

VEGETATION ASSESSMENT OF HAZARGANJI CHILTAN NATIONAL PARK QUETTA IN THE NATURAL HABITAT OF *CAPRA AEGAGRUS CHIALTANENSIS*

Tariq Khan¹, Sohaib Ahmed¹, Noor Muhammad², Ahmad Zamir¹, Arz Muhammad Umrani¹, Umair Safdar¹, Hamida Bibi³, Muhammad Bilal Zia¹, Khalid Hussain Solangi¹, Mukhtar Ahmed⁴, Amber Khalid⁵, Abid Faiz¹

1. *Pakistan Forest Institute Peshawar*
2. *Cotton Research Institute Chinese Academy of Agriculture Sciences (CAAS). Anyang Henan*
3. *Department of Environmental Sciences, Abdul Wali Khan University Mardan*
4. *University of Balochistan, Zoology Department*
5. *Lahore College for Women University Zoology Department*

Corresponding Author: arz.forest87@yahoo.com
tariqkhanesote99@gmail.com

Abstract: The present study has been conducted in Hazarganji Chiltan National Park to assess the existing vegetation in the natural habitat of the Chiltan Wild Goat (*Capra aegagrus chiltanensis*) by evaluating three basic requirements of wild animals i.e. shelter, food and water points. The park is important because of its diverse flora and fauna and recreational values. The study was carried out during the July 2022 using Braun Blanquet method of vegetation analysis. Data was collected for total number of species cover and abundance values of vegetation. For this purpose 40 quadrates were laid out and the listing of vegetation was done on comparatively homogenous sites. Two plant communities were recognized at different elevation slope, directions and on rocky sites. 1) *Juniperus macropoda* – *Perovskia abrotanoides* community and 2) *Sophora griffithii* – *Artemisia maritima* community. These communities constitute the best habitat in Hazarganji Chiltan from the aspect of shelter and food availability of Chiltan Wild Goat (*Capra aegagrus chiltanensis*) during summer and winter seasons. Out of these communities, *Juniperus macropoda* was found on the higher elevation between 2000 m to 2500 m. It was dominantly present on Northern, Southern and Western aspects on calcareous parent rocks. Vegetation cover and abundance percentage (%) of this community was high and more than 95% coverage and abundance values were noted. The density was also high and more than 40 plants were present in 100 m² quadrate. *Sophora* – *Artemisia* is dominating in the habitat from 1200 to 1900 m elevation and had the best coverage and abundance values. The soil under this community was quite deep with sand clay loam texture. The community exhibits

almost 80% coverage and abundance. On the basis of these results, it is recommended that blank areas in the natural habitat of Chiltan Wild Goat may be planted with species such as *Pistacia cabulica*, *Fraxinus xanthoxyloides*, *Prunus eburnea*, *Lonicera quinquelocularis*, *Cotoneaster nummularia*.

Keywords: Chiltan Wild Goat, Hazarganji Chiltan National Park, Natural Habitat, Quetta, Vegetative Assessment.

Introduction: The dispersed populations of *Capra falconeri*, also known as Markhors and initially described by *Wagner in 1839*, is widespread throughout the western Himalayas' arid and steppe areas.. Only Afghanistan, India, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan have discontinuous distributions (*Huffman et al. 2004*).

There were seven generally recognised subspecies of Markhor: *C.f. jerdoni* (Suleiman or straight-horned Markhor), *C.f. megaceros* (Kabul or Kabal Markhor), *C.f. cashmirensis* (Pir Panjal or Kashmir markhor), *C.f. falconeri* (Astor Markhor), *Capra aegagrus chiltanensis* (Chiltan Markhor) when they were originally listed under the Protection Act in 1975 and just three subspecies of Markhor are currently recognised by the majority of authority (*Marshall P. Jones 1999*).

Pakistan is home to five different subspecies. The remaining four subspecies were reduced to just two, the straight and flare-horned markhor, and one subspecies, the so-called Chiltan Markhor, was discovered to be a wild goat (*Capra aegagrus* subspecies) (*Schaller et al. 2003*).

Chaudhari and Barkati (2002), in their study of the ecology and status of the Chiltan wild goat concluded that HCNP is the most crucial habitat for the species since it is the sole surviving sanctuary for the animal, which the IUCN Red Book has listed as an endangered species.

According to Sharif-ud-Din Baloch's (2013) research 984 Chiltan wild goats were found, with 431 (44%) of them living in the Hazarganji area, 401 (41%) in the Chiltan area, and 152 (15%) in the Tal, Haider, and Surkho areas. His research also showed that, on average, the Chiltan wild goat population is significantly growing, with a population growth rate of 8.25% over the preceding ten years (1992-2012).

Additionally, the corresponding population growth rates for men, women, children, and yearlings were found to be 9.22%, 6.93%, 8.44%, and 9.91%. His research also showed a ten-year trend toward increasing male to female and child to female ratios.

Early assessments on the wild goat population in the Chiltan range were carried out in the early 1970s (*Shafique and Barkati 2002*). *Schaller and Mirza* estimated the wild goat population in the Chiltan range to be 200 animals in 1971 following a census. Actually, there were only 107 creatures reported during the study. Later, in 1975, *Mirza* undertook a fifteen-day census of the Chiltan wild goat on the Hazarganji and Chiltan mountains, counting 168 animals. The majority of the animals were restricted to the southern portion of the Chiltan range, and the mature males were held above 2800 m in the most challenging terrains (*Shafique and Barkati 2002*). Following the establishment of Hazarganji Chiltan National Park in 1980, the census of the Chiltan wild goat population was carried out by less experienced staff members from observational vantage points. The observations of animals made at the time were not supported by scientific research. But the results of earlier surveys demonstrate that the Chiltan wild goat population increased in its sole surviving sanctuary (*Shackleton, 1997; GoP et al., 2000*). The Chiltan wild goat's status is listed in the IUCN Red Data Book as being of "least concern" (*Sheikh and Molur, 2005*).

Study Area: Hazarganji Chiltan National Park, Qeutta Balochistan is the subject of the investigation. The names *Hazar* and *Ganji* translate to "a thousand" and "treasures," respectively, while *Chiltan* means "forty bodies or saints." One of Pakistan's most significant national parks, HCNP is classified as a "Category V" protected area on the IUCN protected area list. Moreover, T. Bibi et al., 2014 describes it as a hotspot in Balochistan, a province in Pakistan's southwest, and is situated mostly in Mastung district (30°7'N, 66°54'E). Part 8 of the Sulaiman Mountains encompasses the NP, which measures roughly 27,421 acres.



Figure: 1

Material & Method

Selection Of Sampling Sites: The sampling locations of study area included natural regions situated at various slopes and altitudes. Utilizing Braun Blanquet Method and phyto-sociological approaches, the fieldwork was completed in July 2022. Observations of vegetation like coverage abundance, dominance, density, life forms & phenological approaches were noted by using the quadrat method randomly but having comparatively homogenous vegetation. The study area, which is approximately 70 km, was divided into two sample sites on the basis of difference in elevation with 20 quadrats at each site. For the sake of quantitative analysis of vegetation, a total of 40 quadrats were used.

Data Collection: Quadrat method was used to sample the area while using quadrats of various sizes for herb (1m x 1m) , shrub (2m x 2m) and trees (10m x 10m) and 40 quadrates were laid out homogenous vegetation sites at Two (02) different elevation ranges i.e. 2000m – 2500m & 1200m – 1900m (20 quadrates at each range). The vegetation data was recorded and the observations such as elevation (m) was determined by altimeter, direction and slope was determined by compass and clinometer respectively. The use of quadrat is the best method to assess vegetation analysis in the different landscapes (*Eversen & Clark 1987, Cox 1996 and Goldsmith et al., 1986*). During vegetation sampling following steps which were met sequentially:

- The whole study area was divided into 40 sites on the basis of difference in elevation for quantitative sampling.
- Through quadrats at each site i.e. Easily accessible, mature and disturbed; the vegetation was sampled.
- Simple rope, a rod, and inch tape were used to create quadrats. The common quadrat sizes employed in this study for herbs, shrubs, and trees were 1 m x 1 m, 5 m x 5 m, and 10 m x 10 m, respectively.
- Three quadrats were utilised to sample the flora in three layers—herbs, shrubs, and trees—at each location in order to gather floristic data. The entire woody flora was less than one metre tall in the first layer of shrubs, one to five metres tall in the second layer of shrubs, and more than five meters tall in the third layer of trees.

- All of the plant species were identified. The value of cover/abundance for herbs and shrubs was visually judged in the quadrats using the prescribed Braun-Blanquet scale that Daubenmire modified (*Braun Blanquet 1965 and Daubenmire 1968*). The following formulas were used to calculate the phyto-sociological parameters examined at the abundance/cover & frequency of the species:

$$\text{Cover} = \frac{\text{Total area covered by a species in quadrat}}{\text{Total area of quadrat}} \times 100$$

$$\text{Frequency} = \frac{\text{Number of quadrates in which a species occurred}}{\text{Total number of quadrates sampled}} \times 100$$

- Plant collection was done from the study area and plant specimens were collected from the quadrat for identification in the herbarium.
- The nomenclature was followed after *Stewart (1921)*.

Result & Discussion: The study of the area revealed, following plant communities were recorded in the natural habitat of Chiltan Wild Goat:

1. *Juniperus macropoda* – *Pervoskia abrotanoides* Community.
2. *Sophora griffithii* – *Artemisia maritimea* Community.

***Juniperus macropoda* – *Pervoskia abrotanoides* Community:** This community was found on higher elevation. It was found between 2000 m to 2500 m elevation. *Juniperus macropoda* was dominantly present on Northern, Southern and Western aspect of calcareous parent rocks. The vegetation coverage and abundance percentages (%) of this community were high and more than 95% coverage and abundance value were noted. The density was also high and more than 40 plants were present in 100 m² quadrates. Some of the associated species in this plant community are as follows:

Table 2. Summary of Abundance & Frequency Percentage of Vegetation in *Juniperus macropoda* – *Pervoskia abrotanoides* Community

Species Habit	No. of Species Documented	Species Documented	Abundance (%)	Frequency (%)
Grasses	05	<i>Bromus japonicas</i>	5%	20%
		<i>Saccharum griffithii</i>	10%	50%
		<i>Dichanthium annulatum</i>	5%	30%
		<i>Poa bulbosa</i>	5%	50%
		<i>Melica persica</i>	10%	50%
Herbs	18	<i>Pervoskia abrotanoides</i>	15%	66%
		<i>Salvia macrosiphon</i>	15%	60%
		<i>Ocimum Sanctum</i>	15%	50%
		<i>Onosma hookeri</i>	10%	60%
		<i>Asterllaria korschiti</i>	10%	60%
		<i>Scorzonera kigatha</i>	10%	60%
		<i>Astragalus trichocarpus</i>	10%	50%
		<i>Teucrium stocksianum</i>	10%	40%
		<i>Lactuca serriola</i>	5%	20%
		<i>Lepidium draba</i>	15%	50%
		<i>centaurea iberica</i>	10%	50%
		<i>Aquilegia vulgaris</i>	10%	50%
		<i>Achillea Anatolia</i>	5%	40%
		<i>Bupleurum falcatum</i>	5%	40%
		<i>Ferula ovina</i>	5%	40%
		<i>Polygala chinensis</i>	5%	40%
		<i>Lactuca serriola</i>	5%	40%
		<i>Calendula arvensis</i>	5%	40%
Shrubs	19	<i>Ephedra nebrodensis</i>	80%	100%
		<i>Daphne oleioides</i>	75%	80%
		<i>Cotoneaster nummularia</i>	70%	70%
		<i>Lonicera quinquelocularis</i>	50%	60%
		<i>Caragana ambigua</i>	15%	60%
		<i>Berberis balochistanica</i>	30%	60%
		<i>Jasminum humile</i>	15%	50%
		<i>Prunus eburnean</i>	10%	50%
		<i>Spirea brahuica</i>	20%	50%
		<i>Rumex hastatus</i>	15%	60%
		<i>Thymus serpyllum</i>	20%	60%
		<i>Onobrychis trifolia</i>	10%	50%
		<i>Plectranthus rugosus</i>	10%	50%
		<i>Amaranthus hybridus</i>	15%	50%
		<i>Acantholimon munroanum</i>	5%	20%
		<i>Acantholimon stocksii</i>	15%	60%
		<i>Gaillonia eriantha</i>	5%	40%
		<i>Mentha serpyllum</i>	10%	40%
<i>Prangos pabularia</i>	5%	40%		
Trees	04	<i>Juniperus macropoda</i>	90%	100%
		<i>Pistacia Khinjuk</i>	50%	30%

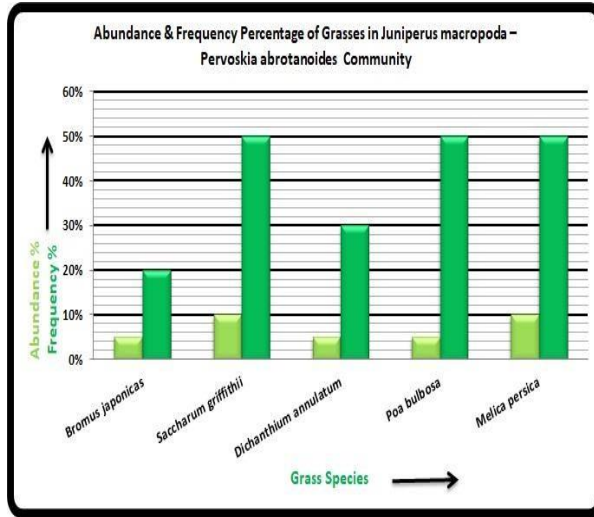


Figure: 2

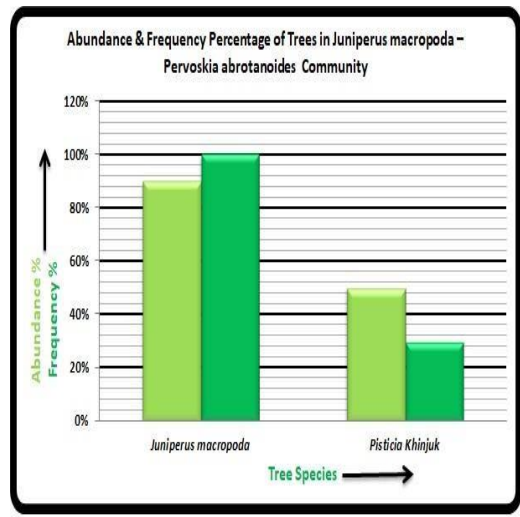


Figure: 3

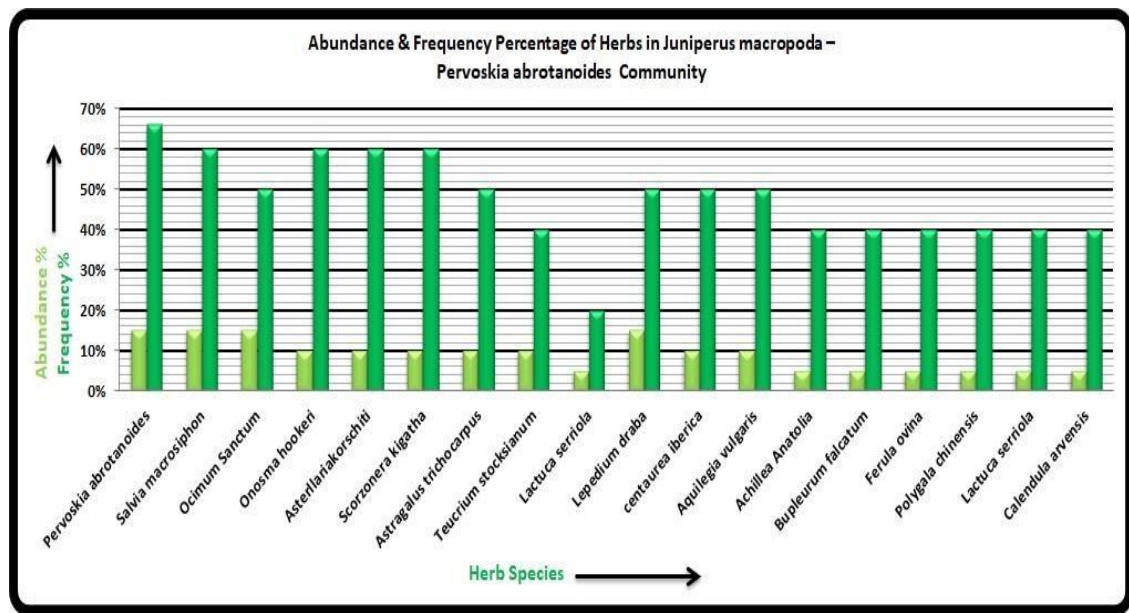


Figure: 4

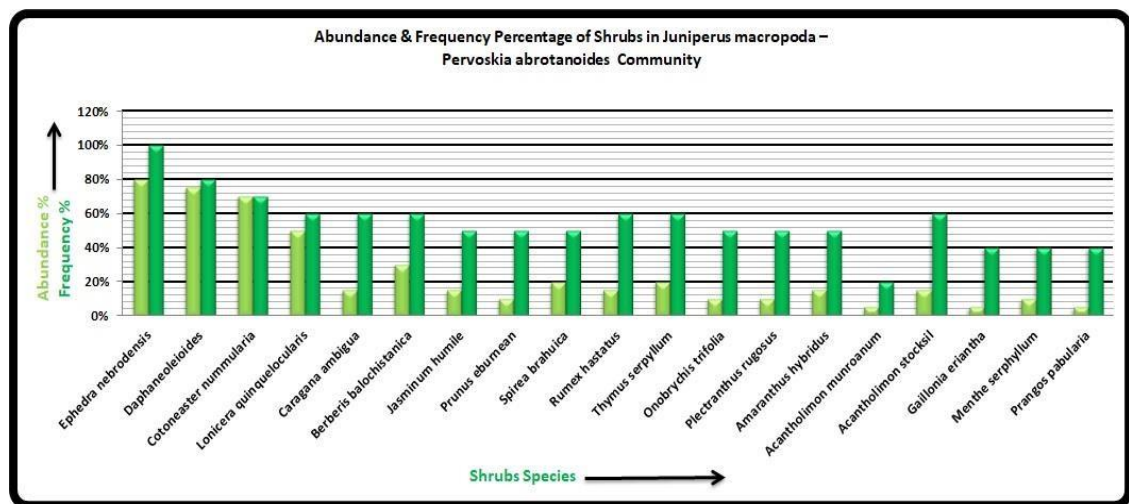


Figure: 5

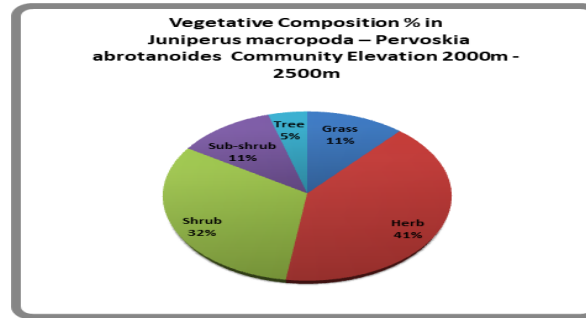


Figure: 6

***Sophora griffithii* and *Artemisia maritima* Community** : This community was found at an elevation ranging from 1200 m – 1900 m. The community was found on calcareous soil. It was present comparatively on gentle slopes. Vegetation, coverage and abundance were ranging from 80-90%. There were 34 species present per 100 sq.m. quadrats. The community is consisting some of the following associate and sub-ordinate spp:

Table 3. Summary of Abundance & Frequency Percentage of Vegetation in *Sophora griffithii* and *Artemisia maritima* Community

Species Habit	No. of Species Documented	Species Documented	Abundance (%)	Frequency (%)		
Grasses	04	<i>Saccharum griffithii</i>	5%	20%		
		<i>Bromus japonicus</i>	5%	20%		
Herbs	36	<i>Plantago ciliata</i>	5%	50%		
		<i>Plantago ovate</i>	5%	50%		
		<i>Artemisia maritima</i>	5%	45%		
		<i>Bupleurum falcatum</i>	5%	30%		
		<i>Heliotropium cabulicum</i>	5%	30%		
		<i>Nepeta bracteata</i>	5%	30%		
		<i>Ferula castata</i>	5%	30%		
		<i>Descurainia sophia</i>	5%	30%		
		<i>Scabiosa cana</i>	5%	30%		
		<i>Stachys pavirflora</i>	5%	30%		
		<i>Lamium amplexicaula</i>	5%	30%		
		<i>Polygala chinensis</i>	5%	20%		
		<i>Silene conoidea</i>	5%	20%		
		<i>Calendula arvensis</i>	5%	20%		
		<i>Hyoscyamus niger</i>	5%	30%		
		<i>Nonea caspica</i>	5%	20%		
		<i>Campanula colorata</i>	5%	20%		
		<i>Pultcaria gnaphalodes</i>	5%	20%		
		<i>Verbascum thapsus</i>	5%	20%		
		<i>Bromus tectorum</i>	5%	20%		
		<i>Hedysarum wrightianum</i>	5%	20%		
		<i>Scorzonera tuberosa</i>	5%	20%		
		<i>Echinops griffithianum</i>	5%	20%		
		<i>Salvia macrosiphon</i>	10%	20%		
		<i>Paracryum purpureum</i>	10%	30%		
		<i>Veronica biloba</i>	10%	20%		
		<i>Lepidium draba</i>	5%	20%		
		<i>Astragalus trichocarpus</i>	5%	20%		
		<i>Teucrium stocksianum</i>	5%	20%		
		<i>Centurea iberica</i>	5%	20%		
		<i>Phlomis stewartii</i>	5%	20%		
		<i>Aquilegia vulgaris</i>	5%	20%		
		<i>Ferula ovina</i>	5%	20%		
		<i>Polygala chinensis</i>	5%	20%		
		<i>Lactuca serriola</i>	5%	20%		
		<i>Calendula arvensis</i>	5%	20%		
Shrubs	19	<i>Prunus eburnea</i>	10%	50%		
		<i>Ephedra procera</i>	10%	50%		
		<i>Plectranthus rugosus</i>	5%	30%		
		<i>Verbascum erianthum</i>	5%	30%		
		<i>Othomopsis intermedia</i>	5%	30%		
		<i>Ephedra nebrodensis</i>	90%	100%		
		<i>Daphne oleoides</i>	70%	70%		
		<i>Lonicera quinquelocularis</i>	40%	50%		
		<i>Caragana ambigua</i>	30%	40%		
		<i>Berberis balochistanica</i>	40%	40%		
		<i>Jasminum humile</i>	70%	30%		
		<i>Spiraea brahuica</i>	30%	30%		
		<i>Rumex hastatus</i>	30%	40%		
		<i>Thymus serpyllum</i>	20%	30%		
		<i>Pervoskia abrotanoides</i>	10%	40%		
		<i>Gaillonia eriantha</i>	5%	20%		
		<i>Menthe serpyllum</i>	5%	20%		
		<i>Prangos pabularia</i>	5%	20%		
		<i>Acantholimon maroccanum</i>	5%	20%		
		Trees	04	<i>Fraxinus xanthoxylodes</i>	10%	50%
				<i>Sophora griffithii</i>	40%	60%
				<i>Prangos pabularia</i>	5%	30%
				<i>Pistacia Khinjūk</i>	40%	100%

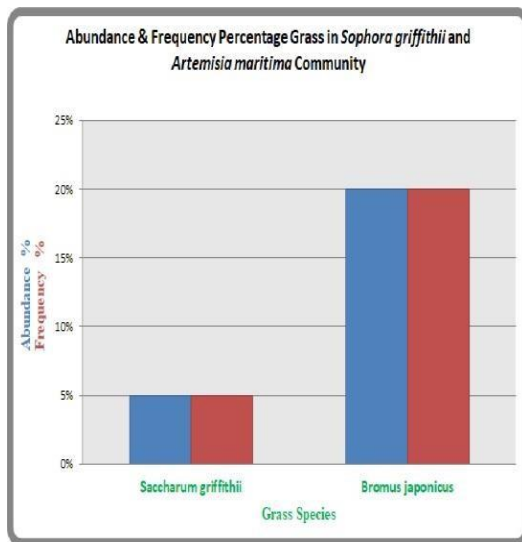


Figure: 7

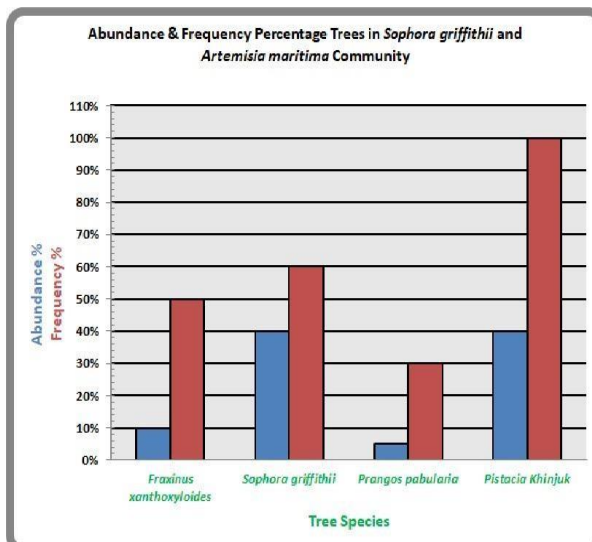


Figure: 8

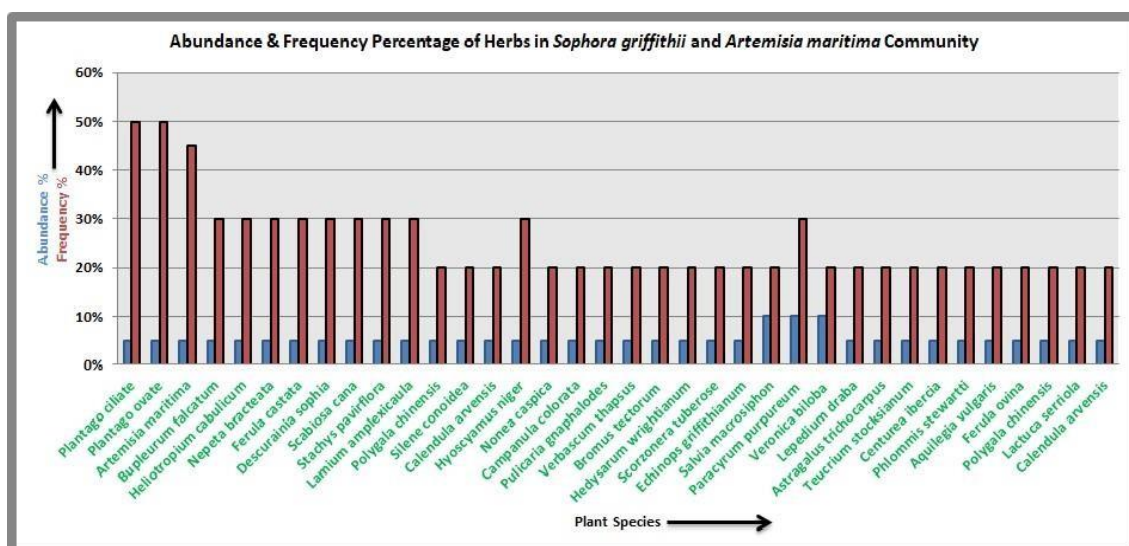


Figure: 9

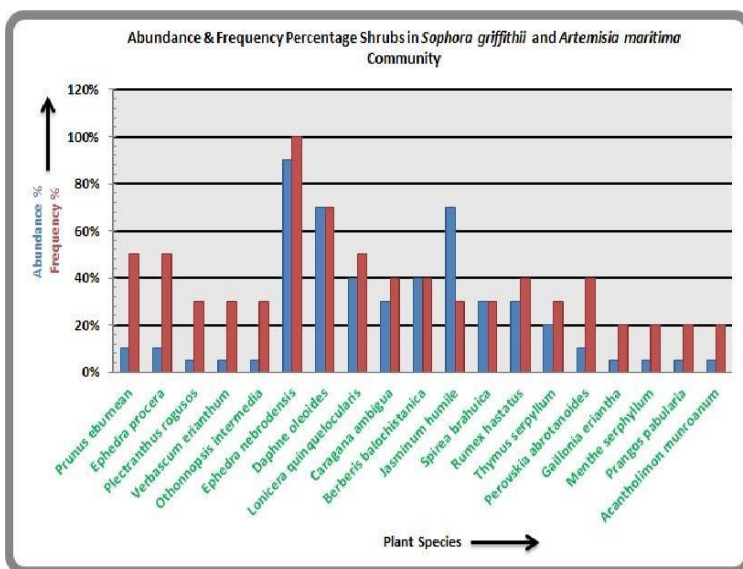


Figure: 10

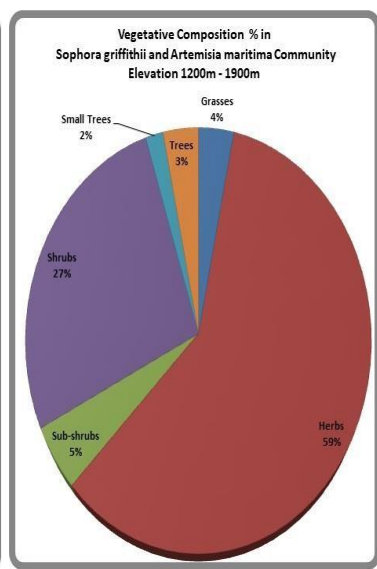


Figure: 11

Distribution/Frequency of Occurrence of Plant Families Recorded in the Habitat of Chiltan Wild Goat at HCNP: On accomplishment of habitat survey and after taxonomic identification of plants specimens; collected from all sampling sites in the habitat of Chiltan Wild Goat; from the herbarium of Pakistan Forest Institute and Flora of Pakistan, following 24 Plant Families named below were recorded :

Table 4. Summary of Total No. of Families documented from all the sampling sites in the Habitat of Chiltan Wild Goat (*Capra aegagrus chiltanensis*)

Study Area	Elevation of Sampling Sites (m)	Total No. of Sampling Sites	No. of Families Documented	Species Documented
HCNP, Quetta	i. 1200 – 1900 ii. 2000 – 2500 (20 sampling sites at each elevation)	40	24	<i>Anacardiaceae</i>
				<i>Boraginaceae</i>
				<i>Berberidaceae</i>
				<i>Bryophyte</i>
				<i>Caryophyllaceae</i>
				<i>Companulaceae</i>
				<i>Chenopodiaceae</i>
				<i>Compositae</i>
				<i>Convolvulaceae</i>
				<i>Cruciferae</i>
				<i>Cupressaceae</i>
				<i>Dipsacaceae</i>
				<i>Euphorbiaceae</i>
				<i>Gramineae</i>
				<i>Gnetaceae</i>
				<i>Gentianaceae</i>
				<i>Geraniaceae</i>
				<i>Liliaceae</i>
				<i>Moraceae</i>
				<i>Oleaceae</i>
				<i>Orobanchaceae</i>
				<i>Papaveraceae</i>
				<i>Plumbaginaceae</i>
				<i>Polygalaceae</i>

The habitat further revealed that the Frequency of occurrence/distribution of Graminaea Family was maximum as compare to the other recorded families. The following frequency chart describe the detailed information regarding the distribution/frequency of different families recorded in all the sampling sites in the habitat of Chiltan Wild Goat at Hazarganji – Chiltan National Park Quetta, Balochistan:

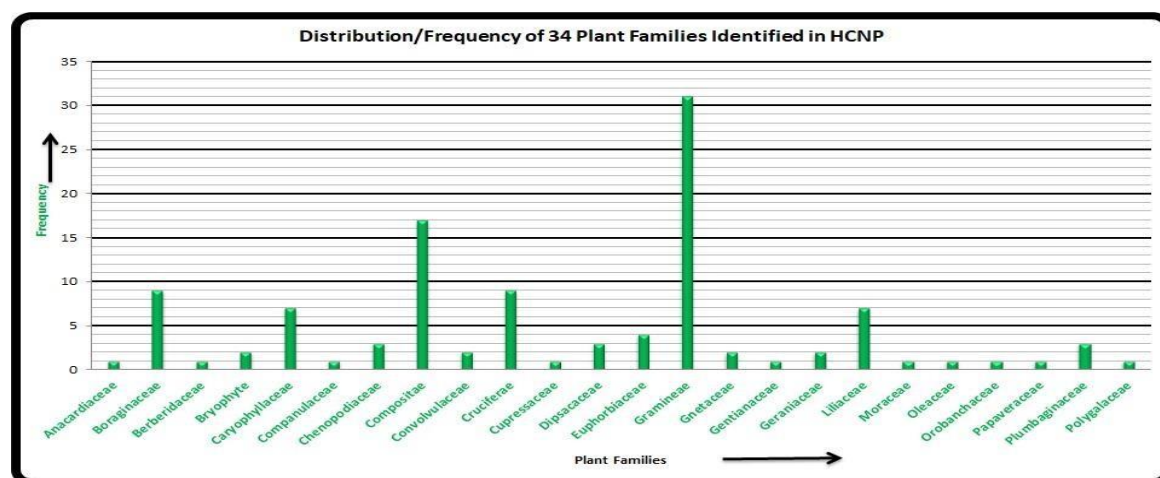


Figure 12

Feeding Habit & Preferred Diet of Chiltan Wild Goat: Principal food of the Chiltan Wild Goat in winter was determined to be Juniper. During observation, a female goat was found climbing the juniper tree and feeding on it. However, in summers chiltan wild goat graze at night and take rest during day time hiding themselves under bushes and shady cliffs. The Chiltan Wild Goat is found indulged in browsing most of the time as more browsing vegetation is available compare to grasses in Hazarganji range.

The following 12-plant species are recorded to be preferred by animals. A detailed list of palatable species was also collected by Khan (1989):

Table 5. Summary of Vegetative species preferred by Chiltan Wild Goat (*Capra aegagrus chiltanensis*) in the study area.

Study Area	Species Habit	Species
HCNP, Quetta	Grasses	<i>Melia persica</i>
		<i>Cymbopogon schoenanthus</i>
		<i>Chrysopogon aucheri</i>
		<i>Oryzopsis spp</i>
	Herbs	<i>Bupleurum flaccatum</i>
	Shrubs	<i>perovskia arbrotanoides</i>
		<i>Artemisia maritime</i>
		<i>othannopsis intermedia</i>
		<i>Ephedra spp</i>
	Trees	<i>Pistacia khinjak</i>
		<i>Fraxinus xanthoxyloides</i>
		<i>Alnus nitida</i>

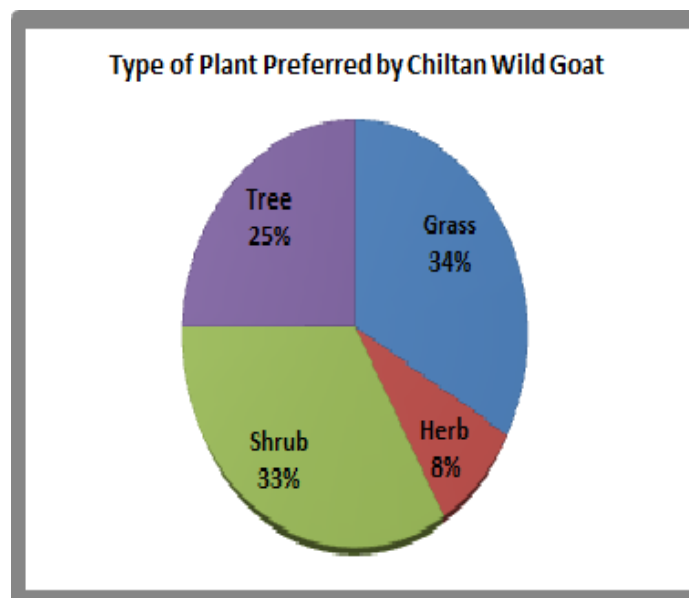


Figure: 13

Discussion: In the present study Twenty Four (24) plant families were studied in the natural habitat of Chiltan Wild Goat at HCNP Quetta where the habitat under study was

bifurcated on basis of difference of elevation i.e. 1200 – 1900m & 2000 – 2500m during July 2022. The documented families showed characteristics in common as well as variances from the vegetation found in the rest of the country; for example, the most prevalent families were the *Gramineae* and *Compositae* (Abbas Z et al., 2016 and Abbasi et al., 2013).

24 families and 109 plant species were identified in the current study. *Gramineae* and *Compositae* were recorded as the two most prevalent families. The *Poaceae* family was the dominating family at this site, and several others were comparable across a number of places, according to recent research (Iqbal MS et al., 2015, Ijaz F et al., 2016, Shaheen H et al., 2011 and Malik H et al., 2001). A total of 38 shrubs, 54 herbs, 5 tree species, and 5 grass species were identified in the study area. Additionally, the recorded value is within the indicated range for other Pakistani regions (Pielou EC, 1977).

Conclusion: From the study of the area it seems that sufficient vegetation of palatable species is in existence for summer and winter habitats both in Chiltan and Hazarganji. The coverage and abundance values for shelter species such as *Juniperus macropoda*, *Pistacia khinjuk*, *Fraxinus xanthoxylolides*, and *Daphne oleoides*, range upto 80% while the density of the dominant species range from 50-60 plants in the sample plots of 100m². One can safely conclude from the above data that the present species are sufficient to provide food and shelter to the animal in these areas. However, an improvement in vegetation for food and shelter is required with the increasing number of animals populations and grazing pressures on the palatable plant communities.

References

Abbas Z, Khan SM, Abbasi AM, Pieroni A, Ullah Z, Iqbal M, et al. Ethnobotany of the Balti community, Tormik valley, Karakorum Range, Baltistan, Pakistan. J Ethnobiol Ethnomed, 2016, 12, 38. <https://doi.org/10.1186/s13002-016-0114-y> PMID: 27612599.

Abbasi AM, Khan SM, Ahmad M, Khan MA, Quave CL, Pieroni A. Botanical ethnoveterinary therapies in three districts of the Lesser Himalayas of Pakistan. J. Ethnobiol. Ethnomed. 2013, 9, 84. <https://doi.org/10.1186/1746-4269-9-84> PMID: 24359615

Aleem, A. (1979) Observations on Survival ratio of Markhor young. Pakistan Journal of Forestry. 27 (4):238-244.

- Aleem, A. (1979), Markhor, population dynamics and food availability, in Chitral Gol Wildlife sanctuary, Pakistan Journal Forest 29(3) 166-181.
- Baloch S., (2013), The distribution & Population of chiltan Wild Goat (*Capra aegagrus chiltanensis*) in its last remaining refuge of Hazarganji Chiltan National Park, Park.
- Brawn Blanquet. (1965) plant Sociology translated by fuller and conard M.C Graw hills book company Newyark.
- Braun-Blanquet J, Conard HS, and Fuller GD, Plant sociology: the study of plant communities. N.Y: McGraw-Hill. 1932.
- Cox GW, Laboratory Manual of General Ecology. 7th ed. Dubuque: Willium C. Brown Publishers, 1996.
- Cox, C.B. and P.O. Moore, 1993. Biogeography: An Evolutionary Approach. London: Blackwell Scientific.
- Daubenmire RF, Plant communities: a textbook of plant synecology. New York: Harper & Row, 1968.
- Everson C, & Clarke G, A comparison of six methods of botanical analysis in the montane grasslands of Natal. Plant Ecol, 1987, 73, 47–51.
- Government of Balochistan and IUCN Pakistan. 2000. Balochistan Conservation Strategy. IUCN Pakistan and GoB, Karachi. Pakistan xxxii + pp354.
- Goldsmith FB, Harrison CM, Morton AJ, Description and analysis of vegetation. Methods in Plant Ecol. 2nd Edition. 1986, 437–524.
- Huffman, B. 2004. "Capra falconeri (Markhor)" (On-line). The Ultimate Ungulate Page. Accessed June 02, 2005 at http://www.ultimateungulate.com/Artiodactyla/Capra_falconeri.html.
- Ijaz F, Iqbal Z, Rahman IU, Khan SM, Shah GM, Khan K et al. Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan. J Ethnopharmacolo, 2016, 179: 208–233. <https://doi.org/10.1016/j.jep.2015.12.050> PMID: 26739924
- Iqbal MS, Khan MA Khan, Rahman IU, Abbas Z and Zahidullah. Exploration and inventorying of weeds in wheat crop of the district Malakand, Pakistan. Pakistan Journal of Weed Science Research, 2015, 21(3): 435–452.
- Pielou EC, Ecological diversity. Wiley, New York.- 1977. Mathematical Ecology. Wiley, New York, 1975.
- Shaheen H, Khan SM, Harper DM, Ullah Z, Allem Qureshi R. Species diversity, community structure, and distribution patterns in western Himalayan alpine pastures of Kashmir, Pakistan. Mountain Research Development, 2011, 31, 153–159.
- Shafique, CM. and Barkati, S. 2002. Status and Ecology of Chiltan Wild goat *Capra aegagrus chiltanensis* (Caprinae) Rec. Zool. Surv. Pakistan. 14: 81-93.

Shackleton, D.M., IUCN/SSC Caprinae Specialist Group, 1997. Wild Sheep and Goats and Their Relatives. Status Survey and Conservation Action Plan for Caprinae. IUCN, Gland, Switzerland and Cambridge, UK, 390.

Schaller, G.B., 1977. Mountain Monarchs. Wild Sheep and Goats of the Himalaya. University of Chicago Press.

Stewart, R.R. (1972). Flora of west Pakistan an annotated catalogue of the vascular plants of west Pakistan and Kashmir, Karachi.