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ASSESSMENT OF FLORISTIC DIVERSITY IN THE DESERT ECOSYSTEM OF CENTRAL KARAKORAM NATIONAL PARK (KARAKORAM RANGE) GILGIT-BALTISTAN, PAKISTAN

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Abstract

The Central Karakoram National Pakistan is one of the largest National Park in Pakistan, covering an area of 10,000 km^2. The park consists of 14 valleys of Karakoram Range out of which four floristically important valleys were selected for current research namely, Istak, Turmic, Haramosh and Shighar valleys. Assessment of floristic diversity provide basis for planning the suitable strategies for conservation of plant resources. The current study was conducted to understand the floristic diversity along an altitudinal gradient with elevations varying from 1200m to 4000m in cold desert area of CKNP region. Plant specimens were collected during the springs of 2001-2016 from various habitats of the selected valleys of this region. In the course of present inventory 190 taxa of Spermatophytes from 48 families were found from different habitats of study area. The largest group was Dicot with 172 species and 122 genera from 44 families. Monocots are represented by 13 species and 12 genera from 2 families followed by Gymnosperms 5 species, 2 genera from 2 families. There were 44 shrubs 9 trees 27 annuals and 110 perennials were classified according to their life forms. Out of these 190 plant species, 116 were ranked as common, 34 was very common, 7 rare 2 very rare and 31 were infrequent. It was observed that family Compositae was the largest family containing 38 species followed by Fabaceae with 19 species, Labiatae, 11 species, Poaceae 11 species, Rosaceae 8 species, Chenopodiaceae 7 species, Boraginaceae 6 species and the remaining families represents less than 5 species. In general, the vegetation was composed of perennial herbs and few shrubs which form the permanent frame work of the area. The Index of similarity for shrub and herb species between different altitudes was low which indicates remarkable degree of dissimilarity in plant species between different altitudes. The medicinally important plant species of the study area was observed under threat due to commercial exploitation by the locals which need proper management for conservation. The abundance of these commercially exploited species had declined in their abundance during the last decades.

Key words: Floristic diversity, Desert area, CKNP, Gilgit-Baltistan, Pakistan.

Introduction

The Central Karakoram National Park (CKNP) is the largest National Park of Pakistan, covering an area of 10,000 km^2. The park situated between 35°N to 36.5°N Latitude and from 74°E to 77°E Longitude. The park was declared in 1993 due to its high glacier resources, rich biodiversity and the greatest mountain peaks. The park has great deposit of snow and glaciers especially the well-known glaciers area Siachen (75km long), Baltoro (57km), and Hispur-Biafo (122 km). The park consists of 14 valleys of Karakoram Range and the selected valleys of current research were Istak, Turmic, Haramosh and Shighar valleys. Out of these four valleys Haramosh valley is a part of Gilgit District while remaining three valleys are the part of Baltistan region (Fig. 1). These four valleys are situated along the right bank of the river Indus. Assessment of floristic diversity provide basis for planning the suitable strategies for conservation of the plant resources. High altitude regions are characterized by cold and arid climate and landscapes of many microhabitats, exhibiting a vegetation of specific adaptation resulting a peculiar life form of species in upper zones (Kumar & Sharma, 2013). It is observed that variation among the species will takes place gradually in nature. To evaluate the diversity, it is essential a develop a continuous monitoring mechanism to generate data find out the species distribution, composition and (Watson & Novell, 2004). The vegetation of desert ecosystem is under pressure due to newly under construction dam and KKH road Skardu and also over-exploitation including over grazing. Mountainous communities are dependent on the natural resources of the area. The altitudinal variation of different valleys, exhibit the diversified flora. Most of herb dominant in the alpine and subalpine regions, to semi-desert shrub communities situated in the lower areas where mostly plants are halophytic in nature. The establishment, growth, regeneration and distribution of the plant communities are controlled by many factors, such as geographical position, physiographic features and human impacts (Shaltout & El-Sheikh, 2003; Ku¨rschner & Neef, 2011; Alatar *et al*., 2012; Korkmaz & Ozcelik, 2013). The information about floristic composition of an area is said to be a perquisite for any phyto-geographical, ecological, and management activities (Rafay *et al*., 2013). Field surveys are very essential to obtain the base line data from the region (Keith, 1988; Ali, 2008; Saima *et al*., 2010). Due to the diverse habitats and topography the area has diverse floral wealth. The different microclimatic and varied environmental conditions support diverse habitat and ecosystems with equally diverse life forms particularly in the Karakoram Range. Therefore, assessment of cold desert plant species of these valleys of the Karakoram Range may provide a key information for its conservation.

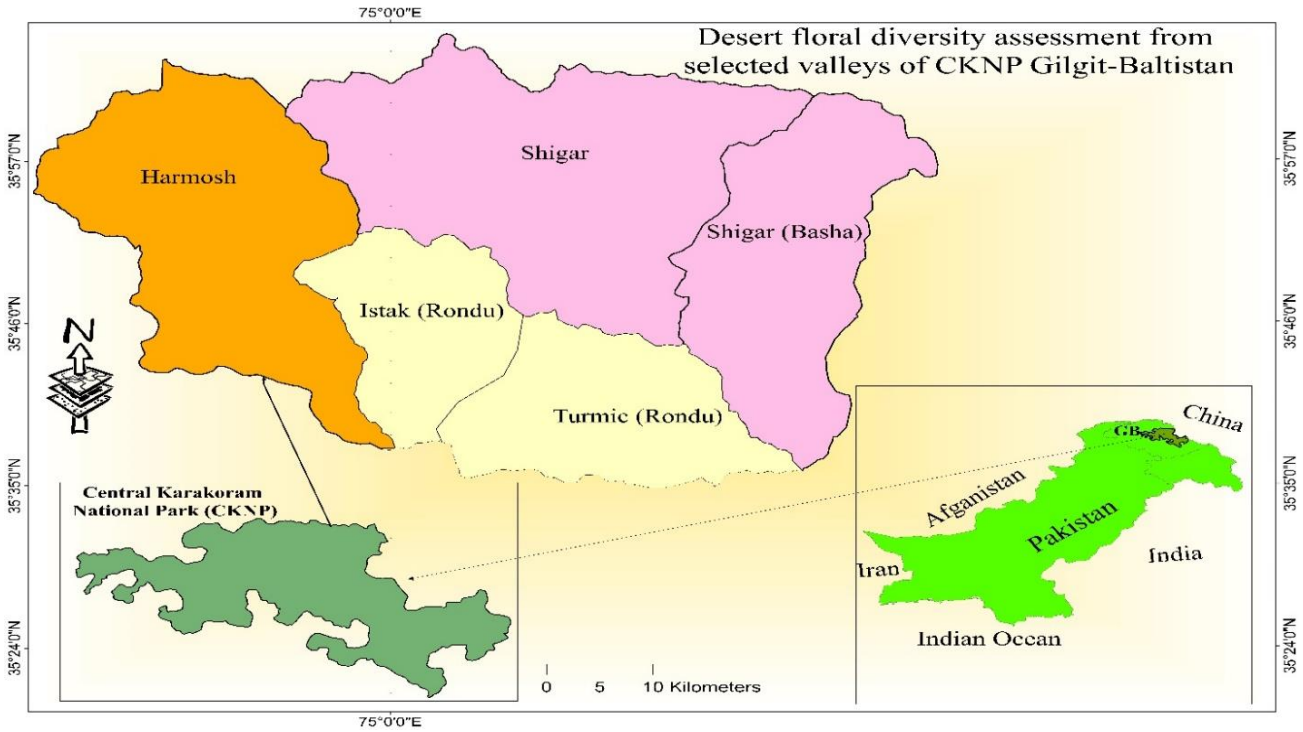

Fig. 1. Map of the study area.

Materials and Methods

The present study was mainly focused on the desert ecosystem and habitats of Haramosh, Istak, Turmic and Shighar valleys of the Karakoram Range, Gilgit-Baltistan. An intensive floristic assessment of desert plant species was carried out during the summer months i.e. from April to September 2001-2016, for the collection and identification of plants in various habitats between the altitudinal ranges of 1200m-4000m. The whole area was divided into eight altitudes i.e., 1200-1600m, 1200-3000m, 1200-4000m, 1600-3000m, 1600-4000m, 2000-3000m, 2000-4000m and 3000-4000m on the basis of species distribution pattern in different microclimatic elevation. Extensive field information was collected based on habit, habitat, altitude and abundance. To collect the maximum information about desert flora, field notes regarding the plant distribution pattern, composition, altitudinal aspect, upward shifting due to climatic condition, topographic condition and threats to the plant species were noted down. For the study of desert species and their distribution in different elevations, the altitude of every species was recorded with the help of GPS and monitoring their population size and upward shifting process throughout the sixteen years' study period. The collected plant specimens from various localities of the valleys were identified with the help of Flora of Pakistan (Nasir & Ali, 1970-89; Ali & Nasir, 1989-1991; Ali & Qaiser, 1993-2017), Stewart (1972), and on line available flora of neighboring countries. After the proper identification the plant specimens have been deposited for future record and research in the Karachi University Herbarium (KUH) as well as in the Herbarium of Karakoram International University. Life-form categories of Raunkiaer's system (Raunkiaer, 1934), as presented by Ellenberg *et al.*, (1991) were accepted.

Results and Discussion

During the present study we documented a total 190 drought resistant species belonging to 48 families and 136 genera from the Karakoram Range. The dominant families were Asteraceae (38 species), Fabaceae (19 species), Labiatae and Poaceae (11 species), Rosaceae (8 species), Chenopodiaceae (7 species) and Boraginaceae (6 species) and the remaining families contained less than 5 species. Their generic representation was quite variable. However, one family was represented by more than 27 genera (Compositae), another by14 genera (Fabaceae; the third, most represented family carries about 9 genera (Poaceae). Out of 190 species 9 trees, 44 shrubs, 27 annual herbs and 110 perennial drought resistant species distributed in different elevation from 1200m-4000m (Fig. 3). On the basis of our 16 years' field observation we categorized these species into common, very common, rare, very rare and infrequent species. The basis of characterization of these species was based on their population size and distribution of species in different altitudinal gradients. According to these observation, we found 34 very common, 116 common, 31 infrequent, 7 rare and 2 very species in the study area (Fig. 2). There were 5 gymnosperms, 13 monocots and 172 dicot species distributed in the dry habitats of the area. Among these we identified 53 phanaerophytes, 33 chamaephytes, 75 hemicryptophytes, 27 therophytes and 2 geophytes from different elevations of the study area (Fig. 4). The distribution of life form is closely related to topography and landform (Osman *et al*., 2014). In Karakoram Range, the composition of life forms represented a typical desert flora, the majority of species being hemicryptophytes, therophytes and chamaephytes. Vegetation of the area, in general is not constant; it varies from year to year, depending upon the moisture level (Siddiqui & Al-Harbi, 1995; Osman *et al*., 2014).

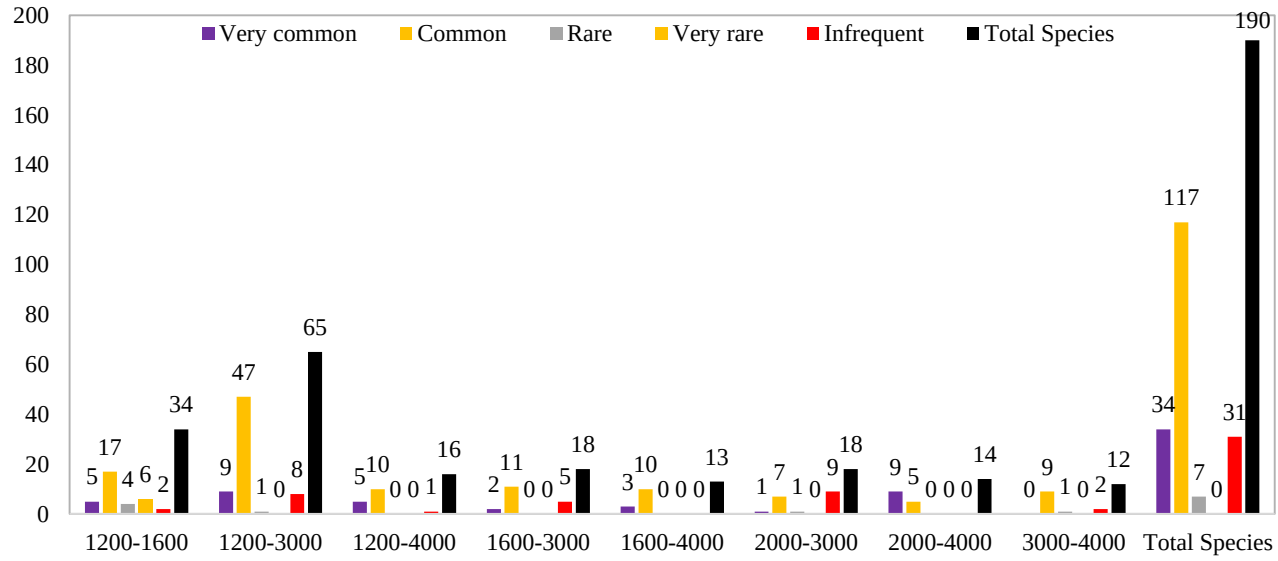

Fig. 2. Distribution of common, rare and infrequent species in different elevation.

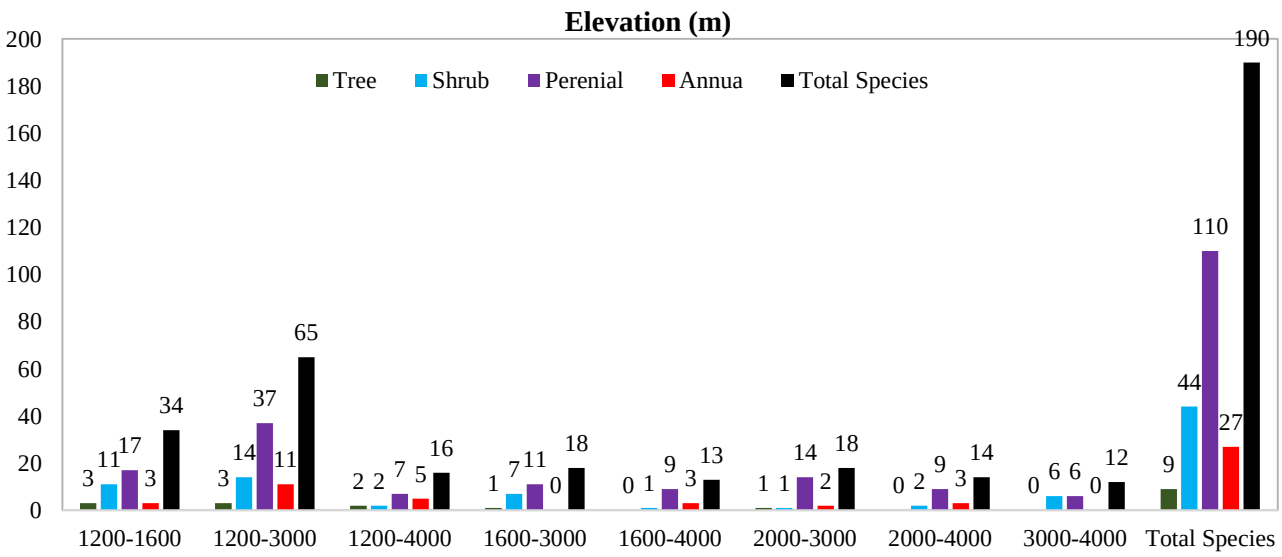

Fig. 3. Distribution of the Habit categories in different elevations.

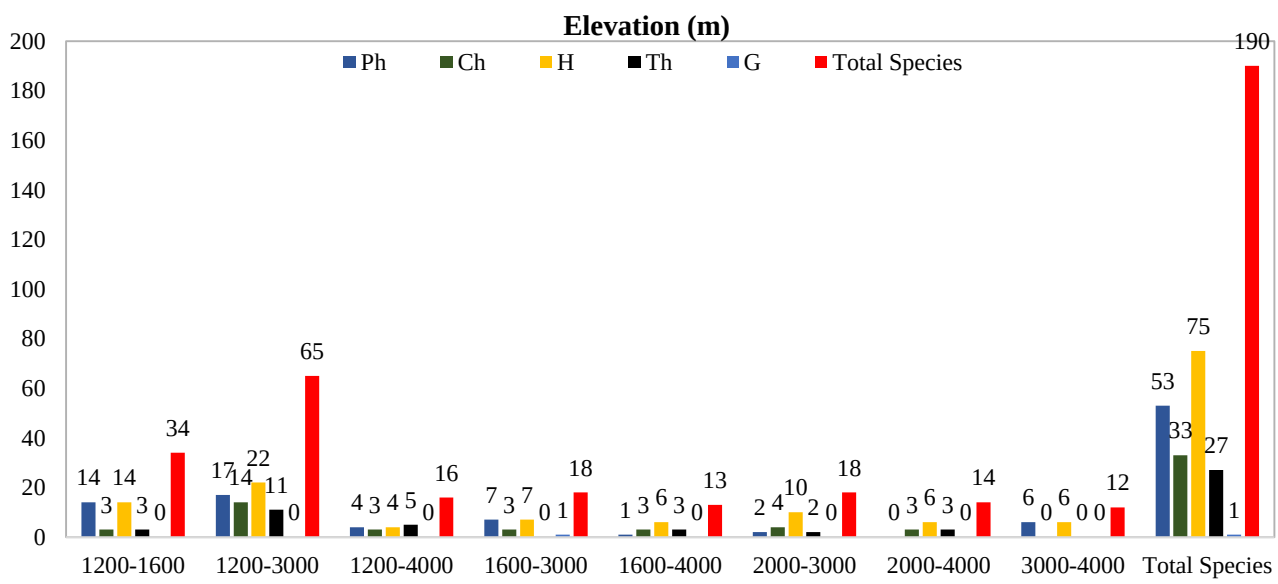

Fig. 4. Distribution of life-form categories in different elevations.

At elevation 1200-1600 m, total number of drought resistant species was 34 and among these species 11 shrubs, 3 trees, 3 annuals and 17 were perennial herbs (Table 1). Out of these 34 drought resistant species 10 species like *Capparis spinosa*, *Salsola tragus, Tamarix arceuthoides*, *Tamarix leptostachya, Solanum surattense, Withania coagulans, Caralluma tuberculata*, *Datura stramonium* and *Peganum harmala* belonged to the Saharo-Sindian Phytogeographic region and remaining species are Iraano-Turanian elements (Ali & Qaiser, 1986). Among these species distributed and dominant up to 1600m elevation were *Paganum harmala*, *Capparis spinosa*, *Salsola tragus* and *Kochia prostrata*. The floristic distribution in different ecological zones is dependent on the different ecological conditions and edaphic factors (Kershaw, 1973; Singh & Yadava, 1974; Kunhikannan *et al.*, 1998). All these species which are found in the desert areas of Gilgit-Baltistan are also found in other adjacent areas of Pakistan except *Haplophyllum gilesii* which is an endemic and rare species of Gilgit found only along the River Indus from Diamer to Gilgit City and Haramosh only. The endemic species is under threat due to Habitat devastation for the construction of Dams and expansion of roads. Some other species which were become rare due to over-exploitation for medicinal use like *Caralluma tuberculata* and for fuel wood like *Pistacia khinjuk,* and *Olea ferruginea* during the last decade. *Withania coagulans, Periploca aphylla, Euphorbia osyridea,* were found very rare, probably these were newly entrant in the area. About 40 individuals of each species were observed during the last sixteen years. Other than these species the Saharo-Sindian elements gradually and continually increased their population and upward shifting in the different localities of the study area.

At the elevation 1200m-3000m, total number of drought resistant species was 65, among which there were 3 trees, 14 shrubs, 37 perennial herbs and 11 annual herbs (Table 2). The species which were distributed from 1200-3000m are mostly Irao-Turanian elements. *Chenopodium botrys* was found dominant followed by *Artemisia* spp. Mostly all the species were found common in this elevation range. Only one rare species and 8 infrequent species were recorded out of 65 species. The increase of major genera and zone-specific species into the upper zones is because of climate change and shifting at higher altitudes. Such type of studies from the other parts of the world have documented or predicted the species migration in response to global warming. Lenior *et al*., (2008) reported 171 forest species of W. Europe upward shifted an average 29 meter per decade between 1986 to 2005. During this study we observed that many species of this range gradually increased its population and found to upward migration into upper zones. During our study we observed that *Hippophae rhamnoides*, *Fraxinus hookeri, Colutea nepalensis, Daphne mucronata* were under threats due to over exploitation for fuel wood and habitat degradation.

Sixteen drought resistant species were found widely distributed from 1200m-4000m (Table 3). *Artemisia brevifolium* and *Verbascum thapsus* were found very common and drought resistant species of the area. These sixteen species are continually and gradually shifting upward and reached at the extreme limits of distribution in the area during the last 15 to 20 years due to increase in temperature and lack of rains. The twentieth century was the warmest century, and 1990 to 2000 was the warmest decade, of the past millennium (Hardy, 2003) and warming trends have been observed in the elevated regions such as the Himalayan- Tibetan region, leading to the retreat of glaciers (Ramanathan, 2007). During just the last 150 years, the earth's global average temperature has increased by about 0.8°C and at higher latitudes has increased by several degrees Celsius (Dodd, 1994).

Eighteen species of different families were found only from 1600m-3000m (Table 4). These species have narrow distribution but some species are gradually upward shifting due to climatic changes. In this elevation mostly perennial herbs and shrubs were found and all were fairly common in the area. The distribution of life form is closely related to topography and landform (Kassas & Girgis, 1965; Zohary, 1973; Orshan, 1986; Fakhireh *et al*., 2012). Some species gradually increased their population and some were under threats like *Berberis pseudumbellata*, *Arnebia guttata*, *Caragana tragacanthoides*, *Sageretia thea, Tamaricaria elegans* due to habitat degradation, climate change and over exploitation practices.

Thirteen drought resistant species were distributed from 1600m-4000m (Table 5), eighteen species were found from 2000m-3000m elevation (Table 6). Species found in these altitude were mostly perennial herbs which were commonly distributed in these elevations. All these species were common, gradually increased their population and gradually replaced the habitats of the species of upper ranges. It was observed that all these species were non palatable and drought resistant. Due to overgrazing by the animals in these elevations mostly palatable species gradually disappeared and shifted upward for their existence.

Similarly, 14 droughts resistant and grazing resistant species were found from 2000m-4000m (Table 7) and 12 species were distributed from 3000m-4000m (Table 8). In these elevation mostly perennial herbs and shrubs were found with few annual herbs. The upper mountain slopes above some 2,300 m hosted vegetation types that benefited from the extra zonally moist conditions. The upper pediment sites are mainly covered by moderately dense semi-desert steppes which benefit from still relatively high precipitation at high altitude and true mountain species are absent, as are desert species (Burkart *et al*., 2000; Kawamura *et al*., 2003; Kogan *et al*., 2004; Yu *et al*., 2004; Khan *et al*., 2016). All these species were commonly found in their distributional ranges. Index of similarity for shrub and herb species between different altitudes was low indicating more dissimilarity of species between different altitudes. By the end of the present study, which focused on desert flora of the Karakoram Range, six of collected families Asteraceae, Fabaceae, Labiatae, Poaceae, Rosaceae, and Chenopodiaceae represented maximum number of species. Que´ zel, (1978); Al-Hassan, (2006), reported 458 species distributed in the different localities of the Kingdom Saudi Arabia from desert areas.

Table 1. Distribution of desert species from 1200m-1600m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Anacardiaceae	*Pistacia khinjuk* Stocks	+	+	+	+	T	Ph	R	Over-exploitation for timber wood
2.	Asclepiadaceae	*Cynanchum acutum* L.	+	+	+	+	P(cl)	H	C	No threat observed
3.	Asclepiadaceae	*Periploca aphylla* Decne.	+	-	-	-	Sh	Ph	R	Habitat degradation
4.	Asclepiadaceae	*Caralluma tuberculata* N. E. Brown	+	-	-	-	P	H	Inf.	Over exploitation for medicinal use
5.	Boraginaceae	*Heliotropium dasycarpum* Ledeb.	+	+	+	+	P	H	CC	No threat observed
6.	Capparidaceae	*Capparis spinosa* L.	+	+	+	+	Sh	Ph	C	No threat observed and upward shifting
7.	Chenopodiaceae	*Salsola tragus* L.	+	+	+	+	A	Th	C	No threat observed and gradually upward shifting
8.	Chenopodiaceae	*Kochia prostrata* (L.) Schrad.	+	+	+	+	P	Ch	CC	No threat observed and upward shifting
9.	Compositae	*Echinops cornigerus* DC.	+	+	+	+	P	H	Inf.	No threat observed increase population
10.	Compositae	*Echinops echinatus* Roxb.	+	+	+	+	P	H	C	No threat observed increase population
11.	Compositae	*Filago hurdwarica* (Wall.ex Dc.) Wagenitz	+	-	-	-	A	Th	Inf.	Habitat degradation due to developmental activities
12.	Compositae	*Ifloga spicata* (Forssk.) Sch.Bip.	+	+	-	-	A	Th	Inf.	Habitat degradation due to developmental activities
13.	Compositae	*Scorzonera virgata* DC.	+	+	+	+	P	Ch	C	No threat observed
14.	Euphorbiaceae	*Euphorbia osyridea* Boiss.	+	+	-	-	Sh	Ph	RR	Habitat destruction due road expansion
15.	Oleaceae	*Olea ferruginea* Royle	+	+	+	-	T	Ph	R	Over –exploitation for fuel wood
16.	Fabaceae	*Glycyrrhiza glabra* L.	+	+	-	-	P	H	C	Over –exploitation for medicinal use
17.	Fabaceae	*Indigofera heterantha* (Wall. ex Brandis) var. *gerardiana*	+	+	+	-	Sh	Ph	C	No threat observed increase population
18.	Fabaceae	*Robinia pseudo-acacia* L.	+	+	+	+	T	Ph	C	No threat observed
19.	Fabaceae	*Sophora alopecuroides* L.	+	+	+	+	Sh	Ph	C	No threat observed increase population
20.	Fabaceae	*Sophora mollis* (Royle) Baker ssp. *mollis*	+	+	+	+	Sh	Ph	INf.	No threat observed increase population
21.	Poaceae	*Cymbopogon pospischilii* (K.Schum.) C.E.Hubbard	+	+	+	+	P	H	C	No threat observed increase population
22.	Poaceae	*Enneapogon persicus* Boiss.	+	+	-	-	P	H	C	No threat observed
23.	Poaceae	*Pennisetum flaccidum* Griseb.	+	+	+	+	P	H	C	No threat observed
24.	Poaceae	*Saccharum filifolium* Nees ex. Steud.	+	+	+	+	P	H	C	No threat observed
25.	Poaceae	*Stipagrostis plumosa* (L.) Munro ex T. Anderss.	+	+	+	+	P	H	CC	No threat observed
26.	Polygonaceae	*Rumex hastatus* D.Don	+	+	+	+	Sh	Ph	CC	No threat observed, gradually increase population
27.	Rutaceae	*Haplophyllum gilesii* (Hemsl.) C.C.Townsend	+	-	-	-	Sh	Ph	R	Endemic species of the area and may become extinct due to anthropogenic activities
28.	Tamaricaceae	*Tamarix arceuthoides* Bunge	+	+	+	+	Sh	Ph	CC	Increase its population and rapidly upward shifting
29.	Tamaricaceae	*Tamarix leptostachya* Bunge	+	+	+	+	Sh	Ph	C	Increase its population and rapidly upward shifting
30.	Solanaceae	*Solanum surattense* Burm.f.	+	+	+	+	P	H	Inf.	No threat observed gradually increase its population and shift upward
31.	Solanaceae	*Withania coagulans* (Stocks) Dunal	+	-	-	-	Sh	Ph	RR	Habitat degradation due to expansion of roads
32.	Solanaceae	*Datura stramonium* L.	+	+	+	+	P	H	C	No threat, increase its population and shift upward
33.	Zygophyllaceae	*Fagonia bruguieri* DC.	+	+	+	+	P	Ch	C	No threat and gradually increase its population shift upward
34.	Zygophyllaceae	*Peganum harmala* L.	+	+	+	+	P	H	C	No threat and gradually increase its population shift upward

Table 2. Distribution of desert species from 1200m- 3000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Alliaceae	*Allium humile Kunth*	+	+	+	+	P	G	CC	No threat observed
2.	Berberidaceae	*Berberis orthobotrys* Bien. ex Aitch.	+	+	+	+	Sh.	Ph	C	Over-exploitation for medicinal purposes
3.	Brassicaceae	*Matthiola flavida* Boiss.	+	+	+	+	P	H	C	No threat observed
4.	Brassicaceae	*Sisymbrium brassiciforme* C. A. Mey.	+	+	+	+	A	Th	CC	No threat observed
5.	Brassicaceae	*Sisymbrium orientale* L.	+	+	+	+	A	Th	C	No threat observed
6.	Caryophyllaceae	*Dianthus anatolicus* Boiss.	+	+	+	+	P	H	C	No threat observed
7.	Caryophyllaceae	*Dianthus falconeri* Edgew.	+	+	+	+	P	H	C	No threat observed
8.	Caryophyllaceae	*Stellaria media* (L.) Vill.	+	+	+	+	A	Th	CC	No threat observed
9.	Chenopodiaceae	*Chenopodium album* L.	+	+	+	+	A	Th	C	No threat observed increase population
10.	Chenopodiaceae	*Chenopodium botrys* L.	+	+	+	+	A	Th	C	No threat observed increase population
11.	Compositae	*Artemisia absinthium* L.	+	+	+	+	P	Ch	C	No threat observed increase population
12.	Compositae	*Artemisia scoparia* Waldst. & Kit.	+	+	+	+	P	Ch	C	No threat observed increase population
13.	Compositae	*Artemisia sieversiana* Ehrh. ex Willd.	+	+	+	+	A-B	Th	C	No threat observed increase population
14.	Compositae	*Anaphalis virgata* Thoms. ex C. B. Clarke	+	+	+	+	P	Ch	C	No threat observed increase population
15.	Compositae	*Carduus edelbergii* Rech.f.	+	+	+	+	P	H	C	No threat observed increase population
16.	Compositae	*Cichorium intybus* L.	+	+	+	+	P	H	C	No threat observed increase population
17.	Compositae	*Cirsium vulgare* (Savi) Ten.	+	+	+	+	P	H	C	No threat observed increase population
18.	Compositae	*Heteropappus altaicus* (Willd.) Novopokr.	+	+	+	+	P	H	C	No threat observed increase population
19.	Compositae	*Hieracium prenanthoides* Vill.	+	+	+	+	P	H	C	No threat observed increase population
20.	Compositae	*Lactuca dissecta* D.Don.	+	+	+	+	A	Th	C	No threat observed increase population
21.	Compositae	*Launaea procumbens* (Roxb.) Rama. & Raj.	+	+	+	+	P	Ch	C	No threat observed increase population
22.	Compositae	*Phagnalon niveum* Edgew.	+	+	-	-	P	Ch	C	No threat observed
23.	Compositae	*Saussurea candicans* Clarke	+	-	-	-	P	H	Inf.	No threat observed
24.	Compositae	*Scariola orientalis* Podlech & Rech.f. ssp. *nuristanica*	+	+	+	+	P	Ch	C	No threat observed
25.	Compositae	*Senecio glaucus* L.	+	+	-	-	A	Th	Inf.	No threat observed
26.	Compositae	*Senecio kraschenninikovii Schis*.	+	+	+	+	A	Th	C	No threat observed
27.	Compositae	*Tanacetum artemisioides* Schultz-Bip. ex Hook.f.	+	+	-	-	P	Ch	C	No threat observed
28.	Compositae	*Taraxacum officinalis* L.	+	+	+	+	P	H	C	No threat observed
29.	Compositae	*Tricholepis tibetica* Hook.f.ex Thomson	+	+	-	-	P	Ch	C	No threat observed
30.	Cuscutaceae	*Cuscuta europaea* L.	+	+	+	+	P(cl)	H	C	No threat observed
31.	Elaeagnaceae	*Elaeagnus angustifolia* L. var. *angustifolia* L.	+	+	+	+	T	Ph	CC	No threat observed
32.	Elaeagnaceae	*Elaeagnus angustifolia* L. var. *orientalis* (L.) Kuntze	+	+	+	+	T	Ph	CC	No threat observed
33.	Elaeagnaceae	*Elaeagnus umbellata* Thunb.	+	+	+	+	Sh	Ph	C	No threat observed
34.	Elaeagnaceae	*Hippophae rhamnoides* L. ssp. *turkestanica*. Rousi	+	+	+	+	Sh	Ph	CC	Selective removal from the habitat due to expansion of agriculture lands

Table 2. (Cont'd.).

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Ephedraceae	*Ephedra gerardiana* Wall. ex Stapf	+	+	+	+	Sh	Ph	C	Over-exploitation for medicinal use
2.	Ephedraceae	*Ephedra intermedia* Schrenk & Meyer	+	+	+	+	Sh	Ph	C	Over-exploitation for medicinal use
3.	Fumariaceae	*Corydalis adiantifolia* Hook. f. & Thoms.	+	+	+	+	P	Ch	C	No threat observed
4.	Grossulariaceae	*Ribes alpestre* Decne.	+	+	+	+	Sh	Ph	C	No threat observed
5.	Grossulariaceae	*Ribes orientale* Desf.	+	+	+	+	Sh	Ph	R	No threat observed
6.	Labiatae	*Isodon rugosus* (Wall. ex Benth.) Codd	+	+	+	+	Sh	Ph	CC	No threat observed
7.	Labiatae	*Leonurus cardiaca* L.	+	+	+	+	P	Ch	CC	No threat observed
8.	Labiatae	*Perovskia abrotanoides* Karel.	+	+	+	+	Sh	Ph	Inf.	Habitat degradation
9.	Labiatae	*Perovskia atriplicifolia* Benth.	+	+	+	+	Sh	Ph	Inf.	Habitat degradation
10.	Malvaceae	*Malva neglecta* Wallr.	+	+	+	+	P	Ch	C	No threat observed
11.	Oleaceae	*Fraxinus hookeri* Wenzig	+	+	+	+	T	Ph	C	Over-exploitation for timber wood, medicine and fodder.
12.	Fabaceae	*Astragalus bicuspis* Fischer	+	+	+	+	Sh	Ph	C	No threat observed gradually shift upward
13.	Fabaceae	*Astragalus chlorostachys* Lindl.	+	+	+	+	P	H	C	No threat observed gradually shift upward
14.	Fabaceae	*Astragalus rhizanthus* Royle ex Benth.	+	+	+	+	P	Ch	C	No threat observed gradually shift upward
15.	Fabaceae	*Colutea nepalensis* Sims	+	+	+	+	Sh	Ph	C	Over-exploitation for timber wood as well as for making local baskets
16.	Fabaceae	*Medicago sativa* L.	+	+	+	+	P	H	C	No threat observed
17.	Fabaceae	*Melilotus alba* Desr.	+	+	+	+	P	H	C	No threat observed
18.	Plantaginaceae	*Plantago lanceolata* L.	+	+	+	+	P	H	C	No threat observed
19.	Plantaginaceae	*Plantago major* L.	+	+	+	+	P	H	C	No threat observed
20.	Poaceae	*Koeleria macrantha* (Ledeb.) Schult.	+	+	+	-	P	H	C	No threat observed
21.	Poaceae	*Pennisetum flaccidum* Griseb.	+	+	+	+	P	H	C	No threat observed
22.	Ranunculaceae	*Clematis graveolens* Lindl.	+	+	+	+	P (Cl)	Ch	C	No threat observed and species increase its population and upward shifted
23.	Ranunculaceae	*Clematis orientalis* L.	+	+	+	+	Sh	Ph	C	No threat observed and species increase its population and upward shifted
24.	Rubiaceae	*Rubia cordifolia* L.	+	+	+	+	P (cl)	Che	CC	No threat observed
25.	Scrophulariaceae	*Scrophularia moniliformis* Penn.	+	+	+	+	P	H	Inf.	No threat observed
26.	Scrophulariaceae	*Scrophularia nudata* Penn.	+	+	+	+	P	H	Inf.	No threat observed
27.	Solanaceae	*Hyoscyamus niger* L.	+	+	+	-	A- B	Th	Inf.	No threat observed
28.	Thymelaeaceae	*Daphne mucronata* Royle	+	+	+	+	Sh	Ph	C	Decrease its population due to anthropogenic activities
29.	Umbelliferae	*Heracleum pinnatum* C.B.Clarke	+	+	+	+	P	H	Inf.	No threat observed
30.	Urticaceae	*Parietaria judaica* L.	+	+	+	+	P	H	C	No threat observed
31.	Zygophyllaceae	*Tribulus terrestris* L.	+	+	+	+	A	Th	C	No threat observed increase population and gradually upward shifting

Table 3. Distribution of desert plant s from 1200m-4000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Compositae	*Artemisia brevifolium Wall. ex DC.*	+	+	+	+	P	Ch	CC	No threat observed and rapidly upward shifted
2.	Compositae	*Crepis flexuosa* (DC.) Benth. & Hook.f.	+	+	+	+	A	Th	C	No threat observed and rapidly upward shifted
3.	Compositae	*Lactuca decipiens* (Hook. & Thoms.) Clarke	+	+	+	+	P	H	C	No threat observed and rapidly increase its population and upward shifted
4.	Convolvulaceae	*Convolvulus arvensis* L.	+	+	+	+	P(cl)	H	CC	No threat observed and rapidly increase its population and upward shifted
5.	Cupressaceae	*Juniperus excelsa* M. Bieb.	+	+	+	+	T	Ph	CC	Over- exploitation for construction and timber wood
6.	Cupressaceae	*Juniperus turkestanica* Komarov	+	+	+	+	T	Ph	CC	Over- exploitation for construction and timber wood and reached its extreme limits
7.	Fabaceae	*Trifolium pratense* L.	+	+	+	+	P	H	C	Important weed rapidly increasing its population and upward shifted
8.	Fabaceae	*Trifolium repens* L.	+	+	+	+	P	H	C	Important weed rapidly increasing its population and upward shifted
9.	Poaceae	*Setaria viridis* (L.) P.Beauv.	+	+	+	+	A	Th	C	No threat observed
10.	Poaceae	*Bromus oxyodon* Schrenk	+	+	+	+	A	Th	C	No threat observed
11.	Poaceae	*Bromus pectinatus* Thunb.	+	+	+	+	A	Th	C	No threat observed
12.	Poaceae	*Bromus tectorum* L.	+	+	+	+	A	Th	CC	No threat observed
13.	Polygonaceae	*Rumex nepalensis* Spreng.	+	+	+	+	P	Ch	C	Increase population and reached in the extreme limits of upper elevation
14.	Rosaceae	*Rosa webbiana* Wall.ex Royle	+	+	+	+	Sh	Ph	C	Increase population and reached in the extreme limits of upper elevation
15.	Scrophulariaceae	*Verbascum thapsus* L.	+	+	+	+	P	Ch	Inf.	Increase population and reached in the extreme limits of upper elevation
16.	Tamaricaceae	*Myricaria germanica* (L.) Desv. ssp. *alopecuroides* (Schrenk) Kitamura	-+	+	+	+	Sh	Ph	C	Increase population and reached in the extreme limits of upper elevation

Table 4. Distribution of desert plants from 1600m- 3000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Alliaceae	*Allium chitralicum Wang & Tang*	+	+	+	+	P	G	C	No threat observed
2.	Berberidaceae	*Berberis pseudumbellata* Parker	+	-	-	-	Sh	Ph	C	Over –exploitation for medicinal uses
3.	Boraginaceae	*Arnebia guttata* Bunge	+	+	+	+	P	H	Inf.	Over exploitation for medicinal uses
4.	Boraginaceae	*Cynoglossum glochidiatum* Wall.ex Benth.	+	+	+	+	P	H	C	No threat observed
5.	Brassicaceae	*Descurainia sophia* (L.) Webb & Benth.	+	+	+	+	P	H	CC	No threat observed
6.	Caryophyllaceae	*Cerastium glomeratum* Thuill.	+	+	+	+	P	H	C	No threat observed
7.	Chenopodiaceae	*Kochia stellaris* Moq.	+	+	+	+	P	H	C	No threat observed
8.	Compositae	*Artemisia gmelini* Web.ex Stechm.	+	+	+	+	P	Ch	CC	Increase population and upward shifting
9.	Fabaceae	*Caragana tragacanthoides* var. *himalaica* Komarov	+	+	+	+	Sh	Ph	C	Environmental degradation
10.	Umbelliferae	*Ferula assa-foetida* L.	+	-	-	-	P	Ch	Inf.	Over exploitation for medicinal uses
11.	Umbelliferae	*Heracleum candicans* Wall. ex DC.	+	+	+	+	P	H	C	No threat observed
12.	Umbelliferae	*Seseli libanotis* (L.) W. Koch	+	+	-	-	P	Ch	C	No threat observed
13.	Rhamnaceae	*Sageretia thea* (Osbeck) M. C. John.	+	+	-	-	Sh	Ph	Inf.	Environmental fluctuation
14.	Rosaceae	*Cotoneaster integerrima* Medik.	+	+	+	+	Sh	Ph	C	No threat observed
15.	Rosaceae	*Prunus jacquemontii* Hook.f.	+	-	-	-	Sh	Ph	Inf.	Environmental fluctuation
16.	Rosaceae	*Potentilla salesoviana* Steph.	+	+	+	+	Sh	Ph	Inf.	No threat observed
17.	Solanaceae	*Physochlaina praealta* Hook.	+	+	+	+	P	H	C	No threat observed
18.	Tamaricaceae	*Tamaricaria elegans* (Royle) Qaiser & Ali	+	+	+	+	Sh	Ph	C	Habitat modification and it replace by *Myricara germinica*

Table 5. Distribution of desert plants from 1600m-4000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Brassicaceae	*Lepidium apetalum* Willd.	+	+	+	+	P	H	C	No threat observed
2.	Compositae	*Artemisia desertorum* Spreng.	+	+	+	+	P	Ch	CC	No threat observed
3.	Compositae	*Artemisia santolinifolia* Turcz. ex Krasch.	+	+	+	+	P	Ch	C	Population increase and gradually upward shifting
4.	Ephedraceae	*Ephedra regeliana* Handl.	-	-	+	+	Sh	Ph	C	No threat observed gradually upward shifting
5.	Labiatae	*Nepeta brachyantha* Rech. f. & Edelb.	+	+	+	+	P	Ch	C	No threat observed increase population
6.	Labiatae	*Nepeta discolor* Royle ex Benth.	+	+	+	+	P	H	CC	No threat and gradually increase population
7.	Labiatae	*Nepeta leucolaena* Benth. ex Hook.f.	+	+	+	+	P	H	C	No threat and gradually increase population
8.	Labiatae	*Nepeta podostachys* Benth.	+	+	+	+	P	H	C	No threat and gradually increase population
9.	Labiatae	*Thymus linearis* Benth. ssp. *linearis*	+	+	+	+	P	H	CC	No threat increase population and upward shifted
10.	Orobanchaceae	*Orobanche alba* Steph.	+	+	+	+	A	Th	C	No threat observed gradually shift upward
11.	Orobanchaceae	*Orobanche cernua* Loefl. var. *cernua*	+	+	+	+	A	Th	C	No threat observed gradually shift upward
12.	Fabaceae	*Oxytropis mollis* Royle ex Benth.	+	+	+	+	P	H	C	No threat observed
13.	Rubiaceae	*Galium verum* L.	+	+	+	+	A	Th	C	No threat observed

Table 6. Distribution of desert plant species from 2000m-3000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Boraginaceae	*Eritrichium canum* (Benth.) Kitamura	+	+	-	-	P	H	C	No treat observed
2.	Boraginaceae	*Myosotis alpestris* F.W.Schmidt var. *albicans* (H. Riedl) Y. Nasir	+	+	+	+	P	H	C	No threat observed
3.	Boraginaceae``	*Myosotis alpestris* F.W. Schmidt var. *asiatica* Vest. ex Hulten	+	+	+	+	P	H	C	No threat observed
4.	Brassicaceae	*Capsella bursa-pastoris* (L.) Medik.	+	+	+	+	A	Th	C	No threat observed
5.	Celastraceae	*Euonymus hamiltonianus* Wall.	+	-	-	-	T	Ph	Inf.	Over-exploitation for timber as well as making agriculture tools
6.	Chenopodiaceae	*Chenopodium atripliciforme* Murr	+	-	-	-	A	Th	CC	No threat observed
7.	Chenopodiaceae	*Kraschenninnikovia ceratoides* (L.) Guldenst.	+	+	+	+	sh	Ph	C	No threat observed, gradually upward shifting
8.	Compositae	*Saussurea albescens* (DC.) Sch.	+	+	+	+	P	H	Inf.	No threat observed
9.	Compositae	*Anaphalis boissieri* E. Georg.	+	+	+	+	P	H	C	No threat observed
10.	Compositae	*Anaphalis staintonii* E. Georg.	+	+	+	+	P	Ch	Inf.	No threat observed
11.	Compositae	*Inula obtusifolia* Kern.	+	+	-	-	P	H	Inf.	No threat observed
12.	Compositae	*Steptorrhamphus crambifolius* Bunge	+	-	-	-	P	H	R	No threat observed
13.	Crassulaceae	*Pseudosedum condensatum* Boriss.	+	-	-	-	P	H	Inf.	No threat observed
14.	Crassulaceae	*Pseudosedum lievenii* (Ledeb.) A. Berger	+	-	-	-	P	H	Inf.	No threat observed
15.	Fabaceae	*Onobrychis laxiflora* Baker var. *laxiflora*	+	+	-	-	P	H	C	No threat observed
16.	Plumbaginaceae	*Limonium cabulicum* (Boiss.) O. Kuntze	+	+	-	-	P	Ch	Inf.	No threat observed
17.	Plumbaginaceae	*Limonium gilesii* (Hemsl.) Rech.f. & Koeie	+	+	+	+	P	Ch	Inf.	No threat observed
18.	Plumbaginaceae	*Limonium macrorhabdon* (Boiss.) O.Kuntze	+	+	+	+	P	Ch	Inf.	No threat observed

Table 7. Distribution of Desert Plant species from 2000m -4000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IS	Tur	Shi				
1.	Caryophyllaceae	*Arenaria griffithii* Boiss.	+	+	+	+	P	H	C	No threat observed
2.	Caprifoliaceae	*Lonicera heterophylla* Decne.	+	+	+	+	Sh	Ph	C	No treat observed
3.	Caprifoliaceae	*Lonicera microphylla* Willd. ex Roem.	+	-	+	-	Sh	Ph	C	No threat observed, shifting upward
4.	Crassulaceae	*Rosularia alpestris* (Kar. & Kir.) Boriss.	+	+	+	+	P	H	C	No threat observed
5.	Crassulaceae	*Hylotelephium ewersii* (Ledeb.) H.ohba	+	+	+	+	P	H	CC	No threat observed
6.	Compositae	*Brachyactis pubescens* (DC.) Aitch.	+	+	+	+	P	Ch	CC	No threat observed
7.	Compositae	*Cousinia thomsonii* Clarke	+	+	+	+	P	H	CC	Increase population and gradually upward shifting
8.	Compositae	*Hieracium prenanthoides* Vill.	+	+	+	-	P	H	C	No threat observed
9.	Compositae	*Leontopodium leontopodinum* (DC.) Hand.-Mazz.	+	+	+	+	P	Ch	C	No threat observed, increase population and upward shifting
10.	Compositae	*Picris hieracioides* L.	+	+	+	+	P	Ch	C	No threat observed
11.	Fabaceae	*Hedysarum falconeri* Baker	+	+	+	+	P	H	CC	No threat observed
12.	Polygonaceae	*Polygonum molliaeforme* Boiss.	+	+	+	+	A	Th	C	No threat observed
13.	Polygonaceae	*Polygonum polycnemoides* Jaub. & Spach	+	+	+	+	A	Th	C	No threat observed
14.	Scrophulariaceae	*Leptorhabdos parviflora* (Benth.) Benth.	+	+	+	+	A	Th	CC	No threat observed ,Population increase and gradually upward shifting

Table 8. Distribution of desert plants from 3000m-4000m elevation.

S. No.	Family	Species name	Valleys of occurrence				Habit	Life form	Abundance	Conservation scenarios
			HA	IST	Tur	Shi				
1.	Boraginaceae	*Lindelofia stylosa* (Kar. & Kir.) Brand	+	+	+	+	P	H	C	Gradually upward shifting and population become increase
2.	Caryophyllaceae	*Silene kunawarensis* Benth.	+	+	+	+	P	H	C	No threat observed
3.	Caryophyllaceae	*Silene moorcroftiana* Wall.ex Benth.	+	+	+	+	P	H	C	No threat observed
4.	Caprifoliaceae	*Lonicera purpurascens* (Decne.) Walp.	+	+	+	+	Sh	Ph	C	No threat observed
5.	Caprifoliaceae	*Lonicera semenovii* Regel	+	+	+	+	Sh	Ph	Inf.	No threat observed
6.	Plumbaginaceae	*Acantholimon lycopodioides* (Girard) Boiss.	+	+	+	+	Sh	Ph	Inf.	No threat observed gradually increase its population
7.	Rosaceae	*Potentilla dryadanthoides* (Juz.)Viroshilov	+	+	+	+	Sh	Ph	R	Its population is gradually decrease due to habitat degradation disturbance environment a fluctuation
8.	Rosaceae	*Sibbaldia cuneata* Horne. ex Kunt.	+	+	+	+	P	H	C	No threat observed gradually upward shifting
9.	Rosaceae	*Sibbaldia procumbens* L.	+	+	+	+	P	H	C	No threat observed gradually upward shifting
10.	Rosaceae	*Sibbaldia tetrandra* Bunge	+	+	+	+	P	H	C	No threat observed gradually upward shifting
11.	Rosaceae	*Sorbus tianshanica* Rupr.	+	+	+	+	Sh	Ph	C	No threat observed
12.	Rosaceae	*Spiraea canescens* D.Don	+	+	+	+	Sh	Ph	C	Habitat degradation

Abbreviation: T= Tree, Sh =Shrub, P =Perennial herb, B = Biennial herb, A = Annual herb, Ph = Phanaerophytes, Ch = Chamaephyte, H = Hemicryptophyte, Th = Therophyte, G = Geophyte, Hy = Hydrophyte, CC = Very common, C = Common, Inf. = Infrequent, R = Rare, RR = Very Rare, Ha= Haramosh, IST= Istuk, Tur= Turmic, Shi= Shighar

The important plants of medicinal value found in the desert ecosystems of Karakoram range were *Artemisia brevifolia, Artemisia gmelinii, Capparis spinos, Pistacia khinjuk, Caralluma tuberculata*, *Glycyrrhiza glabra, .Solanum surattense*, *Withania coagulans, Peganum harmala*, *Berberis orthobotrys, Chenopodium botrys Artemisia absinthium, Cichorium intybus, Tanacetum artemisioides, Hippophae rhamnoides, Ephedra gerardiana, Ephedra intermedia, Fraxinus hookeri, Rubia cordifolia, Tribulus terrestris, Trifolium pretense, Verbascum thapsus, Berberis pseudumbellata, Arnebia guttata, Descurainia Sophia, Ferula assa-foetida, Artemisia santolinifolia* and *Thymus linearis.* Among these species some were under severe threats of overexploitation for medicinal use, fuel wood and habitat degradation. These included *Pistacia khinjuk, Caralluma tuberculata*, *Glycyrrhiza glabra, Withania coagulans, Berberis orthobotrys, Tanacetum artemisioides, Hippophae rhamnoides, Berberis pseudumbellata, Arnebia guttata* and *Ferula assa-foetida.* Floristic composition reflects the diversity of vegetation of an area and can be affected by many factors such as overgrazing, soil deterioration, deforestation and dependence of local people/pastoralists on plants (Rafay *et al.*, 2013). Due to increased human population, environmental fluctuations, heavy livestock grazing, over exploitation of species are the major threats for the flora of desert areas.

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