Species composition of dry-temperate forest as an important habitat for wildlife fauna species

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Abstract

Aim: To determine the present species composition and diversity in dry temperate forest ecosystem, especially trees, shrubs, ground cover, birds, reptiles and mammals.

Methodology: The vegetation composition and diversity of dry-temperate forest in Kumrat valley was determined through employing the 20x20 m (0.4 ha) quadrant method. In addition, fauna species were detected through direct visual observations. A total of 100 quadrant plots were randomly selected to determine the vegetation composition and diversity from July, 2017 to August, 2018.

Results: A total of 7 tree species, 3 shrubs, and 12 grass species were identified, which were attracted into the study area. The highest tree density was determined for *P. wallichiana* (3.375 tree ha⁻¹) and the lowest one for *J. regia* (0.300 tree ha⁻¹). CAP tests indicated that the diversity indices, i.e., Shannon-Winner's Diversity Index ($H_1=2.908\pm0.161$), Margalef's Richness Index ($R_1=3.26\pm0.112$) and McIntosh Evenness Index ($E=0.9746\pm0.0206$) occurred in Kumrat valley. Further, diversity indices of trees varied from species to species, e.g., the highest tree species diversity ($H_1=2.248$) and species richness ($R_1=2.730$) was recorded in *Picea smithiana* and the lowest one ($H_1=0.297$) and richness ($R_1=0.4024$) in *Juglans regia*. *Taxus baccata* ($E=0.9763$) showed even distribution in the study area as compared to other tree species. The direct observation observed a total of 11 mammal species (6 endangered, 3 data deficient, and 2 species least concern), 41 bird species (41 least concern), and 6 reptile species (4 least concern, 1 data concern, and 1 vulnerable) simultaneously within the same area where plant cover was determined.

Interpretation: The results of this study demonstrated that plant cover structure and composition of dry-temperate forest is the most prominent factor that had formed a wide array of different habitats to attract the higher diversity of fauna.

Key words : Birds, Food resources, Mammals, Reptiles, Species diversity

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Introduction

Determining the plant cover structure and diversity is an essential tool to gather information about the habitat suitability and extent of disturbance, recovery process, and management activities. In addition, plant diversity also indicates the current status of the forest ecosystem health, disturbance and productivity (Onaindia et al., 2004; Ahmad et al., 2015), which are the essential factors attracting the wildlife fauna species to inhabit, forage, rest and breed.

Plant cover composition and diversity is the most prominent component of the dry-temperate forest ecosystem and it has been considered as an important habitat for a wide array of wildlife fauna species. The flora of dry-temperate forest may vary from area to area, depending upon site quality, aspect, slope, microclimate, topography, and anthropogenic interference. The variation among the species composition and structure establishes heterogeneous habitats characterized by spatial variability in layers and rich in food resources, which harbor higher diversity of wildlife species that directly or indirectly are dependent on plant cover structure and composition for their survival (Frickle et al., 2013; Douglas et al., 2014). Wildlife fauna species are habitat specialists and show close associations with plant diversity and richness. Which could be due to the fact that habitat diversity offers a variety of food resources, safe breeding sites, suitable loafing grounds, and shelter from predators and harsh weather (Attua and Pabi, 2013; Rajpar and Zakaria, 2014; Rajpar, 2018).

The dry-temperate forest is bestowed with a diversity of plant species composition, such as; trees, shrubs, grasses, herbs, etc. This diversity and structure varies from area to area, i.e., dense patches, fragments, remnants and scattered trees. The difference in the plant cover thickness, compactness, distribution, and heterogeneity form different layers attracting mammals, birds and reptiles. Wildlife fauna are integral part of the dry-temperate forest ecosystem as they play a crucial role in forest ecosystem health and management, e.g., gene dispersal, food chain, food web, prevent population expansion of pests, disperse seed, control the grasses, pollinate the flowers, increase the fruit production, and balance nutrients in the soil (Greenberg and Walter, 2010; Carlo et al., 2013; Bauer and Hoyer, 2014). They also serve as bio-indicators of forest ecosystem by indicating productivity and environmental condition (Roemer et al., 2009; Dawson and Efford, 2009).

There are eleven types of forest habitats in Pakistan and these vary in the structure and composition, as well as food resources which attract 757 birds, 174 mammals and 195 reptile species (Wilson and Reeder, 2005). Unfortunately, these forested habitats are being lost and degraded because of human intervention (DeFries et al., 2005; Wright, 2005; Clark et al., 2009; Edwards et al., 2011), such as; alteration in land use patterns (Fitzherbert et al., 2008; Sodhi et al., 2010; Miettinen et al., 2011), deforestation for agricultural conversion, human settlements,

cattle ranches, illegal logging for timber and fuel wood collection, and fire (Cristobal-Azkarate and Arroyo-Rodriguez, 2007; Irwin, 2008; Gonzalez-Zamora et al., 2009). The land use change is the major driving factor altering the plant cover structure and composition (Maas et al., 2009) as well as productivity, i.e., food resources (Chaves et al., 2012; Höbinger et al., 2012) which ultimately lead towards habitat fragmentation, scarcity of food resources, and effects the distribution and population parameters of wildlife fauna species (Mayaux et al., 2005).

Notably, monitoring the structure and composition of plant cover together with faunal diversity is highly essential, because it helps in tracking the changes in plant species structure and composition, and fluctuation in faunal diversity (Rajpar et al., 2017; Rajpar, 2018) and richness during a specific period. No detailed study has been carried out till now to quantify the species composition and diversity as a prominent component of the dry-temperate forest ecosystem allowing it to serve as an ideal habitat for a wide array of faunal species. In light of the above, the aim of this study was been to determine the plant species composition and diversity of dry-temperate forest of Kumrat valley so as to understand their effects on the diversity of wildlife fauna species.

Materials and Methods

Study Area: Study was carried out in a dry-temperate forest in Kumrat valley, Dir Upper District, Khyber Pakhtoonkhwa Pakistan (Fig. 1). Kumrat valley lies between 2211-2454 m above sea level at 35° 32' 11" N latitude and 75° 13' 45" E longitude, covering an area of 41,840 ha as forest. The topography of the valley is rough with the mountains located at the foothills of Hindukush mountain range and surrounded by Chitral (North), Kalam (East), Ayun Valley (West) and Lower Dir (South). It is full of evergreen pastures, snow-clad mountains. The flora is comprised of *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Pinus wallichiana*, which frequently grow on hill ridges associated with evergreen broad leaf tree species namely; *Quercus ilex*, *Q. dilatata*, *Q. semecarpifolia*, *Betula utilis* and few others. A prolific shrubby vegetation covers the ground as an undergrowth and is composed of *Viburnum nervosum*, *Berberis lyceum* and the species of *Salix*, *Lonicera* and *Ephedra*.

The climatic conditions are moderately cool in summer with 20-25 °C temperatures, but in winters it ranges between 4-10 °C. The mean annual precipitation lies between 100-255 mm and most of it falls during winter in the form of snow, with good infiltration into the soil.

Plant species survey: The species composition of trees, shrubs (Mumby et al., 1997; Hudon, 1997; Fernandez-Alaez et al., 2002; Hassen-Aboushiba et al., 2013) and grasses was investigated for their structure by employing "Quadrat method" (20x20 m) in different habitats. In all 20x20 m (0.04 ha) 100 quadrats were sampled randomly to record the plant diversity from July to August 2017. The location of each sampling plot was recorded with the help of GPS for an easy relocation. In each quadrat ground cover

Fig. 1 : Location map of the study area.

(%) and number of tree species, wood or shrub and grasses were noted. The methodology was same as followed by Sharma *et al.* (2016) and Fernandez-Alaez *et al.* (2002).

Fauna Survey: Fauna species were surveyed every month at different locations simultaneously at the same locations with factors like plant cover structure and composition from 0800 hrs to 1200 hrs in each month. Multiple visits were made to survey fauna

species throughout the study period. The methodology was followed as described by Kunz *et al.* (2007), Boldreghini and Dall'Alpi (2008) and Hamel *et al.* (2009).

Data Analysis

Tree Density: The tree density were calculated following the methods outlined by Baboo *et al.* (2017), Karki *et al.* (2017), and

Vibhuti and Bargali (2018). It is the simple number of trees per ha. The tree density was measured using 20x20 m quadrant plot = 400 m² or 0.4 ha. We determine the 100 sample plots for vegetation density ha⁻¹.

Tree Density = Sample area x total sample plot = 40 ha

Tree Density = Total number of detected tree individuals / total sample plot area (ha)

Diversity indices : The diversity indices of plant cover were analyzed using Community Analysis Package (PCA) Version 4.0 according to Henderson and Seaby (2007). Shannon's diversity index, Margalef's Richness Index and McIntosh's Evenness index were used to determine the diversity indices of plant cover.

Species diversity: It is an index that incorporates the number of plants in an area and also takes into account their relative abundance and provides more information about plant cover composition, such as (Hassen-Aboushiba et al., 2013), rarity and commonness of trees, shrubs, grasses and herbs in a particular area.

Shannon's Diversity Index:

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

where, H' designates diversity, S indicates the number of species, i specifies the abundance of species, N relates to the total number of all individuals and p_i is the relative abundance of each species.

Species richness: It is the number of different plant species in a given area. It also provides information on homogeneity and rarity of plant cover structure.

Margalef's richness index:

$$(R) = S - 1/\ln(n):$$

where, S = Σ species in the plot and n = Σ Individuals of all species (Hassen-Aboushiba et al., 2013).

Species evenness: It is a measure of the relative abundance of different plant species in a particular area. **McIntosh's Index:**

$$D = \frac{N - N_i}{N - \sqrt{N}}$$

where, N is the total number of individuals in the sample and U is given by the expression:

$$U = \sqrt{\sum n_i^2}$$

where, n (i) is the number of individuals in the ith species and the summation is undertaken over all the species, U is the Euclidean distance of the community from the origin (Henderson and Seaby, 2007).

Results and Discussion

Species composition: Seven evergreen and broad leaved tree species occurred in Kumrat valley. Out of these seven species, five were coniferous and two broadleaved. *Pinus wallichiana* was the most dominant tree species (39.82%) and *Juglans regia* the rarest tree species (3.54%). Few shrub species were also documented in the area, however, species composition varied from area to area depending on the altitude, hilly terrain and bottom of valleys (Table 1).

Tree density: The highest tree density was determined for *P. wallichiana* (3.375 tree ha⁻¹) and the lowest one for *J. regia* (0.300 tree ha⁻¹) (Table 1).

Tree species diversity: Community Analysis Package (CAP; Version 4.0) test results indicated that overall tree diversity of dry-temperate forest was Shannon-Winner's Diversity Index; H_i=2.908±0.161, however the tree diversity varied from species to species, e.g., the highest tree diversity was recorded in *Picea smithiana* (H_i=2.248) and the lowest in *Juglans regia* (H_i=0.297) (Table 1).

Tree species richness: The results of Margalef's Richness Index (R_i) states that species richness of trees may vary depending upon edaphic and site quality. In the study area, the highest species richness was recorded in *Picea smithiana* (R_i=2.730) and the lowest in *Juglans regia* (R_i=0.4024). However, it was concluded that overall tree species richness of Kumrat valley was R_i=3.26±0.112 (Table 1).

Tree species evenness: McIntosh Evenness Index indicated that tree species evenness of Kumrat valley was around E=0.9746±0.0206. *Taxus baccata* (E=0.9763) was evenly distributed in the area as compared to other tree species (Table 1).

Mammal species composition: Eleven mammal species were sampled in the valley during the study period. Out of 11 species, 6 species were endangered, 3 species data deficient, and the rest two species were of least concern. These findings indicated that the valley forms a suitable habitat for them (Table 2).

Bird species composition: Kumrat valley occurs at higher altitude above sea level full of pine and broadleaved species, falling in the dry-temperate forest of Pakistan. A total of 41 bird species belonging to 22 families were noted through direct observation. These included eagles, kites, tits, tree creepers, doves, crows, treepies, jays, drongos, buntings, finches, shrikes, swallows, thrushs, flycatchers, wagtails, pheasants, quails and few others. The higher number of bird species indicates that this valley is rich in plant cover as well as food resources, which attract a wide variety of bird species (Table 3).

Reptile species composition: A total of six reptile species were detected which included agama, lizards, snake, and skink. The

Table 1 : Vegetation species composition, density and diversity indices in Kumrat valley

Scientific name	Common name	Total of individuals	Percent tage(%)	Density / ha	Shannon–Winner's Diversity Index (H _i)			Margalef's Richness index (R _i)			McIntosh Evenness Index (E)			
					Index	Expected Index	Lower Index @ 95%	Upper Index @ 95%	Index	Lower Index @ 95%	Upper Index @ 95%	Index	Lower Index @ 95%	Upper Index @ 95%
Tree species composition														
<i>Pinus wallichiana</i>	Blue Pine	135	39.82	3.375	2.177	8.816	1.985	2.294	2.446	2.039	2.446	0.8598	0.8011	0.8965
A.B. Jacks (Pinaceae)														
<i>Cedrus deodara</i> (Roxb)	Himalayan Cedar	80	23.60	2.000	1.829	6.226	1.625	1.950	1.587	1.369	1.597	0.8695	0.7842	0.9203
G. Don (Pinaceae)														
<i>Abies pindrow</i> (Royle ex D. Don) (Pinaceae)	West Himalayan Fir	41	12.10	1.025	2.015	7.502	1.611	2.173	2.424	1.616	2.424	0.8731	0.7738	0.9371
<i>Picea smithiana</i> (Wall.) Boiss (Pinaceae)	West Himalayan Spruce	38	11.20	0.950	2.248	9.468	1.906	2.317	2.730	1.911	2.730	0.9433	0.8594	0.9646
<i>Taxus baccata</i> L. (Taxaceae)	English Yew	20	5.90	0.500	1.081	2.946	0.845	1.096	0.6671	0.6676	0.6676	0.9763	0.7183	0.9919
<i>Platanus orientalis</i> L. (Platanaceae)	Oriental Plane-tree	13	3.84	0.325	1.073	2.925	0.690	1.093	0.7797	0.3899	0.7797	0.9680	0.6394	0.7150
<i>Juglans regia</i> L. (Juglandaceae)	Persian Walnut	12	3.54	0.300	0.297	1.332	0	0.637	0.4024	0	0.4024	0.2716	0	0
	Standard Error				0.161	-	-	-	0.112	-	-	0.0206	-	-
Shrub species composition														
<i>Salix alba</i> L. (Salicaceae)	White willow		0.10	-	-	-	-	-	-	-	-	-	-	-
<i>Indigofera tinctoria</i> L. (Fagaceae)	True Indigo		5.35	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus semecarpifolia</i> Sm. (Fagaceae)	Brown Oak		0.75	-	-	-	-	-	-	-	-	-	-	-
Grass species composition														
<i>Fragaria vesca</i> L. (Rosaceae)	Wild Strawberry		16.0											
<i>Helianthus tuberosus</i> L. (Asteraceae)	Rank		14.0											
<i>Chenopodium album</i> L. (Amaranthaceae)	White Goose Foot or Pig Weed		13.0											
<i>Cannabis sativa</i> L. (Cannabaceae)	Marijuna/Gallow Grass		12.0											
<i>Bamboo</i> spp. (Poaceae)	Bamboo		9.0											
<i>Amaranthus</i> spp. (Amaranthaceae)	Amaranth		8.0											
<i>Artemisia</i> spp. (Asteraceae)	Sagebrush		7.0											
<i>Ranunculus</i> spp. (Ranunculaceae)	Crowfoot/Buttercup		6.0											
<i>Rumex hastatus</i> L. (Polygonaceae)	Arrowleaf Dock		5.0											
<i>Pennisetum purpureum</i> (Poaceae)	Napier Grass		4.0											
<i>Schumacheria</i> (Violaceae)	Common Blue Violet		3.0											
<i>Trifolium repens</i> L. (Fabaceae)	White Clover Plant		2.0											

Table 2 : List of mammal species found in Kumrat Valley

Family	Scientific Name	Common Name	Status
Bovidae	<i>Capra falconeri</i> Wagner.	Kashmir Markhor	Endangered
	<i>Capra ibex sibirica</i> Pallas.	Himalayan Ibex	Endangered
Canidae	<i>Canis lupus</i> Linnaeus.	Indian Wolf	Endangered
	<i>Vulpes vulpes</i> Linnaeus.	Red Fox	Data Deficient
	<i>Canis aureus</i> Linnaeus.	Jackal	Least Concern
Ceropithecidae	<i>Macaca mulatta</i> Zimmermann.	Rhesus Monkey	Least Concern
Felidae	<i>Lynx lynx</i> Linnaeus.	Eurasian Lynx	Endangered
Moschidae	<i>Moschus chrysogaster</i> Hodgson.	Himalayan Musk Deer	Endangered
Mustelidae	<i>Martes flavigula</i> Boddaert.	Yellow-throated Martin	Data Deficient
Sciuridae	<i>Eupetaurus cinereus</i> Thomas.	Woolly Flying Squirrel	Data Deficient
Ursidae	<i>Ursus thibetanus</i> G. Curvier.	Asiatic Black Bear	Endangered

fewer numbers of reptiles could be due to the fact that this valley is falling under cold weather condition, e.g., winter has severe snow fall. Reptiles are cold vertebrates and cannot maintain their body temperatures. The species recorded by us were detected near human settlements and within the agriculture fields, especially during summer season (Table 4).

Determining the plant species composition and food resources is an important tool to examine the habitat suitability and productivity of a forest ecosystem; reason being plant cover structure, composition, and diversity plays a crucial role to attract a diversity of faunal species, such as; mammals, birds and reptiles. This information would help to understand how to enhance the population of endangered species.

Our results on the plant cover has shown that Kumrat valley has diverse topography; hilly terrain, snow covered peaks, pastures, riparian habitats, and mixed plant cover (conifer and broadleaved evergreen plant species). These diverse habitats harbor different herbivorous mammal species (*C. falconeri*, *M. chrysogaster* and *C. ibex sibirica*) and carnivorous mammal species, such as; *C. lupus*, *U. thibetanus*, *L. lynx* and *V. vulpes*. Recording sufficient number of endangered mammal species clearly shows that this valley is ideal habitat for them (Khan et al., 2016). However, it was found that habitat preference among the mammal species varies depending on the habitat requirement, foraging behaviour and anthropogenic disturbances (Bagchi et al., 2003; Nagmail, 2006; Phillips et al., 2006; Ashraf et al., 2014).

The existence of a wide array of bird species indicates that the valley is ideal and productive habitat for them. It offers a good shelter for a wide range of species for distribution, plenty of food resources, safe breeding and foraging grounds, as well as, protecting them from severe weather conditions. The other reason being, dry-temperate forest is encompassed of heterogeneous habitats, i.e., dense patches of trees, thick and dense fragments of shrubs, and variety of pastures. Alpine pastures dominated by variety of grasses and shrubs offers suitable foraging sites, and shelter from predators for *L.*

impejanus, *L. lerwa*, *T. himalayensis*, *A. chukar*, *P. macrolopha*, *L. leucomelanos* and *C. coturnix*. These bird species are opportunistic and adaptive in foraging and habitat preference (Li et al., 2010). They often select pine dominated habitats, mostly cliff areas having pine trees and tall grasses (Iamsiri and Gale, 2008). The pheasants often prefer evergreen mix pine and broadleaved forests with more than one meter tall shrub layers (Iamsiri, 2008). The habitat preference can be attributed to the occurrence of food resources like seeds of grasses, roots, insects, fruits and wild nuts (Li et al., 2010). Similarly, chukar (*A. chukar*) and partridges (*L. lerwa*) often prefer permanent areas with dense grass cover for foraging and breeding purposes, reason being grasses produce a variety of grains forming primary diet for them and also provide protection in breeding and around chick rearing grounds. The grassy areas offer good shelter from predators and harsh weather (Homan et al., 2000; Leif, 2005).

Likewise, *A. chrysaetos*, *A. virgatus*, *E. caeruleus*, *F. tinnunculus* and *A. badius* have curved beak and claws, superb eyesight and powerful wings (Parejo et al., 2001; Serrano et al., 2001; Balbontin et al., 2008). They are vagrant species (often keep changing their habitats) and carnivorous in nature, mostly preying on variety of animals, rats, mice, ground squirrels, passerine birds and reptiles. It was observed that raptors differ in habitat selection e.g., eagle preferred forested habitats, besra and shikra utilized scrublands, and kites agricultural fields and foraging ecology, golden eagle search food from a perch, besra and kestrel search food while on flight, and black-winged shoulder kite through hovering (Martin and Piersma, 2009; Martin and Portugal, 2011; O'Rourke et al., 2010; Potier et al., 2016). Similarly, it was observed that *P. leucogenys*, *P. leucotis* and *P. cafer* bulbuls often concentrated around the fruit trees, shrubs, agricultural fields, parks and grassy lawns, foraging on fresh fruits (berries), grains, and arboreal insects. It was also observed that buntings were closely linked with arable fields and patches of shrublands to forage on invertebrates, especially insects (Kosinski and Tryjanowski, 2000; Mason and Macdonald, 2000; Donald et al., 2001; Dale and Manceau, 2003; Menz et al., 2009).

Table 3 : List of the bird species recorded in Kumrat valley

Family	Scientific name	Common name	Current status
Accipitridae	<i>Aquila chrysaetos</i> Linnaeus.	Golden Eagle	Least Concern
	<i>Accipiter virgatus</i> Temminck.	Besra	Least Concern
	<i>Elanus caeruleus</i> Desfontaines.	Black-shouldered Kite	Least Concern
	<i>Accipiter badius</i> Gmelin.	Shikra	Least Concern
Aegithalidae	<i>Aegithalos concinnus</i> Gould.	Black-throated Tit	Least Concern
Certhiidae	<i>Certhia himalayana</i> Vigors.	Ber-tailed Treecreeper	Least Concern
Columbidae	<i>Streptopelia decaocto</i> Frivaldszky.	Eurasian Collared Dove	Least Concern
Coridae	<i>Zenaidra macroura</i> Linnaeus.	Mourning Dove	Least Concern
Corvidae	<i>Corvus macrorhynchos</i> Wagler.	Large-billed Crow	Least Concern
	<i>Dendrocitta vagabunda</i> Latham.	Rufous Treepie	Least Concern
	<i>Garrulus lanceolatus</i> Vigors.	Black-headed Jay	Least Concern
Dicruridae	<i>Dicrurus macrocercus</i> Vieillot.	Black Drongo	Least Concern
Emberizidae	<i>Emberiza leucocephalos</i> S.G. Gmelin.	Pine Bunting	Least Concern
	<i>Emberiza cia</i> Linnaeus.	Rock Bunting	Least Concern
Falconidae	<i>Falco tinnunculus</i> Linnaeus.	Common Kestrel	Least Concern
Fringillidae	<i>Carpodacus erythrinus</i> Pallas.	Common Rosefinch	Least Concern
Hirundinidae	<i>Hirundo rustica</i> Linnaeus.	Common Swallow	Least Concern
Laniidae	<i>Lanius tephronotus</i> Vigors.	Grey-backed Shrike	Least Concern
	<i>Lanius vittatus</i> Valenciennes.	Bay-backed Shrike	Least Concern
Leiothrichidae	<i>Trochalopteron lineatum</i> Vigors.	Streaked Laughing Thrush	Least Concern
Meropidae	<i>Merops orientalis</i> Latham.	Green Bee-eater	Least Concern
Monarchidae	<i>Terpsiphone paradise</i> Linnaeus.	Asian Paradise Flycatcher	Least Concern
Motacillidae	<i>Motacilla maderaspatensis</i> Gmelin.	White-browed Wagtail	Least Concern
	<i>Motacilla flava</i> Linnaeus.	Western Yellow Wagtail	Least Concern
	<i>Motacilla alba</i> Linnaeus.	White Wagtail	Least Concern
	<i>Motacilla cinerea</i> Tunstall.	Grey Wagtail	Least Concern
Muscicapidae	<i>Myophonus caeruleus</i> Scopoli.	Blue Whistling Thrush	Least Concern
	<i>Saxicola caprata</i> Linnaeus.	Pied Bushchat	Least Concern
Paridae	<i>Parus major</i> Linnaeus.	Great Tit	Least Concern
Phasianidae	<i>Lophophorus impejanus</i> Latham.	Himalayan Monal Pheasant	Least Concern
	<i>Lerwa lerwa</i> Hodgson.	Snow Partridge	Least Concern
	<i>Tetraogallus himalayensis</i> G.R. Gray.	Himalayan Snowcock	Least Concern
	<i>Alectoris chukar</i> Gray.	Chukar	Least Concern
	<i>Pucrasia macrolopha</i> Lesson.	Koklass Pheasant	Least Concern
	<i>Lophura leucomelanos</i> Latham.	Khalig Pheasant	Least Concern
	<i>Coturnix coturnix</i> Linnaeus.	Common Quail	Least Concern
	<i>Phylloscopus collybita</i> Vieillot.	Brown Chiffchaff	Least Concern
Phylloscopidae	<i>Phylloscopus collybita</i> Vieillot.	Brown Chiffchaff	Least Concern
Pycnonotidae	<i>Pycnonotus cafer</i> Linnaeus.	Red-vented Bulbul	Least Concern
	<i>Pycnonotus leucotis</i> Gould.	White-eared Bulbul	Least Concern
	<i>Pycnonotus leucogenys</i> Gray J.E.	Himalayan Bulbul	Least Concern
Sturnidae	<i>Acridotheres tristis</i> Linnaeus.	Common Myna	Least Concern

Table 4 : List of reptile species recorded in Kumrat valley

Family	Scientific name	Common name	Current status
Agamidae	<i>Paralaudakia himalayana</i> Steindachner.	Himalayan Agama	Least Concern
	<i>Calotes versicolor</i> Daudin.	Oriental Garden Lizard	Least Concern
	<i>Laudakia tuberculata</i> Gray.	Kashmir Rock Agama	Least Concern
Elapidae	<i>Naja oxiana</i> Eichwald.	Caspian Cobra	Data Deficient
Scincidae	<i>Eutropis macularia</i> Blyth.	Bronze Grass Skink	Least Concern
	<i>Asymblepharus himalayanus</i> Gunther.	Himalayan Ground Skink	Vulnerable

In this study, few reptiles were also sampled which utilized different habitats having vertical vegetation structure, such as; shrubs, trees, and rock crevices for shelter and foraging. It was

also found that reptiles often shifted their habitat throughout the day, i.e., early in the morning often utilized rocky sites dominated by shrubs and during midday they moved in to open grassy areas

(Castilla and Bauwens, 1991) and bedrock substrate for foraging and hideout (Quirt et al., 2006).

The findings of this inventory revealed that vegetation species composition of dry-temperate forest constitute ideal and productive habitat to harbor higher wildlife fauna species to utilize it. Unfortunately, this fragile ecosystem is facing threats due to human interventions, i.e., illegal logging for timber and fuelwood, conversion into agriculture fields along the contours in hilly terrain and human settlements. Hence, it is strongly recommended that this valuable and highly productive habitat should be declared as a protected forest on the priority basis for sustainable use and for future generations.

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