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THREATENED PLANT RESOURCES: DISTRIBUTION AND ECOSYSTEM SERVICES IN THE WORLD'S HIGH ELEVATION PARK OF THE KARAKORAM RANGES

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Abstract

This study aims to investigate diversity, distribution, status, ecosystem services and threats to the plant resources in the study area based on field survey and ethno ecological knowledge for effective conservation and sustainable ecosystem services. The present study was conducted in the world's high elevation Khunjerab National Park (KNP) of the Karakoram ranges in Pakistan bordering China. Tremendous ecosystem services are obtained from the park and considered the most important habitat for many plant biodiversity and wildlife species. Field surveys were conducted to collect plants in transect along the road side of seven valleys ranging from 3160m to 4934m altitudinal variation. The names and traditional uses were recorded from the local people of the area by semi structured questionnaires and direct interviews. The data was analyzed by excel spreadsheets, direct matrix ranking, and pair comparison tests. Asteraceae was the dominant family with 15% species followed by Chenopodiaceae 10%, Poaceae 8%, Papilionaceae and Rocaceae 7%each, Brasicaceae 6%. Plant resources contribute direct and indirect ecosystem services such as food, medicine, fuel, timber, thatching, water purification, mineral and soil retention, and most importantly as sink of global carbon stock especially in the high altitude peatlands. Herbs were the dominant species in the area with 89%. Fodder is the most common usage for plants, followed by medicine. Plants with percentages 27% and 39% found to be highly palatable and palatable respectively. Competition for food between wildlife and livestock was high recorded for 60% plants. Plants used to cure various diseases including stomachache, asthma, cancer and tuberculosis etc. Plant resources in KNP are unique and vary with climate and altitude. This floral wealth is under tremendous threats of global climate change and anthropogenic activities like overgrazing, increasing population, and a rapidly declining traditional knowledge for sustainable use. Awareness for sustainable harvesting of plants, reducing grazing pressure, equitable resource sharing, marketing of the products, effective management and policy decisions and research on ecosystem services assessment, valuation and climate change impact on wild plant resources are recommended.

Key words: Distribution, Diversity, Ethnobotany, Ethno-ecology, KNP, Medicinal plants, Palatability, Ecosystem services, Threats.

Introduction

Plant resources contribute in provisioning, regulating, cultural as well as supporting services. Plants provide food, raw materials, fresh water and medicinal resources (Anon., 2005; Wittmer, 2010). Anthropogenic and climate change effects are major causes of degradation of natural resources. "It is widely accepted that the main driver of the observed decline in biological diversity is increasing human pressure on Earth's ecosystems" (Geldmann *et al.*, 2014). The distribution and diversity of plant species in high elevation areas is very important for its obvious contribution to a sound mountain ecosystem (Shiekh *et al.*, 2002). It is observed that an increasing plant diversity increase ecosystem services (Quijas *et al.*, 2012). Altitude, latitude, slope, aspect, and climatic factors form the plant composition of an area (Ilyas *et al.*, 2012). The variation in species diversity has been found with reference to climate, productivity, biotic interaction, and habitat heterogeneity by Shaheen *et al.* (2012) in the Himalayan region. In mountainous regions altitude has a much greater effect on temperature and the rate of decrease is much more rapid in summer, which ultimately causes the altitudinal limits of plant species (Shaheen & Shinwari, 2012). Phyto-climatic gradient of vegetation and habitat specificity was found by Khan *et al.* (2013) in the high elevation western Himalayas. The area of Khunjerab National Park (KNP) mostly consists of huge mountains with snow covered peaks, valleys and nullahs. Physical erosion, landslides and glaciers are commonly seen in different valleys of the Park. Most of the valleys are characterized by stony beds and surrounded by hill slopes of gravels and hailstones while others have hill slopes with about 50% soil particles. Four types of vegetation zones can be identified in KNP. Dry alpine scrub, Moist alpine pastures, Dry alpine plateau pastures, and Sub alpine scrub and birch forests. The area is dominated by herbs and mostly used as fodder for the animals, with medicine as the second most common use. Palatability class is determined first time in the study area. Palatability is a plant characteristic in which plants or parts of plants are consumed by grazing animals as simulated by the sensory impulse (Heath *et al.*, 1985; Hussain & Durani, 2009). Preference is the selection of plant species by animals for feed. Many factors affect palatability such as

animal, plant and climate. The animal factors are age, stage of pregnancy, general health and hunger of animal; while plant factors include seasonal availability, degree of maturity, growth stage, phenology, morphological and chemical nature, relative abundance and accessibility to the area (Nyamangara & Ndlovu 1995; Hussain & Durani, 2009). The most dominant plants species were found as Myricaria, Salix on river beds, while Artemisia, Ephedra and Krascheninikovia sp. were found on upper parts above the road in KNP (Qureshi *et al*., 2011). In the beginning plant use was restricted to food, medicine and shelter but with the passage of time man explored the potential of plants for a number of other purposes. Hence, their dependency on plants increased both directly and indirectly (Ali & Qaiser, 2009). It was found in an estimation that 80% of the population in developing countries rely on traditional medicines from nature. The global market value of medicinal plants exceeds 60 billion

USD annually. Almost half of the local medicinal plants are threatened with extinction (Anon., 2005; Colfer, 2012). There are 8,000 plant species in South Asia with known medicinal use. Plant-derived materials are widely used because they are relatively safer than synthetic ones and more easily available and cheaper (Iwn *et al.*, 1999). About 6000 flowering plants have been reportedly been found in Pakistan. A very large number of drug plants are found in northern and northwestern parts of country (Ali & Qaiser, 1986). In the Himalayan region at least 70 to 80% of the population depends upon traditional medicine for health care (Pie, 1987). People living in villages have been using indigenous plants as medicine for ages because this knowledge transfers from generation to generation and is based on lifelong experiences. The villages are far away from cities and mostly lack proper health facilities; people depend on plants to fulfill their daily requirement and necessities. In the past many researchers have conducted studies on ethnobotanical, economic and medicinal uses of plant resources such as Shinwari & Khan (2000), Kazmi & Siddiqui (1953), Bukhari (1994b), Rasool (1998), Mehmood *et al.* (2004), Ibrar *et al.* (2007), Mohan *et al.* (2008), Abbas *et al.* (2013), Iqbal *et al.* (2010), Shedayi & Gulshan (2012), Shedayi *et al.* (2014). Very few studies have been conducted on plant resources in the KNP among which Qureshi *et al.* (2011) listed the plant species, Khan *et al.* (2011) documented the plant species used for medicinal purposes from KNP. No such studies have been undertaken which could depict a holistic picture of the plant wealth of this very important high altitude National Park. An understanding of the linkages among biodiversity, ecosystem functioning and the production of ecosystem services is required for planning and policy making (Kinzig *et al.*, 2012; Cardinale *et al.*, 2012). The area is rich with plant resources that have tremendous contributions in the services of human well-being, uplifting the socioeconomic condition in terms of fodder, medicine, fuel, water purification, soil retention, ecosystem maintenance, sinks for global carbon stock, trophy hunting, eco-tourism, cultural, and recreational activities. The diversity, distribution, and uniqueness of plant species with climatic and altitudinal variation in this high altitude park of the world is highly significant. Current climate change events have affected the whole area in terms of glaciers melting; land sliding, soil erosion, drought, and ecosystem imbalance. The anthropogenic activities and misuse of natural resources, lack of effective management, lack of awareness, and insufficient staff have caused depletion of plant resources which in turn have badly affected the ecosystem services. So far no research has been undertaken to address the gaps as mentioned; comprehensive and intensive research is the prime requirement of the time. This study was conducted to document the distribution, ethno-ecological diversity and ecosystem services of plant resources as fodder, medicine and other benefits obtained from the park. The aim is to know the palatability, functional groups, habitat, seasonal, climatic and altitudinal variation, threats, indigenous knowledge, form, and part of plants used and diseases cured by medicinal plants, as well as resource sharing and competition between livestock, wildlife and people for the plant resources. This is a comprehensive study of its type on ecosystem services with especial reference to uses and benefits obtained from plant resources in the alpine mountain regions. This study will provide basic information and understanding about the plant resources for future researchers, a guideline for conservation organizations and policy makers for sustainable conservation actions. Effective Conservation can be achieved in many stages for example, characterizing the system and defining problems; identifying potential solutions; assessing the feasibility of solutions; identifying or creating opportunities; and taking advantage of opportunities (Moon *et al.*, 2014).

Materials and Methods

Study area: Khunjerab was declared as Khunjerab National Park as on 29 April 1975. Khunjerab Pass, the gateway to China via the Karakoram Highway, is at 4,934m. According to the Management Plan of KNP, the total area of the Park is 6,150 square km. It is situated in the former state of Hunza known as Gojal between the coordinates: Longitude 74° 55’ E - 75° 57’ E and Latitude 36° 01’ N to 37° 02’ N. Khunjerab National Park is one of the highest altitude parks in the world. It is Pakistan's 3rd largest National Park and is adjacent to the Taxkorgan Natural Reserve in China. It consists of 3 different valleys: Khunjerab (through which the Karakoram Highway passes), Ghujerab, and the remote Shimshal valley (WWF, Khunjerab National Park. The park includes the world's highest pass at 4,700 meters between Pakistan and China. Being alpine in nature, the area has comparatively harsh winters but mild autumns and pleasant summers, with the mean maximum temperature ascending up to 27°C in May and descending below 0°C in November and onward. Annual precipitation varies from 200 to 900mm, 90 percent in the form of snow. Location map of the study area is shown in the Fig. 1.

This park is famous for its unique floral and faunal diversity and provides an excellent habitat for many of the world’s important plants and a number of endangered and threatened animal species such as the snow leopard, marco polo sheep, and Himalayan ibex. Both the plant and animal species in the park face tremendous climatic and anthropogenic threats due to lack of awareness, misuse, and lack of management staff. The increasing population in the area and road construction is the important factors of habitat destruction, while illegal hunting, logging, and over grazing are the other threats.

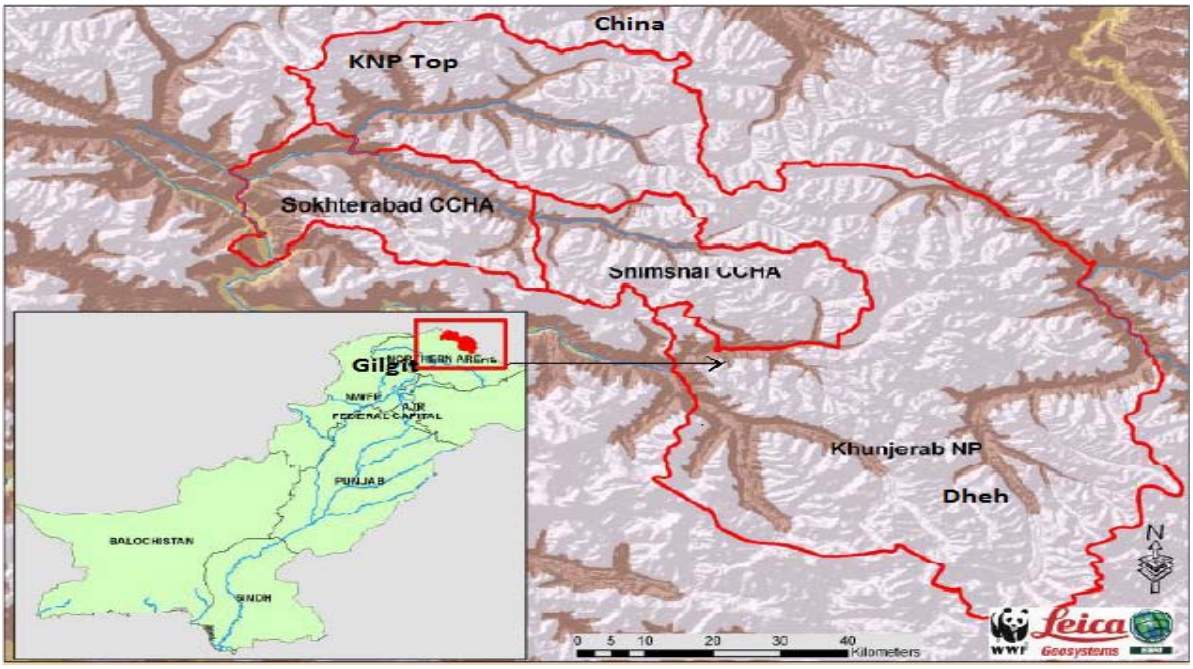

Fig. 1. Map of study area (Khunjerab National Park) Gilgit, Pakistan: Source WWF Pakistan & Qureshi *et al*. (2011).

Data collection: The present research study was undertaken to explore the indigenous flora of Khunjerab National park which has been used locally for various purposes. Three field visits were conducted in May, July, and September, 2009 in the research area to collect plant species at points along the road side 1 km deep in a transect from Dhee to KNP top. Seven points i.e Dhee. Karchani. Arbad Kook, Torqeen. Barkhun, Koksail and Top were selected for this purpose having different elevations e.g. 3160, 3272, 3690, 3400, 3499, 3918 and 4520 meters respectively. The method adopted for the documentation of the indigenous knowledge was based upon the questionnaire and semi structured interviews as mentioned by Huntington (2000) employing a checklist of questions and direct observations of photographs and specimen. Regular field trips were arranged in order to collect information from people of adjacent areas, shepherd, KNP staff and hakims 100 in total to obtain information about medicinal uses, fodder, grazing preferences of livestock and wildlife and other uses. The plants were pressed, dried, and made into voucher specimen and herbarium. Plants were identified with the help of a taxonomist in KIU herbarium and available literature and comparing it with already identified flora of Pakistan (Ali & Qaiser, 2015). The voucher specimens were kept in the herbarium of the department of Biological Sciences KIU.

Data analysis: Each species was assigned a score from 0-3, 0 for no value and 3 for most valuable according to the information collected from the beneficiaries of the park. These plant species then analyzed by paired comparison test according to Fechner (1948) and Mueller (1986) and later on was also used by Shedayi *et al.* (2014). Percentage of total score for each species was find out and then a rank was assigned as 1-19= 5, 20-39=4, 40-59=3, 60-79=2 and 80-89=1. Rank 1 having the highest score and rank 5 the lowest score. The palatability class was made on the basis of plants used by all animals (livestock and wildlife) in all seasons as highly palatable (HP), only used by one group of plants either by wildlife or livestock, palatable (Pl), only used in winter when food becomes scarce, less palatable (LP) and those which were found harmful, poisonous (Ps) or non-palatable. Paired comparison tests were also applied to the threats for the plant resources in the park; the rank scale was made as: 1-14=5, 15-29=4, 30-44=3, 45-60=2 and 60-75=1). We also used direct matrix ranking for diseases cured by plants and medicinal plants used for other purposes after *Shedayi et al.* (2014) according to the preference given by the inhabitants during the survey. For all other results, simple excel spread sheets used to find the percentage, tables and figures drawn on the bases of each findings.

Results

Plant species and families: A total of 70 plant species belonging to 31 families have been collected and investigated for their uses and palatability. The Table 1 and Fig. 2 shows that the highest number of species are found in the family Asteraceae 11 (16%), followed by Chenopodiaceae 7 (10%), Poacea 6 (9%), Papilionaceae and Rocaceae 5 (7%) each, Brasicaceae 4 (6%), Fabaceae, Labiatae, Plantigoginaceae, Primulaceae and Salicacea having 2 species (4) each, with the rest of the families containing only one species each.

Human preference of plant species: Ranking was made after obtaining percentage of the paired comparison test according to the information obtained from the users. It was found that 9, 9 plant species fall in both rank 1, 2 while 7, 25 and 20 plant species fall in the ranks 3, 4 and 5 respectively as shown in the table 1 & Fig. 3. The most and least preferred plants are shown according to their percentage after paired comparison test and assigning ranks as mentioned in the Methods.

Table 1. Plant species and services.

S. No.	Family	Species	Local name	Functional group	Habitat	Parts used	Form used	Uses and palatability			Percentage	Rank
								Medicinal	Fuel/timber /others	Fodder & palatability		
A	Alliaceae	*Allium carolinianum Redoute*	Katchpeerk	Hb	Rk	Fl, Lv	Juice	Fr, Co, As		Vg	70	2
B	Asteraceae	*Achihea milicifolia*	liveshaffs	Hb	Rk,Ds	Wp	Juice, direct	ED, DD		HP	70	2
C		*Ajania fruticulosa* (*Ledeb.*) Poljakov	Sweethpisk	Hb	Rk	Lv, St	direct			HP	33	3
D		*Anaphalis nepalensis* var. *nepalensis* (C. B. Clarke) Ridley	Chez wosh	Hb	Ms	Lv, St	direct			Pl	12	5
E		*Artemisia brevifolia* Wall. ex DC.	Khondatpisk	Hb	Ds	Lv, Fl, St	Juice, direct	WL, SA		HP	80	1
F		*Artemisia maritima* L. ex Hook. f.	Kitch	Hb	Ds	Lv	Juice, direct	SA,		Pl ,Vg	80	1
G		*Artemisia santalinifolia* Turcz. ex Besser	Ravid	Hb	Rk	St, Lv, Fr	Oil, smoke, direct	MP, MR		LP	30	3
H		*Cirsium arvense* (L.) Scop.	Kril	Hb	Ds	St, Lv	Direc, juice			Pl, Vg	11	5
I		*Crepis flexuosa* (DC.) *Bth. \$ Hk. f*		Hb	Rk	Lv, St	direct			HP	13	5
J		*Lactuca dissecta* D. Den	Chesk	Hb	Ds	Lv	Juice, direct	Inj, WH		Pl	23	4
K		*Lactuca tatarica* (L.) C.A.		Hb	Ds	Lv, St	direct			HP	14	5
L		*Senecio krascheninnikovii* Schischk		Hb	Ds	Wp	direct			Pl	14	5
M	Betualaceae	*Betula utilis* D. Don	Forz	Tr	Rk	Bk, Lv, St	Direc, paste	Er.P, Rhe.	WM. PM.		23	4
N	Boraginaceae	*Arnebia euchroma* (Royle) I.M. Johnston.	Pooshk	Hb	Rk	Wp	Paste, direct	Csm,		LP	15	5
O	Brassicaceae	*Arabidopsis himalaica* (Edgew.) Schulz	Khompa	Hb	Ds	Lv	Direc, juice			Pl,Vg	15	5
P		*Lepidium apetalum* Willd.	Yurk-woosh	Hb	Ds	Sd, Lv	direct			HP	15	5
Q		*Lepidium draba* L.	Rookhenpeechan	Hb	Rk	Lv	direct			HP	14	5
R		*Lepidium sativum* L.	Pye sprag	Hb	Ms	Lv	direct			Pl	20	4
S	Capparidaceae	*Capparis spinosa* L.	kaper	Hb	Ds, Rk	Fl,Sd,Fr, Rt	Paste, juice	JP, Pl, Db, As, ND, BP			80	1
T	Caryophyllaceae	*Silene indica* Roxb. Ex Otth		Hb	Ms	Lv	Direc, paste	Fr, Vit		Pl	80	1
U	Chenopodiaceae	*Chenopodium album* Linnaeus	Sheleet	Hb	Ds Ms	Lv, St	Juice, direct	SA		VgPl	80	1
V		*Chenopodium botrys L. Khord*	Khurd	Hb	Ds	Lv	direct			LP	1	5
W		*Chenopodium foliosum* Asch.	Sheath sprag	Hb	Ms	Lv	direct			Pl, Fd	20	4
X		*Halogeton glomeratus* (M. Bieb.) C.A. Mey.		Hb	Ds	Lv	direct			Pl	20	4
Y		*Krascheninikovia ceratoides* (L.) Guldenst.	Sheathn	Sb	Rk	Wp	direct		Fu,	HP	27	4
Z		*Salsola tragus* Linnaeus	livshafshs	Hb	Rk	Lv	direct			LP	1	5
AA		*Suaeda aegyptiaca* (Hasselq.) Zohary	Shaf	Hb	Ds	Lv, St	Paste, direct	SA		LP, Ps	1	5
BB	Crassulaceae	*Crassulaceae Rhodiola heterodonta* (Hook. f. et Thoms.) A. Bor.	Mymendrich	Hb	Rk	Lv, St	direct			LP	1	5
CC	Cupressaceae	*Juniperus excelsa* M. Bieb.	Yarz	Tr	Rk	Fr, Lv, St	Juice,smoke,direct	KS, UP, Leu, TB	Fu		60	2
DD	Cyperaceae	*Carex borii* Nelmes	Gosh wosh	Hb	Ms	Lv	direct			Pl	18	5
EE	Eleueagnaceae	*Hippophae rhamnoides* L.	Zakh	Sb	Ms	WP	Paste,juice,direct,ash	HP, Cn, SA, TA, Csm,	Fu, Fnc		80	1
FF	Ephedraceae	*Ephedra intermedia* Schrenk & C.A. Mey	Yemuk	Hb	Ds	Wp, Fl	paste, ash	TA	Fu, Tob	HP	66	2
GG	Fabiaceae	*Astragalus strictus* Grah. ex Benth.	Zhop	Hb	Ms	Lv, Fl	direct	Vit.		HP	40	3
HH		*Sophora mollis* (Royle) Baker	Popshin	Sb	Ds	Lv, stem	paste	SD,AS,Ic, Pc	Fu	Ps	17	5
II	Fumiraceae	*Corydalis crassifolia* Royle	Sackroz	Hb	Rk	--	--			Ps	8	5
JJ	Gentianaceae	*Comastoma borealis* (Bunge) T.N.Ho.	Loop wosh	Hb	Ms	Wp	direct			HP	20	4
KK	Labiateae	*Mentha longifolia* (L.) Hud		Hb	Ms	Lv, Fl	Juice,powder	Fr, As, BP, Jd,		Pl	50	3
LL		*Nepeta floccosa* Bth.	Buzlanj	Hb	Ds	Lv, Fl	juice	HF, BT, WL			32	4

Table 1. (Cont'd.).

S. No.	Family	Species	Local name	Functional group	Habitat	Parts used	Form used	Uses and palatability			Percentage	Rank
								Medicinal	Fuel/timber /others	Fodder & palatability		
MM		*Melilotus officinalis* (L.)	Selves	Hb	Ds	--				Ps	1	5
NN		*Oxytropis cachemiriana* Camb.	Zarth sprag	Hb	Ds	Lv	Juice, direct	Vit.		Pl	21	4
OO	Papilionaceae	*Oxytopis microphylla* (Pall.) DC.	Chez wosh	Hb	Ds	St, Lv	direct			Pl	23	4
PP		*Oxytropis mollis* Royle	Kharz lop	Hb	Ms	Wp, Lv, Sd, St	direct			HP	24	4
QQ		*Trigonella foenum-graecum* Linn.		Hb	Rk	Lv, St				HP	24	4
RR	Plantaginaceae	*Plantago lanceolata* L.	Sip gilg	Hb	Ms	Lv, St	Paste, direct	AH, AM, BC		Pl	40	3
SS		*Plantago major* L	Sipgilg	Hb	Rk	Lv, St	direct			HP	22	4
TT	Plumbaginaceae	*Acantholimon glumaceum* (Jaub. & Spach.) Boiss.	Ultakpook	Hb	Rk	Lv	direct			LP	1	5
UU		*deschampsia cespitosa*	Palm wosh	Hb	Rk	Sd, Lv, St	direct			HP	23	4
VV		*Elymus himalayanus* (Nevski) Tzvelev	Kishnisar	Hb	Ms	Lv				HP	23	4
WW	Poaceae	*Phragmites karka* (Retz.) Trin. ex Steud.	Nodth	Hb	Ms	Wp	direct		Tha, Dc, Bskt	Pl	28	4
XX		*Poa balbusa* L.	Ghos	Hb	Ds	Lv, St	direct			HP	24	4
YY		*Saccharum bengalensis* Retz	Chagg	Hb	Ms	Wp	direct		Crpt, Cur	Pl	40	3
ZZ		*Stipagrostis plumosa* (L.) Munro ex T. Anderss	Shepedh	Hb	Rk	Lv, St	direct			HP	26	4
AAA		*Androsace baltistanica* Y. Nasir	Zogh jark	Hb	Ms	Lv	direct			LP	1	5
BBB	Primulaceae	*Primula farinose L*	Gul banafshan	Hb	Rk	Fl, Lv, St	direct	ED, HF, HC, WL		Pl	80	1
CCC		*Aconogonon tortuosum* (D. Don)	Wishkwosh	Hb	Rk	Sd, Lv, St	direct			HP	20	4
DDD	Polygonaceae	*Bistorta amplexicaulis* (D. Don)	Sip gilg	Hb	Ms	Lv, St	direct	Vit.		Pl	27	4
EEE		*Rheum tibeticum* Maxim. ex Hook. f.	hepood	Hb	Ms	Lv, St,Tb	Direc, paste, juice	LC		Vg	27	4
FFF	Rananculacea	*Ranunculus arvensis* L.	Sip gilg wosh	Hb	Ms	Lv, St	direct			Pl	27	4
GGG		*Comarum salesovianum Stephen*	Nogradamvash	Hb	Ms	Fl	powder	ED,		LP	1	5
HHH		*Potentilla eriocarpa* Wall. ex Lehm	Zard wosh	Hb	Ms	Lv, Fl, St	direct			Pl	28	4
III	Rosaceae	*Potentila microphylla* D. Don	Satvard	Hb	Rk	Lv, St	Juice, powder	WH, Vit, IC			60	2
JJJ		*Potentilla ochreata* Lindl.	Shipeen	Hb	Ms	Lv, St	direct		Fu, Tha	Pl	60	2
KKK		*Rosa webbiana* Wallich ex Royle	Chareer	Sb	Rk, Ds	Fl, Fr, Sd	Paste, direct	SA	Stk, Fnc		24	4
LLL		*Populus pamirica* Kom.	Togruk	Tr	Ms	St, Lv	direct		Fu, Tim	Pl	60	2
MMM	Salicaceae	*Salix alba* L. ssp. alba	Uonak	Tr	Ms	St, Lv	direct		Fu, AT, Bskt, Flt		61	2
NNN	Saxifragaceae	*Saxifrga hircutis* var. alpina		Hb	Ms	Wp	direct			Pl	29	4
OOO	Scrophulariaceae	*Potentilla albida* Fedde	Rokhn pechan	Hb	Ms	Lv	direct			Pl	40	3
PPP	Tamaracaceae	*Myricaria squamosa* Desvaux	Tark	Sb	Ds	St, Lv	direct	DD	Fu,Stk, Tim	Pl	60	2
QQQ	Umbellifereae	*Cuminum cyminum* L.	Jagali zeera	Hb	Rk	Lv,Fr	juice	HA, DD, Dp	HT		82	1
RRR	Zygophyllaceae	*Peganum harmala* L.	Ispandur	Hb	Ds, Rk	Sd, Lv, Rt	Juice,smoke,	Db, JD	Scrt		82	1

Abbreviations: Functional group: Hb (herb), Sb (shrub), Tr (Tree). **Habitat:**Rk (Rocky), Ds (dry soil, Ms (moist soil). **Parts used:** Wp (whole plant), Lv (leaves), St (stem), Fl (flower), Rt (root), Sd (seed), Fr (fruit), Bk (bark), Tb (tuber). **Medicinal:**TA (toothache), ED (eye disease, DD (digestive disorder), ED (excretory disorder), MS (muscular pain), MR (mosquito repellent), WL (Weight loss), SA (stomachache), Csm (cosmetics), Vit. (Veterinary), Fr. (fever), ED (eye disease), HF (hair fall), HC (hair color), AH (antihelminthic), AM (antimicrobial), BC (blood clotting), Inj (injuries), WH (wound healing), LC (laxative for constipation), Db (diabetes), SD (skin disease), AS (antiseptic), JD (jaundice), JP (joint pain), Pl(paralysis), As (asthma), ND (nerves disorder), BP (brain problem), Co (Cough), HA (headache), Dp (depression), Er.P (ear pain), HP (heart problem), Cn (cancer), KS (kidney stone) , UP (urine problems), Leu (leucorrhoea), TB (tuberculosis), IC (insecticide), Pc (pesticide), BT (body temperature), WL (weight loss), Rhe (rheumatism). **Fuel/timber/others:** Fu (fuel), Tob (tobacco), Crpt (carpets), Cur (curtains), Stk (sticks), Tha (thatching) , Dc (decoration), Bskt (baskets), Scrt (secret), HT (herbal tea), Tim(timber), WM (writing material), PM (packing material), AT (agricultural tools), Flt (flute), Fnc (fencing). **Palatability (fodder):** HP (highly palatable), Pl (palatable), LP (less palatable), Ps (Poisonous).

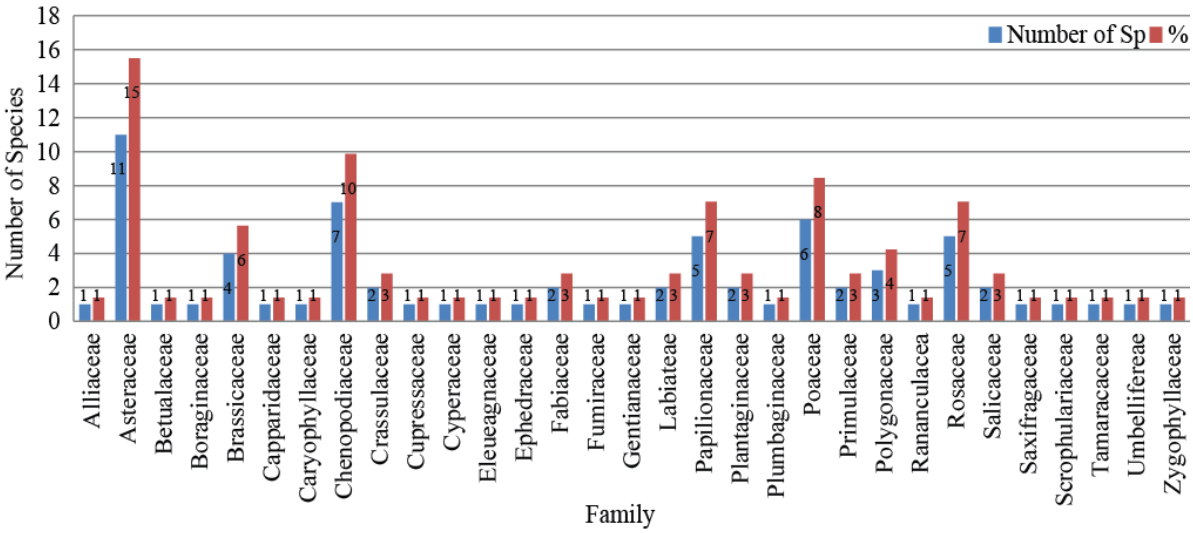

Fig. 2. Number and percentage of species in each family.

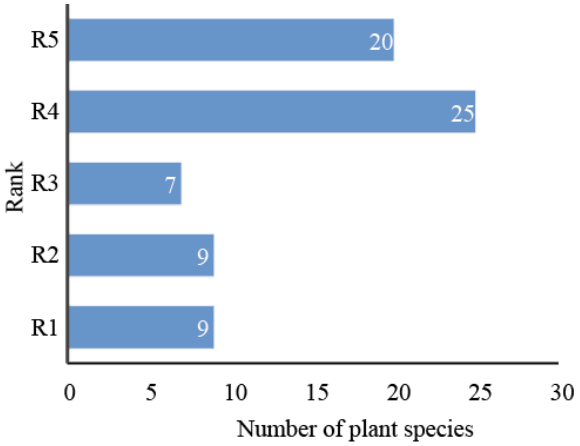

Fig. 3. Number of plant species in each rank.

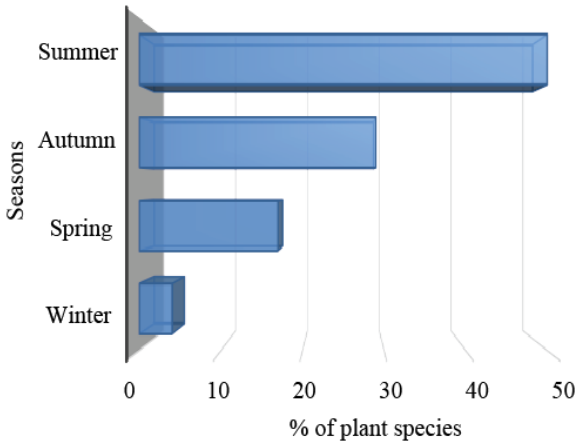

Fig. 4. Seasonal variation of Plant in KNP.

Seasonal and climatic Variation of Plants: Three field surveys were conducted in 4 seasons winter (January), spring (April), summer (July) and autumn (October). The greatest number of plants was found during summer 50% followed by autumn 29%, spring 17% and winter only 4% plants, only trees and some shrubs observed due to severe climatic condition. July and August are the full blossom months in KNP area. The result in the Fig. 4 shows the highest percentage in the summer and lowest in the winter when temperature drops to freezing.

Altitudinal variation of plants: Plant species have been collected from the lowest to the highest altitude regions in the Park in transect with altitudinal variation such as 3160, 3272, 3690, 3400, 3499, 3918 and 4520 meters from Dhee, Karchani, Arbad Kook, Torqeen, Barkhun, Koksail, and Top respectively. In the study area it was observed that Dhee had more species richness with 31(25%) species followed by the KNP Top 25 (20%), Kosal 21(17%), Arbab Kook 15 (12%) and very less number of species was found in Barkhun 7 (6%), Turqeen 11(9%) and then Karchani with 13 (11%) species (Table 2).

Functional group and Habitat of Plants: In this study it is found plants were mostly herbs 62 (89%) with very few shrubs and trees, 5 (7%) and 3 (4%) respectively as shown in the Fig. 5. The area is Rocky and the soil is sandy. The area is divided into 3 habitats: Rocky, Dry soil, and Moist soil and the distribution of plants in these habitats found with a number and percentage 25 (33%), 24 (32%) and 26 (35%) respectively as shown in the Fig. 6.

Table 2. Altitudinal variation of plants.

Area	Dhee	Karchanai	Turqeen	Barkhun	Arbabkok	Koksal	Top
Elevation (m)	3160	3272	3690	3400	3499	3918	4520
Number of plant species	31	13	11	7	15	21	25
Percentage of plants	25%	11%	9%	6%	12%	17%	20%

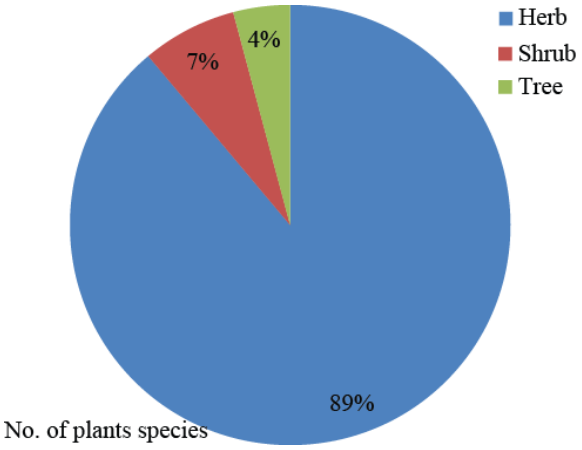

Fig. 5. Functional groups of plants.

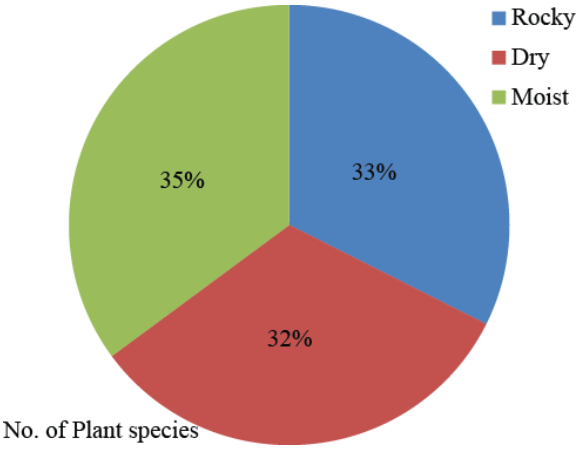

Fig. 6. Habitat of plants.

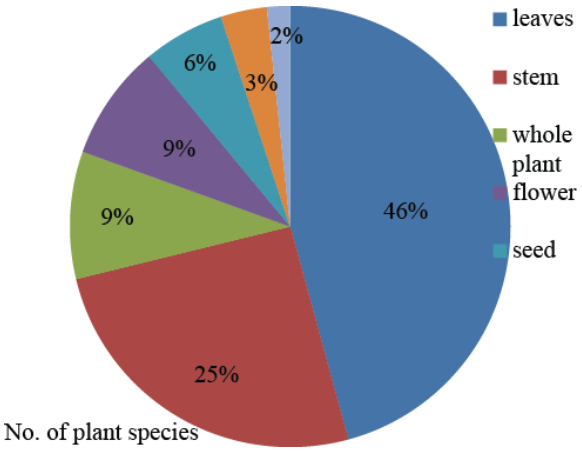

Fig. 7. Parts of plant used.

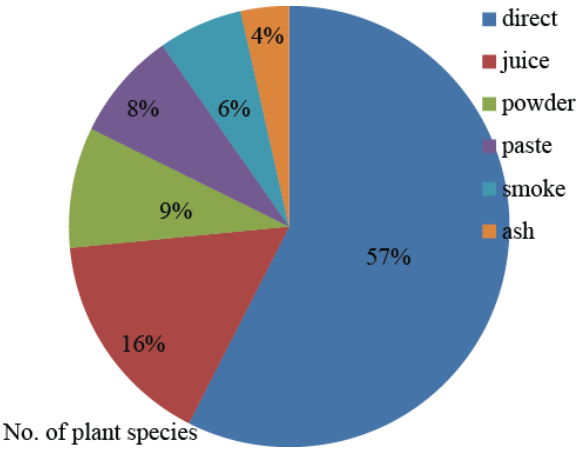

Fig. 8. Form usage.

Parts and form used: Plants are used for fodder, medicine, fuel, timber, and other purposes in the form of leaves, stem, whole plant, flower, seed, fruit, and root as number and percentage were found 54 (46%), 30 (25%),11 (9%), 10 (9%), 7 (6%), 4 (3%%) and 2 (2%) respectively as shown in the Fig. 7. When investigated for usage form it was found that direct 65 (57%), as a juice 18 (16%), powder 10 (9%), paste 9 (8%), smoke 7 (6%), ash 4 (2%), were being used as shown in the Fig. 8.

Plants used as Medicine: In the study area among the plants collected, 31 (29%) plants used for medicinal purposes, while large number of plants 62 (57%) were used as fodder, with some plants 15 (14%) used for different purposes Fig. 9. Among these 31 (29%) plants; 21 (68%) were used for treating different human diseases, 6 (19%) and 4 (13%) for veterinary and wildlife respectively to relieve from different diseases as shown in Fig. 10. According to the investigation it was found that 37 (53%) plants are being used both by livestock and wildlife, while 12 (17%), 7 (10%) and 6 (9%) by livestock, wildlife as fodder, and human being as vegetables respectively as shown in the Fig. 9. In the other uses of plants fuel 9 (13%), thatching & packing 6 (9%), agricultural tools and culture 4 (6%) each and as timber 3 (4%) were found.

Diseases cured by plants: Among the 31 (44%) plants used as medicine, they were used to treat 33 different types of diseases such as stomachache 12, veterinary 6, Asthma and wound healing 4 each, fever, weight loss, hair problems, and insecticides 3 each, nerve disorder, joint pain, diabetes, cosmetics, blood pressure, toothache, jaundice, and urine problems 2 each, ear problem, antimicrobial, antihelminthic, cancer, cough, depression, paralysis, tuberculosis, leucorrhoea, skin disease, body temperature and blood clotting and ranked as 1, 2, 3, 3, 4, 4, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 6, 6, 6, 6 ,6, 6, 6, 6, 6, 6, 6, 6 respectively each (Table 3).

Plants used for other purposes: Besides the usage of medicine and fodder, very few plants are used for other purposes such as for fuel, thatching and packing, agriculture, culture and timber with a percentage of 13, 9, 6, 6 and 4 respectively results are shown in the Table 4 & Fig. 12. Shrubs and trees are very rare because of devastating deforestation practices for timber and fuel before the establishment of the park and still now as illegal practice due to lack of awareness and inadequate management and due to very less number of security guards. Many trees species are at risk of extinction, of which two important species, Juniper and birch, play an important role in ecosystem services.

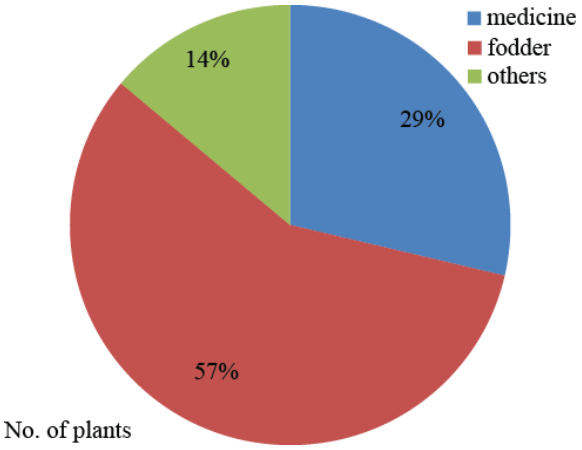

Fig. 9. Percentage use of plants.

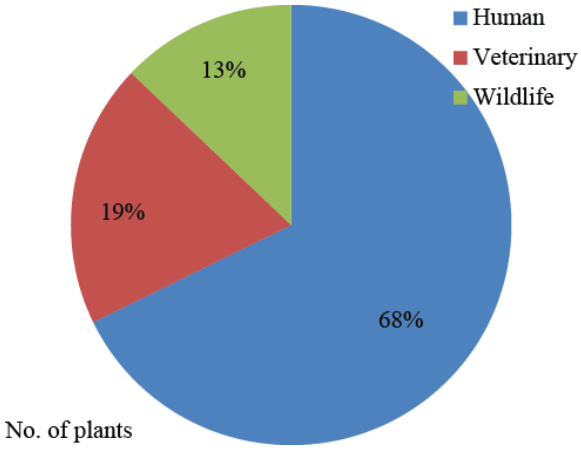

Fig. 10. Percentage use of plants treating animals.

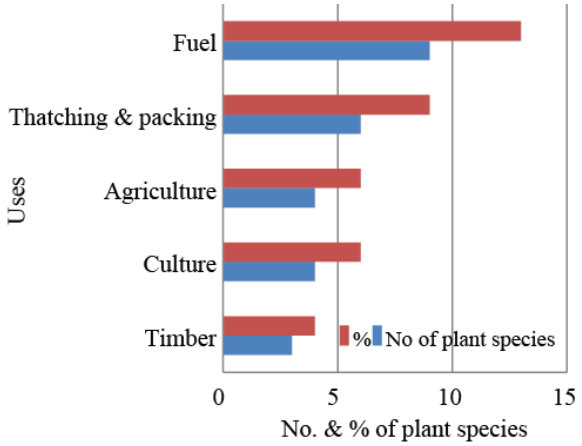

Fig. 11. Plants used for other purposes.

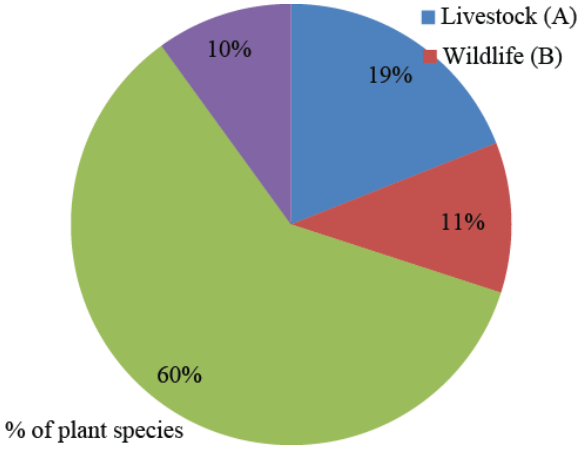

Fig. 12. Competition & resource sharing.

Competition and resource sharing: It was found that there is much competition among livestock, wildlife, and human beings for plant resources. The survey shows that most of the plant species are shared as food between livestock and wildlife with a percentage of 60% followed 19% used as food only by livestock, 11% by wildlife, and 10% by human being as vegetable and tea as shown in the Fig. 11.

Palatability: The palatability class was made on the basis of the usage of plants as fodder and preference of animals in all time or in the scarce time or poisonous (non-palatable). The plants preferred by all animals (wildlife and livestock) at all time is considered as Highly palatable (HP), while plant species preferred to eat by only one group of animals livestock or wildlife is considered as Palatable (Pl), those plant species which are only eaten if no other food is available, such as in winter, are considered as Less palatable (LP), and those plant species which are harmful and eating of which may cause illness or death of the animals are considered as Poisonous (Ps) (non-palatable) plants. These were ranked as 1, 2, 3 and 4 for HP, Pl, LP and Ps respectively and with percentages 32%, 46%, 15% and 7% respectively as shown in the Fig. 13.

Indigenous knowledge resource: Out of 100 people interviewed, the information gathered with a percentage of 40%, 5%, 30%, 15%, and 10% from people aged above 50, below 50, shepherds, KNP staff and Hakims respectively as shown in the Fig. 14.

Threats to the plants in KNP: During the survey the major threats have been identified by continuous observation and data collected from the people and unpublished data of (WWF 2005). The results show that the major threats to the biodiversity of the park were over grazing, climate change impact, natural disasters, road (KKH) construction between Pakistan and China, research exploitation, and increasing human population and intervention. Over grazing and climate change impacts are considered the most alarming threats ranking number 1 each, while natural disaster and cutting for fuel considered to be the threats both ranked 3, road construction activities ranked 4 and human population and research exploitation are considered the least threats ranked 5 in KNP as shown in Table 5. Scoring was made on the basis of the number of individuals and priories given for each threat.

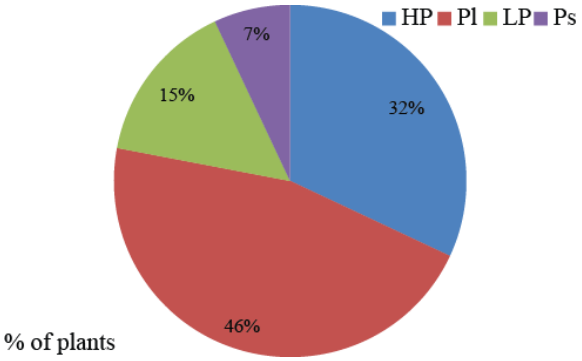

Fig. 13. Palatability of plant resources.

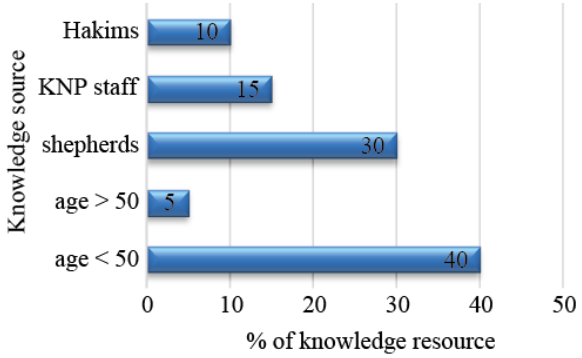

Fig. 14. Indigenous knowledge resource.

Discussion

Plant species and families: Categorization of the status of populations, species, and ecosystems underpins most conservation activities. Status is often based on how a system's current indicator value (e.g., change in abundance) relates to some threshold of conservation concern (Connors & Cooper, 2014). Asteraceae is found to be the dominating family followed by Chenopodiaceae, while majority of families having only one plant species. In an earlier study conducted by Khan *et al.* (2011) in the same area a total of 43 plant species belonging to 28 families were recorded in which Asteraceae family contributed the highest number of species (11.63%) agree with our findings, followed by Fabaceae, Lamiaceae and Rosaceae (9.30% each), Chenopodiaceae and Elaeagnaceae (4.65% each). In contrary in another study, the results show a little variation such as; 62 plant species belonging to 25 families were recorded in which Primulaceae (11.29%), followed by Asteraceae (9.68%), Boraginaceae (6.45%), Brassicaceae (6.45%), Poaceae (6.45%) and Rosaceae (6.45%); whereas, rest of the families had fewer species (Qureshi *et al.*, 2011). Earlier studies conducted by Shedayi & Gulshan (2012) Abbas *et al.* (2013) and Shedayi *et al.* (2014) show that Asteracaceae is the most dominant family having highest number of plant species such as 10, 17 and 8 for the studies respectively and 9, 17 and 10 families having only one plant species each respectively while in our study 19 families comprise only one plant species. Although the park does not support a very large number of plant species due to hard climatic, topographic and climatic conditions, the diversity and distribution of unique and rare and important plant species make it significant.

Table 3. Diseases cured by plants (Number, percentage and rank).

Diseases	SA	Vit	As	WH	Fr	WL	HP	IC	ND	JP	Db	Csm	BP	TA	Jd	UP	EP	AM	AH	Cn.	Co.	Dp	Pl	TB	Leu	SD	BT	BC
No. of plants	12	6	4	4	3	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Percentage	39	19	13	13	#	10	10	6	6	6	6	6	6	6	6	6	3	3	3	3	3	3	3	3	3	3	3	3
Rank	1	2	3	3	4	4	4	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6

Abbreviations: SA (stomachache), Vit (veterinary), As (Asthma), WH (wound healing), Fr (fever), WL (weight loss), HP (hair problem), IC (insecticides), ND (nerve disorder), JP (joint pain), Db (diabetes), Csm (cosmetics), BP (blood pressure), TA (toothache), Jd (jaundice), UP (urine problem), EP (ear problem), AM (antimicrobial), AH (antihelminthic), Cn (cancer), Co (cough), Dp (depression), Pl (paralysis), TB (tuberculosis), Leu (leucorrhoea), SD (skin disease), BT (body temperature), BC (blood clotting)

Table 4. Medicinal plants used for other purposes (number and rank).

Plant uses	*Achillea salicifolia* Besser	*Artemisia brevifolia* Wall. ex DC.	*Betula utilis* D. Don	*Hippophae rhamnoides* L.	*Ephedra intermedia*	*Primula farinose* L.	*Myricaria squamosa* Desvaux	*Silene indica* Roxb. ex Otth	*Chenopodium album* Linnaeus	*Sophora mollis* (Royle) Baker
Fodder	3	5	2	2	3	4	3	4	4	0
Fuel	2	3	5	1	3	2	5	2	1	4
Timber	0	0	3	0	0	0	1	0	0	0
Thatching	2	3	3	3	3	2	3	2	2	2
Total	7	11	13	6	9	8	12	8	7	6
Rank	6	3	1	7	4	5	2	5	6	7

Table 5. Threats to plant biodiversity in KNP. (Rank scale: 1-14=5, 15-29=4, 30-44=3, 45-60=2 and 60-75=1).

Threats	Over grazing	Climate change	Natural disaster	Cutting for fuel	Road construction	Human population	Research exploitation
Score	15	14	8	7	4	3	2
Percentage (%)	71	67	38	33	19	14	10
Rank	1	1	3	3	4	5	5

Human preference of plant species: The preference given by the inhabitants for each plant's use, such as fodder, medicine, fuel, timber and thatching, was ranked after paired comparison tests and the number of plants fall in the ranks 1, 2, 3, 4 and 5 were 9, 9, 7, 25 and 20 respectively as shown in the results. The most preferred plant species were Artemisia brevifolia Wall. ex DC, *Artemisia maritima* L. ex Hook.f., *Capparis spinosa* L., *Silene indica* Roxb. ex Otth, *Chenopodium album Linnaeus, Hippophae rhamnoides* L., *Primula farinose L., Cuminum cyminum* L. and *Peganum harmala L.* which fall in the rank 1.Our results agree with the findings of Khan *et al.* (2011), Qureshi *et al.* (2011), Shedayi & Gulshan, (2012), Abbas *et al.* (2013) and Shedayi *et al.* (2014) with little variation in the species. Human preference is given to only those plants which are directly beneficial to the human being like medicine, fodder, fuel, and thatching. While the plants provide many other indirect services to human being, such as global climate change, ecosystem maintenance, soil retention are usually not considered by local people because of lack of awareness and research.

Seasonal and climatic variation: Most of the plant species found during summer followed by autumn and spring. Our study show similar findings to that of Omer *et al.* (2006) as the plants availability increases from March to July and decreases from August to November, while in winter very few evergreen plant species exist. Hussain *et al.* (2008) recorded 45 medicinal plants from Khyber Pukhtoon Khawan, out of them 17 were perennials/biannual, 20 were found in spring, while 8 species were found in autumn season. Hussain & Durani (2009) found 87 species in May, 72 in July, only 13 plant species in October in another study. The difference with our study is due to having difference in locality, altitude, and climatic factors. In the KNP most of the herbaceous plants grow and bloom during summer. This is due to late onset of the spring in the KNP and the fact that most of the plant species only have 2 to 3 months life span and then die off. However the quantity of plant species was found to be greater in autumn than in spring and very few ever green plants found in the winter. The climate of the area is continental-Mediterranean type easterly monsoon precipitation has least influence while westerly winds have an impact (Khan, 1996). The average rain fall is 140.73 mm per year, the mean maximum is 23.66mm in May and June and mean minimum is 2.26 mm in January. Temperatures are characterized by cold winters with great seasonal differences in higher altitudes and moderate summers. The average minimum monthly temperature is $\pm 4^{o}$C in December and January, while $\pm 25.19^{o}$C during July and August (Steinbauer & Zeidler, 2008).The temperature, direction, evapotranspiration, and wind are essential climatic parameters which determine the conditions for the vegetation type. Some plants from the area have been disappearing for the last couple of years (Khan *et al.*, 2011). As most of the plant species migrate as response of regional climate (Parmesan & Yohe, 2003). The change in the temperature and precipitation affect the distribution of species (Lynch & Lande, 1993). Seasons and temperature variation has great impact on plant diversity, distribution, and availability. As the area has its own unique climate with rocky habitat, the plant species are common in most parts of the park in all seasons, but local microclimate is the cause of variation. Winter, being extremely cold, cannot support plants, although some trees can survive, while summer has pleasant weather and the climate support for lot of plants to grow, bloom, and then die off completing life cycle within 2-3 months. Climate change can put direct and indirect impact on range boundaries and species interaction both in terrestrial and fresh water ecosystems (Thomas, 2010).

Altitudinal variation: Most of the plant species were found in the lowest elevation (3160 m) followed by the highest elevation (4520), while in the rest of plots very less number of plants were found. As Dhee is at lower elevation having comparatively higher temperature, thus it supports more plant species at water banks and open vast valley. Top (at highest elevation) is open having its own unique microclimate, mixed soil and wetland support for most of the plant species at alpine region. In the top most of the plants life cycles complete within 1 to 3 months. No one can observe some of the plants in September which were present in July and August. In the top there is more rain and higher precipitation as compared to the other Rocky valleys. The rest of the valleys have very few plant species, because of the topography, less amount of water, soil, and Rocky habitat. Some plants are found in the crevices of the rocks and hills. The soil temperature decreases from lower to higher altitudes (Ghulam *et al.*, 1999). The alpine pasture had a unique climatic condition as compared to the other stands. The geological and geographic conditions from Dhee to the Koksal are comparatively similar with little variation. The area contains rugged terraces, rocks; gravels and sandy soil with less vegetation cover. The species diversity from Dhee to the Koksal was decreasing with an increasing altitude. The KNP Top having its own microclimate cannot be compared with the lower stands. It had alpine grasses with biennial and perennials Herbs. The study reveals that altitudinal variation has its effect on plant distribution and diversity, but most importantly, local microclimate has its own impact and act as the driving force for plant diversity, distribution and services.

Functional groups and habitat of plant species: As mentioned in the results most of the plant species found in KNP are herbs with few shrubs and very small quantity of trees. Trees like salix, populous, birch, and junipers were observed. As observed only a few juniper species in the park with many remnants/stumps indicating this species has been facing severe threats because of its high level cutting for timber, fuel and medicinal use. Very small patches of birch forest can be observed at high altitude

shady deep valleys. In Dhee and Karchani near river banks some Seabuckthorne and in Koksal at river bank Myricaria are found. While rest of the plant species are herbaceous and grasses. Earlier studies at KNP such as Khan *et al*. (2011) and Quereshi *et al.* (2011) also report highest number of herbs as compared to shrubs and trees. The area is narrow covered with rough rocks with small amount of soil. Streams at different localities provide habitat for most of the plant species. Some plants grow even on rocky habitat, while the soil is sandy in most parts of the area with little sandy loam soil at the top, which has its own microclimate. At the top and at water banks moist soil is found, which facilitate germination and growth of plants. Islam *et al*. (2006) classified 49 weed species into herbs shrubs, trees and climbers. The survival of plant species in such rocky and extreme temperatures depend on their adaptation to such environmental conditions from District Swat. These plants achieve the ability to cope with specific environmental demands in three ways a) evolutionary adaptation b) ontogenic modification or c) modulation (Korner, 2003).This study provides unique information about the habitat of plant species in the area. The shrubs and trees have been threatened due climatic and anthropogenic activities, like drought, cutting for timber and fuel and research exploitation.

Parts and form of use: Our study shows that leaves are the most commonly used parts followed by stem and whole plant while Khan *et al.* (2011) also reported that leaves (24.7%), flowers (21.9%) and whole plant and fruits (13%) used for preparation of medicine. Shedayi *et al.* (2014) and Shedayi & Gulshan (2012) also recorded leaves as the most commonly used parts in Gilgit-Baltistan. Different parts of medicinal plants used as medicine by the local traditional healers among them, the leaves were most frequently used for the treatment of diseases followed by the whole plant, fruits, stem, root, seed and flowers. Previous studies from other regions do not agree with our findings, this may be due to the differences in climatic, topographic, social and ethno-cultural diversity and differences in the life style and food habits as per regional and local conditions. According to previous studies the most frequently used form was powder, followed by paste, and juice (Luitel *et al.*, 2014), most of the herbal remedies used in the form of paste (Buragohain & Konwar, 2007), as juice and powder are mostly used parts for medicinal purpose (Shedayi *et al.*, 2014).

Services of plant resources: The plant resources in KNP are being used for fodder, medince, fuel, timber, thatching. These play important role in the socio-economic condition and poverty eradication of the area providing services directly and indirectly. A plant in one place may be useful as food, feed, fiber and medicine while in any other it may be a weed. Pakistan is one of the few places on earth with such a unique biodiversity, comprising of different climatic zones with a wide range of plants species (Shinwari & Malik, 1989). Various medicinal plant species are also used as food along with their medicinal benefits, evaluating their metal content can help to understand the suitability of these plants species (Husain *et al.*, 2009). Among the 48 woody species that are mostly native plants have 70 uses by the residents of Haramosh and Bagrot valleys, predominantly as medicines, timber, shelter, domestic items and fuel (Khan & Khatoon, 2007). Abbass *et al.* (2013) reported 141 plant species which were recorded being used ethno botanically by the people of Naltar valley District Gilgit. People living in the mountainous areas of Pakistan use plants in many ways including medicines, timber, wood, firewood, food and fodder (Hussain & Khaliq, 1996). In hilly areas, the local plants are documented on fodder for domestic and wild animals, nutritional and vitamins supplement for people, constituents of many indigenous medicines (Goodman & Ghafoor, 1992). In the KNP most of the plants observed are being used as fodder (about 80%) because the area not only supports the wildlife but also livestock are feeding on the same plant resources. These findings agree with those of Hussain & Mustafa (1995), who reported 51 species from Hunza as fodder resources. Hussain *et al.* (2005) also reported plants that are traditionally used for curing diseases like fever, cough, asthma, respiratory problems, stomach and abdominal disorders, rheumatism and joints pain etc. Changes in their life style seem to be responsible for the decline of practice in the local use of herbs for medicinal uses. It is therefore important to record the ethnobotanical uses of these plants before the information is lost. Edible plants include 6 species, which are locally used as vegetables. Some of the species are used as condiments and flavoring agents. The inhabitants take these plants to their home and use them for different purposes. The tribal people of western Madhya Pardash of India use 13 plants for the treatment of jaundice disease (Samvatsar & Diwanji, 2000). A similar study conducted by Shedayi & Gulshan (2012) found 35 plant species used to treat 34 different diseases. A recent study shows; 34 plant species used to treat 31 different diseases (Shedayi *et al.*, 2014). The increasing numbers from most to least preference show the similarities in both studies. Khan & Khatoon (2008) also found similar diseases such as fever, cough, asthma, respiratory problems, stomach and abdominal disorders, rheumatism, joints pain cured by medicinal herbs in Haramosh Valley. These ecosystem services of the KPN have significant impact on the socio-economic condition of the inhabitants of the area as well as their contribution to global change. Besides being used as traditional medicine, plants are widely used in the modern pharmaceutical industries as raw material and ingredient for manufacturing of medicines (Sadia *et al.*, 2013). The people are benefiting from the ecosystem services of KNP in terms of soil retention, air and water purification, food/fodder, medicine and maintenance of climate, food chain, global climate change as being the sink for global carbon stock, trophy hunting and ecotourism and cultural products.

Palatability of plant species: Depending on plant chemical composition, growth stage, and the type of plant species, animal's like or dislike due to relative preference is called palatability (Heady, 1964). Our results show that most of the plants were palatable followed highly palatable, while a very small number of plants were less palatable or poisonous (non-palatable). Our results are similar to that of Amjad *et al.* (2014) in which they found 55 percent plants species were palatable and 45 percent were non-palatable out of 110 plant species, among which16.66% were highly palatable, 36.66% mostly palatable, 31.66% less palatable and15% were rarely palatable species. Our results also indicate that most of the plant species in the study area are useful and have significance. Most of the plants in KNP are found in

herbaceous form with some shrub species and a very few number of trees. Animals prefer whole herbs to eat followed by leaves then seeds and fruits. While in another study in arid range land Kalat, Pakistan, Hussain & Durani (2009) found that 129 palatable species including 50.4% highly palatable, 41.1% mostly palatable, 4.65% less palatable and 3.87% rarely palatable species in the area. Our results also agree with these previous studies. There are 3 major factors that affect palatability as recorded by Marten (1978) these are 1) the animal factors 2) plant factors 3) Environmental factors. Palatability is a good indicator of the services of the plant resources and their uses as forage by animals. In this study we found that most of the plants species are palatable and used by wildlife and livestock.

Competition for plant resources: Most of the plant species are used both by livestock and wildlife. Livestock and wild life both share basic needs such as food, water, cover, and space Bailey & Brown (2011). Wild life species are selective consumers and they select plant species according to their physiological and morphological adaptation. Both wildlife and livestock are categorized by their degree of selection of food such as grass/roughage, intermediate and concentrate (Hofmann, 1989). Grass/roughage (eat most of the plant species except poisonous plants), intermediate (eat about 50% plant species) and concentrate (much selective and prefer to eat very few plant species). This competition for food has put a pressure and cause declination or migration of plant resources. The most vulnerable among all are plants followed by wildlife. As plants are directly eaten by most of the wildlife such as marmot, ibex, marco polo sheep and blue sheep and sometimes by bear. Most of the herbivores are food for the carnivores such as snow leopard, brown bear, wolf and wild dog. Cutting of plants and overgrazing by livestock are the major causes of making the ecosystem food chain imbalance. Because of the misuse of these plant resources, the food chain of the ecosystem is disturbed, which may cause migration or extinction of some of the unique and important plants and animals.

Indigenous knowledge resource: Gilgit-Baltistan is an ecologically sensitive and fragile area that the knowledge system of the native people is sporadic and incomplete (Khan *et al*., 2011). The declining indigenous knowledge is also a threat and it was found that only the old aged people in the valley know the local names, uses, grazing preference and site effects of the plants. Similar results were also recorded by Shiekh *et al.* (2002), Khan *et al.* (2011), Shedayi & Gulshan (2012), Abbas *et al.* (2013) and Shedayi *et al.* (2014). The reason of the declination of the traditional knowledge about plant uses is because of communication gap between old age people and youngsters. Modern technological advancements have also contribution in making youngsters busy all the time and widening the gap. Only some herbalists, hakims and elders know the uses of these plants. It is predicted that the older folk will die with lot of traditional knowledge un-transferred. Until now, all the studies on ethnobotany and ethnoecology have revealed that the traditional knowledge is confined to only the old age people. The unique uses of plants in the area for the human welfare are in its edge because of lack of awareness and lack of facility for knowledge transfer.

Threats to the plants in KNP: The results show that the major threats to the biodiversity of the park were over grazing, climate change impact, natural disasters, construction activity, research exploitation, and increasing human population and intervention. The managed ecosystem have comparatively high species diversity and also associated with traditional extensive livestock grazing (Ribeiro *et al.*, 2014). The people of the adjacent valleys have large numbers of livestock which graze in the pastures of the KNP throughout the year. This has exerted lot of pressure on the plants resources. Livestock grazing has more impacts on land use affecting ecosystems. Grazing impacts depends on the number of stocks and elevation of the land (Bradley & Osullivan, 2011). Secondly, there is competition between livestock and wildlife as both shares the largest number 60% of plants to graze. Climate change impact is the next threat for biodiversity in the region. It is predicted that in the future this threat will exert the most severe impact on biodiversity by altering the weather conditions and increasing natural disasters. Earth's natural biodiversity and landscape is altered by global climate changes fostered by human induced impacts (Neilson *et al.*, 1992). Dry regions face severe consequences of climate change as many endemic species migrate or extinct while the increasing demand of drought tolerant species may result the introduction of new species (Bradley *et al.*, 2010; Diez *et al.*, 2012) which may increase competition between the invasive and endemic plants. Human intervention by road construction has put pressure on most of the plant species and wildlife. Many people visit the area and smuggle the precious medicinal plants in huge amounts for medicinal and pharmaceutical purposes. Smuggling, exploitations and natural disasters are the major threats for the Plants in Naltar valley Gilgit (Sheikh *et al.*, 2002). Although cutting of plants from KNP is prohibited, some people living around KNP, due to lack of basic facilities such as electricity, gas and coal depend mostly on plants for fuel. Fuel wood is the major source of household energy. It has become a threat for the vegetation of this area. Threats to the medicinal plants in Pakistan are reported as unawareness about their importance, mismanagement of habitat, language problems, ignorance, over cutting for fuel, wood consumption, careless uprooting of medicinal plants, and heavy grazing (Qureshi & Ahmad, 1996); Malik & Hussain, 2007). Qureshi *et al.* (2011), Khan *et al.* (2011) and Abbas *et al.* (2013), Shedayi & Gulshan, (2012) and Shedayi *et al.* (2014) also have reported threats similar to our findings. These threats will exert serious consequences on the ecosystem services if not addressed by urgent based efforts and effective management.

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