits | Puneet Kumar |
| 8      | Silene vulgaris (Moench) Garcke Caryophyllaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Open, slightly moist places, Perennial herb; greyish green; stem weak; leaves lancelate to ovate; inflated calyx; white petals | Puneet Kumar |
| 9      | Malva neglecta Wallr. | Malvaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Dry open places, Common; perennial herb; long tap root; leaves rounded, serrated; white flowers with pink tinge | Puneet Kumar |
| 10     | Dianthus angulatus Royle | Caryophyllaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Dry open slopes, Perennial clump forming grass like herb; leaves narrowly linear; light pink flowers, limb fimbriate | Puneet Kumar |
| 11     | Sedum ewersii Ledeb. | Crassulaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Among boulders, rocky slopes, Perennial herb; leaves opposite, sessile, succulent; pink flowers | Puneet Kumar |
| 12     | Aconitum heterophyllum Wall. ex Royle Ranunculaceae | Eco Sensitive Zone near Twan | 33° 01.784' N | 76° 37.286' E | 3059 m | Moist slopes, Biennial herb; erect stem; leaves heteromorphic, light pink or greenish, stem purplish-blue, sesquiterpene lactone; yellow anthers | Puneet Kumar |
| 13     | Epilobium angustifolium | Onopordaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Open, slightly moist places, Perennial herb; greyish green; stem weak; leaves lancelate to ovate; inflated calyx; white petals | Puneet Kumar |
| 14     | Origanum vulgare | Lamiaceae | Eco Sensitive Zone near Twan | 33° 01.790' N | 76° 37.181' E | 3040 m | Open, slightly moist places, Perennial herb; greyish green; stem weak; leaves lancelate to ovate; inflated calyx; white petals | Puneet Kumar |
| 15     | Lotus corniculatus L. | Leguminaceae | Eco Sensitive Zone near Twan | 33° 01.804' N | 76° 37.163' E | 3037 m | Dry open sandy slopes, Annual herb; straggling; flower yellow, papilionaceous corolla | Puneet Kumar |
| 16     | Taraxacum officinale (L.) Weber ex F.H.Wigg. | Asteraceae | Eco Sensitive Zone near Twan | 33° 01.804' N | 76° 37.163' E | 3037 m | Open moist sandy slopes, Perennial scapose herb; leaves all radical, sessile, lobed; capitulum solitary, yellow | Puneet Kumar |
| 17     | Pteridium revulutum (Blume) Nakai Dennstaedtiaceae | Eco Sensitive Zone near Twan | 33° 02.635' N | 76° 37.340' E | 3176 m | Abundant in forest area, Chogalu Dhar | | Puneet Kumar |
| 18     | Meconopisis aculeata (Kar. & Kir.) Chogalu Dhar Crassulaceae | Along Tarund Nalla towards | 33° 02.555' N | 76° 37.149' E | 3089 m | On rocks near river bed, small herb; succulent leaves; pinkish flowers | Puneet Kumar |
| 19     | Crassulaceae | Along Tarund Nalla towards | 33° 02.555' N | 76° 37.149' E | 3089 m | | | Puneet Kumar |
| 20     | Aconitum heterophyllum Wall. ex Royle | Ranunculaceae | Along Tarund Nalla towards | 33° 02.555' N | 76° 37.149' E | 3089 m | On open slopes near water stream, | Puneet Kumar |
| 21     | Taraxacum officinale (L.) Weber ex F.H.Wigg. | Asteraceae | Along Tarund Nalla towards | 33° 02.555' N | 76° 37.149' E | 3089 m | | | Puneet Kumar |
| 22     | Thymus linearis Benth. | Lamiaceae | Along Tarund Nalla towards | 33° 02.555' N | 76° 37.149' E | 3089 m | | | Puneet Kumar |
| 23     | Polygonum polystachyum | Polygonaceae | Along Tarund Nalla towards | 33° 02.999' N | 76° 37.247' E | 3108 m | Moist places along stream; pink flowers | Puneet Kumar |
| 24     | Potentilla argyrophylla Wall. ex Lehm. | Rosaceae | Along Tarund Nalla towards | 33° 02.995' N | 76° 37.247' E | 3203 m | Moist slopes | Puneet Kumar |
| 25     | Euonymus fimbriatus Wall ex Roxb. | | | | | | | | Puneet Kumar |
| 26     | Betula and Lonicera | Betulaceae | Along Tarund Nalla towards | 33° 02.598' N | 76° 37.190' E | 3134 m | | | Puneet Kumar |
| No. | IR Code   | Scientific Name                  | Family            | Location Details                                                                 | Author |
|-----|-----------|----------------------------------|-------------------|-----------------------------------------------------------------------------------|--------|
| 27  | 127210    | Verbascum thapsus L.             | Scrophulariaceae   | Along Tarund Nalla towards Chogla Dhar, 33° 02.635' N 76° 37.339' E, 3175 m, Abundant in open dry slopes | Puneet Kumar |
| 28  | 127241    | Spiraea canescens D.Don          | Rosaceae          | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Dry rocky open slopes, bushy | Puneet Kumar |
| 29  | 127243    | Sorbaria tomentosa (Lindl.) Rehder | Rosaceae          | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Open dry slopes, fruit orangeish red | Puneet Kumar |
| 30  | 127255    | Hyoscyamus officinalis L.        | Lamiaceae         | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 31  | 127256    | Impatiens brachycentra Kar. & Kir. | Balsaminaceae     | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 32  | 127243    | Sorbaria tomentosa (Lindl.) Rehder | Rosaceae          | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Open dry slopes, fruit orangeish red | Puneet Kumar |
| 33  | 127258    | Hyoscyamus officinalis L.        | Lamiaceae         | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 34  | 127259    | Anisopus seminigrubus Regel       | Cupressaceae       | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 35  | 127278    | Arcandiolobium minutissimum Hook. | Santalaceae       | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 36  | 127291    | Trifolium repens L.              | Leguminosae        | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 37  | 127292    | Inula orientalis Lam.            | Asteraceae         | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 38  | 127304    | Meconopsis smithiana (Wall.) Beiss. | Pinaceae         | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 39  | 127311    | Polygonatum verticillatum (L.) All | Convallariaceae   | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |
| 40  | 127336    | Aralia cachemirica Decne.        | Araliaceae         | Along Jambu Nalla towards Ghatar, 33° 01.157' N 76° 38.403' E, 3301 m, Moist shady places, white flower | Puneet Kumar |

The grasslands are very important component of the ecosystem. These are found in eastern Afghanistan, Pakistan, and northwestern India (Kinnaur, Himalayan Pradesh and Haplam area in Pang Valley) is an economically important species growing at elevations between 1800 and 3350 metres above sea level. Pinus wallichiana (Dhup) is a commercially exploited plant used as incense. Picrorhiza kurrooa (Kour) is an endangered, ayurvedic plant used to make incense. Podophyllum hexandrum (CR) another endangered medicinal plant used in traditional medicine. Some high alpine plants such as Picea smithiana (Wall.) Boiss. (a commercially exploited plant used as incense), Pinus wallichiana (Dhup) is a commercially exploited plant used as incense. Podophyllum hexandrum (CR) another endangered medicinal plant used in traditional medicine.
in the valley. However, activities such as entry of large livestock for grazing in summer to valley from adjoining areas and dependence of people on wood as a fuel are the activities noted down during collection trip which may pose threat to local flora in a long term if not checked on time. Man and nature conflict is evident. There is a need of more efforts to study the fragile ecosystem of this region of North Western Himalaya. However, there are a few threats to note. i) unchecked deforestation and use of forest wood as a fuel, ii) grazing by the livestock from surrounding areas is goes unchecked, iii) ever increasing agriculture on slopes where ever possible and replacement of native forest by Salix and other broad leaf species poses a serious threat to local flora and fauna of the valley.

As the road connectivity is getting better with years, once a remote tribal area, Pangi is now set on path of development in terms of Infrastructure, economy, education, communication etc. However as the region is tribal and most of the local economy is directly or indirectly dependent on the natural resources, there is a near threat to the biological wealth of the region. There is need to put in more efforts for conservation and protection of biological resources in this magnificent valley of inner Himalayas so that its cultural and biological heritage is conserved for the future generation.

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