

Final report

Biodiversity Impact Assessment of military firing and other associated activities in Mandal Thang Field Firing Range in Union Territory of Ladakh



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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1. Background

Ladakh represents the Indian Trans-Himalaya region, comprising three major mountain ranges viz., i) the Ladakh range ii) the Zaskar range and iii) the Karakoram range. The cold arid landscape of Ladakh is characterized by several limiting environmental factors, including the high intensity of radiation, tremendous ruggedness of terrain, a high degree of seasonality in resources, and ecosystems exhibiting low productivity. This has resulted in the uniqueness of local biodiversity, adapted to the intense topographic and climatic conditions. The remoteness and challenging terrain have also made local communities and wildlife dependent on natural systems and sparse resources for sustenance. There have been efforts made by the state government in the form of a Protected Area Notification to maintain the ecosystem integrity and protect the region's unique biodiversity. Presently, there are three PAs in Ladakh viz., Hemis National Park (notified in 1981), and Changthang and Karakoram Wildlife Sanctuaries (notified in 1987). Karakoram Wildlife Sanctuary (KWS) is located in the easternmost parts of the Karakoram range, in the north, of the Leh district. The Sanctuary was established in 1987, and covers about 16000 km² geographic area. Most part of the Karakoram region is semi-arid and strongly continental, with scarce precipitation not exceeding 100 mm, mainly in the form of winter snow, and rainfall on the lower and middle slopes. KWS exhibits heavy glaciation, with southern parts showing more humid slopes. These glaciers are the source of the main two rivers of KWS viz., Nubra river and Shyok river. The area is characterized by a cold desert, comprising of sparsely vegetated habitat, riverine vegetation and marshes along the major rivers. These are crucial habitats for a wide diversity of flora and fauna, particularly for mammals and birds. The KWS is home to several mammalian and avian species, which includes the snow leopard (*Panthera uncia*) Eurasian lynx (*Lynx lynx*), Himalayan wolf (*Canis lupus*), Tibetan antelope (*Pantholops hodgsonii*), etc. (Dawa et al., 2003; Habib et al., 2013). The region is home to 310 species of birds acting as an important breeding and staging ground, particularly for various resident and migratory avifauna (Pfister, 2004; Hussain et al., 2021). Besides, wildlife the area has a massive presence of military and para-military, and high tourist visitations. Defence engagement in this region was started in 1962-1965 due to international border disputes along both the eastern and western borders. The formation of defence settlements in this region has resulted in some developments in terms of infrastructure for security needs. Following the settlement of defence, several infrastructures and firing ranges have been planned in the region. One of the most strategically important training range for the

Indian Army in this landscape is Mandal Thang Field Firing Range (MTFFR) located in the Shyok valley at Galwan.

The MTFFR Range provides the military the necessary modernized training capabilities to be effective in contemporary and future scenarios at harsh environments. MTFFR, was in use by Indian Army as all arms firing range in Galwan valley of Ladakh. The Indian Army has been using this firing range since 6th March 2017 for artillery training of its troops. In 1987, the government of Jammu and Kashmir notified Karakoram Wildlife Sanctuary vide SRO number 153, dated 19-03 1987, and the entire MTFFR area is within the sanctuary. On 6th March 2017, the MTFFR was intended for Indian Army as an exercise ground for the period of five years vide state Assembly Notification No. SRO 93, dated 06-03-2017. The said notification expired on 05-03-2022 after a period of five years. The MTFFR re-notification is in the process, awaiting clearance from Wildlife Protection Department.

2. Introduction

The Shyok valley forms the north-eastern edge of KWS, comprises of Galwan valley and Daulat Beg Oldi (DBO) plains situated between Siachen and Karakorum mountain ranges. The cold arid landscape of the Shyok valley is characterised by high intensity of solar radiations, tremendous ruggedness of terrain, seasonality in resources, and low productivity. The entire area is steep semi-arid habitat, long riverine habitat, glaciers and towards the north the plains habitat. The remoteness and tough terrain support a unique arid flora and fauna found in this region. Due to the its harsh and cold climatic and topographic conditions, vegetation cover is sparse, along the river the vegetation cover is sometimes dense. This riverine habitat along the Shyok river provide crucial habitats for small mammals and birds. The vegetation in the valley comprises of mixed scrub steppe, sparse vegetation cover, plantation in the lower part of the valley, herbaceous, sedge meadows and grasslands in the north, and riverine vegetation. The dominant plant species in this area were, *Myricaria spp*, *Artemisia spp*, *Eurotia spp*, *Lonicera spp*, *Kobresia spp*, *Nepeta spp*, and, *Ephedra spp*. **The valley is home to endangered faunal species, such as the Tibetan antelope (*Pantholops hodgsonii*) which is endemic to this region in the entire landscape, snow leopard (*Panthera uncia*), Himalayan/Tibetan wolf (*Canis lupus chanco*), and other important species.** The valley is also home to many bird species (Bhatnagar and Wangchuk, 2001). Military and para-military presence has been predominant since the 1960s. Due to the strategic importance of the area the defence forces

have deployed infrastructure, training camps, roads and firing ranges within this valley.

It is noteworthy to mention that defence training ranges contribute significantly to our national security. The MTFFR is a training range commissioned to enable Indian soldiers to be combat ready in critical atmospheres and harsh landscapes such as that of the Tibetan Plateau. These Firing ranges are required for practicing the use of weapons ranging from ordinary rifles to anti-tank guided missiles to long range artillery. As the Ladakh landscape shares its eastern boundary with China and Pakistan, the Indian Army presence has remained strategic and nationally sensitive in such areas since the Chinese incursion. The majority of military training ranges in UT Ladakh are in the north-eastern part of the landscape. The Indian Army has been utilising this field firing range since 2017 for artillery, infantry, armoured and mechanised infantry weapons testing.

The MTFFR was commissioned due to its strategic location at Galwan valley, presence of existing military establishment, access leading to a much disputed area of Aksai Chin via DBO. Moreover, the area is distant from civilian habitat. Firing practises currently conducted in MTFFR cannot be replicated elsewhere due to their very nature of mechanisation in conjunction with climatic or physical attributes. The re-notification of MTFFR is thus sought for reasons namely, national security and strategic interests.

3. Conservation values and challenges of MTFFR

Ladakh is a part of the Trans-Himalayan biogeographic zones of India, and holds the most unique and diverse habitat. The entire area of the landscape is called cold desert habitat characterized with the rugged terrain of mountains and open plains, with low annual rainfall and low temperature during winter seasons (Hussain et al., 2022). Because of the short summer season only sparse vegetation grow in this landscape, and most of the faunal species depending on the plants are found in extremely low densities in the entire landscape. This landscape harbours about 1250 plant species, 370 species of butterflies, eight species of reptiles and amphibians, about 319 bird species, and 36 mammalian species (Fox and Chundawat 1995, Chandan et al. 2008, Pfister 2004, Chandan et al. 2006). Low productivity, less availability of the resources and sparse distribution of the faunal species keep the wildlife at risk of extirpation in many areas. In the last one decade, due to the increase of human-induced impacts such as, uncontrolled tourism, infrastructure development, and land use changes, often compound conservation challenges in the landscape. To overcome such conservation challenges,

protected areas such as, national parks and wildlife sanctuaries are now the only refuges left that protect the native flora and fauna. Most of mammalian species in the landscape, traverse within the larger areas to find resources. Almost all species have evolutionarily adapted to extreme seasonal and altitudinal patterns that make them charismatic as well as signatures of the cold desert system.

The eastern and western parts of Ladakh remain active in defence activities as they share their boundary with Pakistan and China. With national security needs the increasing defence infrastructure projects in the area may pose major threats for wildlife conservation as the area hold many fragile habitats. Major threats include habitat degradation, soil erosion, and chemical contamination that can lead to irreversible modification of the landscape. Among the threats the chemical spills from garbage sites pose a threat to natural water sources.

The entire area of MTFFR falls within the Karakoram wildlife sanctuary. The activities in the firing range can lead to severe impacts of habitat degradation, change in species composition, and contamination from lead content in bullets may even pollute soil and water sources (Warren et al. 2007, Bilal et al 2018). It is reported that large body sized wild mammals have limited chance of direct mortality, however as they move out of firing range due to associated forms of disturbance, it may lead to population stress (Bhatnagar et al. 2009, Humbert-Droz 2017). Home (2016) argued that military areas have additional impact on wildlife of Ladakh in the form of provisioning of feral dog populations, which is the major threat to wildlife in the landscape.

4. Impact area

The Mandal Thang Field Firing Range (MTFFR), lies between Galwan valley adjacent to Shyok river. The MTFFR is situated 110 km to the north-west Durbuk headquarters on the route to DBO (Figure 1). The predominant land cover of the firing range is sparsely vegetated and riverine habitat, primarily used for firing activities. The lower areas of the firing range have fragmented patches of *Myricaria* species and the adjoining areas are important refuge for wildlife. The area receives heavy snowfall during winter and rainfall is scanty and often remain less than 100mm in a year. Besides the diverse assemblage of migratory birds, the area support mammalian species such as snow leopard (*Panthera uncia*), Asiatic ibex (*Capra sibirica*), Tibetan antelope (*Pantholops hodgsonii*), Nubra pika (*Ochotona nubrica*), Wolf (*Canis lupus*), Blue sheep (*Pseudois nayaur*), etc. The vegetation of MTFFR valley is generally herbaceous.

Some common herb species in the area include *Artemisia* spp. *Eurotia* spp, *Lonicera* spp, *Kobresia* spp, *Nepeta* spp, *Ephedra* spp, *Myricaria* spp, etc.

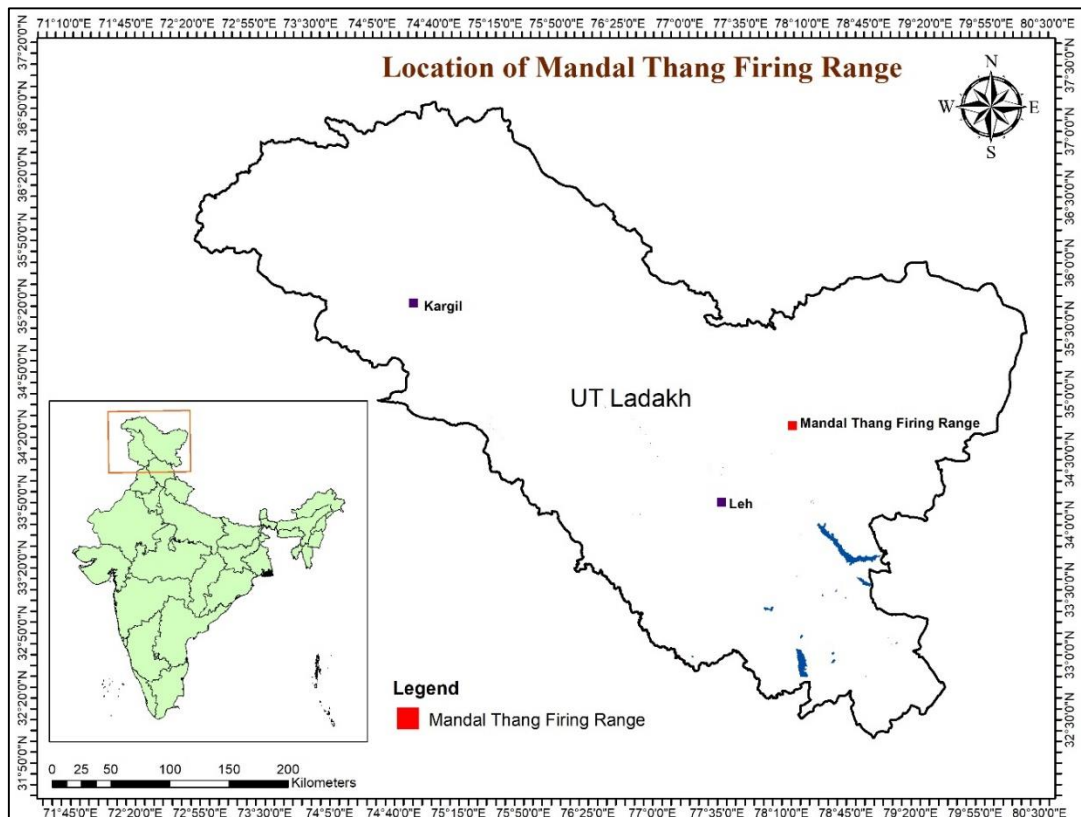


Figure 1: Location of Mandal Thang Field Firing Range, within the Union Territory of Ladakh, India.

5. Scope of the work

The purpose of this study for Biodiversity Impact Assessment (BIA) was to identify, evaluate and report the potential wildlife effects of Military activities in the MTFFR. This process included identification of mitigative measures that may be undertaken to reduce or eliminate potential adverse effects, where appropriate.

Therefore, the scope of the Biodiversity Impact Assessment, covered, the baseline biodiversity condition of the area using field and secondary information. It also includes description of the proposed study site, provisions of the relevant environmental laws, identification of any potential adverse impact to the environment anticipated from the proposed impact site, identification of threats and their appropriate mitigation measures and provision of environmental management plan. The study details observations and investigations of various habitat and fauna in the impact zone of the proposed MTFFR.

6. Objectives of the survey for BIA

The aim of the study is to understand the habitat, ecological and wildlife values of the MTFFR and the nature of operations that may lead to overall impact on the landscape.

- ❖ To assess the wildlife values of the intended area.
- ❖ To understand the possible threats and their potential impacts on wildlife in the study site.
- ❖ To suggest recommendations and mitigatory steps for minimizing impacts on wildlife and its habitat in the intended area.

7. Methodology

Initial desk research was carried out to understand various aspects of the area of interest in terms of wildlife and associated values. Furthermore, several meetings and discussions were held between the survey team and army personnel of MTFFR at Karu, Leh and Camp 120 km, Mandalthang and in the firing range area of Mandal thang area to explain the scope of the study and operational details. At first, a reconnaissance survey was conducted by the survey team with the help of deputed army personnel in the area. For assessing the wildlife values in the intended area and identifying threats and potential impact on wildlife and its habitat we go through the following methods-

The following methods were used to fulfil the objectives of the present study

1. Sign Surveys and direct sighting
2. Vehicle survey
3. Opportunistic Camera trapping
4. Literature Review
5. Focal group discussion/ Interview
6. Conservation Value Area Demarcation
7. Land use and Land cover

7.1. Sign Surveys and direct sighting: Primary sampling technique of the survey was based on sign survey (Namgyal 2004, Ahmad 2015, Hussain et al., 2021). The selected area was surveyed by the team focusing on the overall coverage of the area considering different habitat types such as riverine/ riparian habitat, rocky mountains, sand beds, dry river bed, etc

(figure 2). Based on the possibility of potential problems that impair the identification of animal signs due to substrate quality, animal movement, and army activities (Heinemeyer et al., 2008). The survey was carried out by forming groups in the survey stretches of 3-5 km stretch of each stretch for the total survey area (Shawl et al., 2011). Entire selected areas were surveyed in stretches of habitat carried out based on a standard practical field guide. Signs such as pugmarks, hoofmarks, scats, pellets, scrap marks, etc were searched along the survey route. Vegetation of the area and habitat were observed and recorded. The distances covered during sign surveys were recorded using a Global Positioning System (GPS) (Shawl et al., 2011). For direct sighting, any animal/bird or herd/flock sighted was recorded for location, number, age, and sex composition (Shawl et al., 2011).

7.2. Vehicle survey: The area was also surveyed using two vehicles that maintained a particular speed (<20 km/hr), one along with the river and another on the roadside, the species that were sighted directly or using binoculars during this survey were recorded (Bhatnagar et al., 2008).

7.3. Opportunistic camera trapping: Based on a sign survey camera trapping exercise was carried out. Ten camera traps (reconyx) were installed based on presence, and movement as well as the opinion of the army personnel to maximize the number of species photo captures (Amira et al., 2020). Camera trap locations were selected at strategic paths and points such as *Myricaria* spp. patch, river beds, sand beds, and other areas covering all representative habitats of the survey areas at every 1-2 km (figure 2). The camera trap exercise was carried out for 130 trap nights.

7.4. Literature review: Available literature was very limited for the survey area. Considering that available literature on nearby areas was reviewed for the understanding presence of mammals and avifauna along with the vegetation structure of the area.

7.5. Focal group discussion/Interview: Army personnel (s) were interviewed (Informal) regarding the sighting of any wildlife in a different season, the impact of firing on wildlife (if any), the importance of the range for a basic understanding of the presence of wildlife, impact of firing and need of the firing range (Hussain et al., 2022).

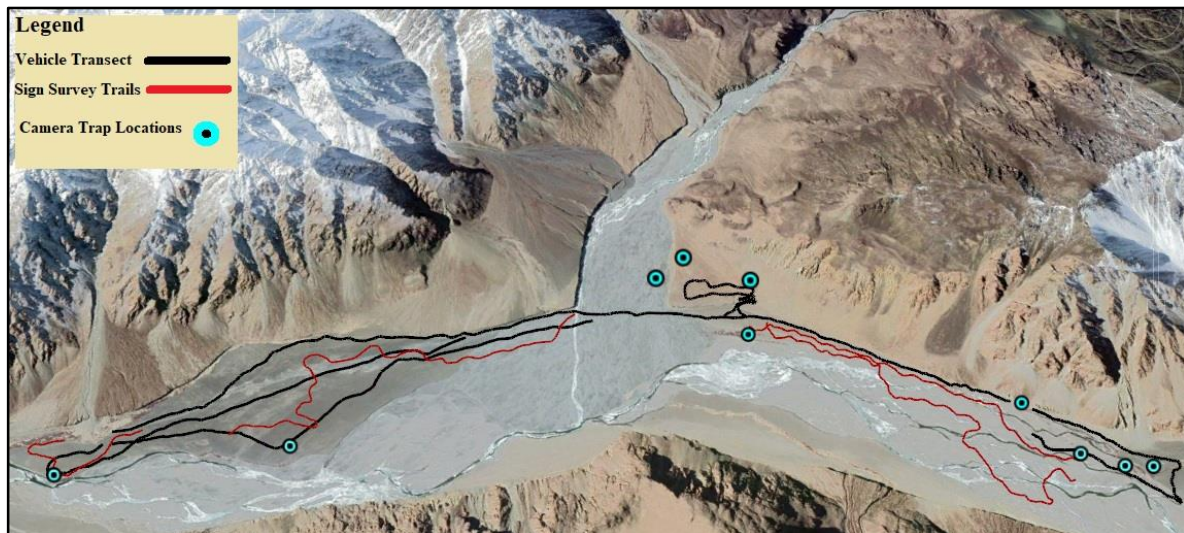


Figure 2: Map showing the tracks of sign survey, vehicle transect and camera trap location in the Mandal thang field firing range.

7.6. Land Use and Land Cover (LULC): Visual Image Interpretation of processed satellite data was used to prepare the map. The generated outputs were updated using limited field information. The polygons were prepared in broad categories and were further assessed. The categories are, 1. Scrub/Shrubs 2. Degraded Land 3. Grasslands/Pastureland 4. Scattered Vegetation with barren land 5. Seasonal Sparse grass with barren land 6. Major Wetlands 7. Plantation 8. Agriculture 9. Non-Vegetative 10. Non-Forest Land 11. Waterbody 12. Settlements 13. Glacier/Snow Cover 14. Marshy land and 15. Road. The Land Use Land Cover (LULC) maps of an area provide information to help us to understand the current landscape (Perez *et. al.*, 2005; Uddin *et al.*, 2015; Batar *et al.*, 2017). For LULC analysis of MTFFR we used CARTOSAT satellite imagery which was classified into the same 5 categories, such as barren, snow cover, waterbody, vegetation, cloud cover, and dry riverbed, the analysis of LULC was done using Arc GIS software (figure 3). The project team conducted opportunistic surveys in the field in October 2022. On field, GPS locations were marked according to the land cover type. By using compass directions were determined and photographs were captured, which were geotagged later.

7.7. Conservation Value Area (CVA) determination: Conservation Value Area is an emerging concept used to identify important forest areas based on a variety of parameters including biodiversity, landscape context, threatened or endangered ecosystems, provisioning of basic ecosystem services, and dependence of local community, among others (figure 3). Identification and maintenance of Conservation Values form the basis of the concept conservation value areas is an ecological, social or cultural attribute including ecosystem

services, considered to be of exceptional importance at the local, regional or global level. The Conservation Value Area was a concept used to identify important areas for wildlife based on a variety of parameters such as, Areas containing globally, regionally or nationally significant concentration of biological diversity including endemic, rare, threatened or endangered species.

Areas containing large landscape-level ecosystems and ecosystem mosaics that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance. Areas that are part of comprise of rare, threatened, or endangered ecosystems, habitats or refugia and areas that provide basic ecosystem services in critical situations including protection of water catchments and control of erosion of vulnerable soils and slopes. The current analysis focused on the identification of Conservation Value Areas in MTFFR for areas of development where defence activities may be regulated. In order to generate maps of conservation areas we used LISS IV (2020-21) and Cartosat 3 (2020-21) data in Remote sensing & GIS.

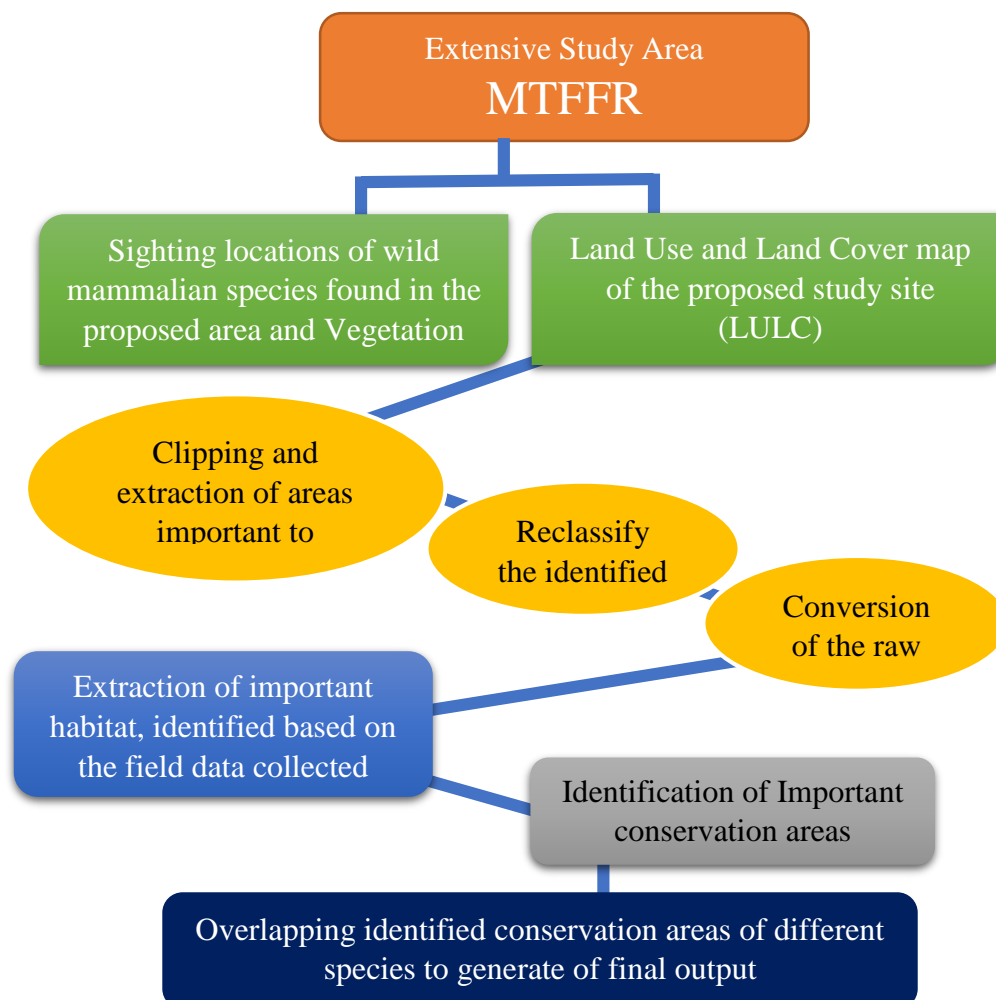


Figure 3: Framework adopted for identifying and demarcating conservation value areas

8. Results

8.1. Wildlife values of the intended impact area

8.1.1. Floral Diversity in MTFRR

In Shyok valley the vegetation was mainly represented by *Salix sp.* and *Myricaria sp.*, plantations along the riverine area and on flat lands, respectively. However, in gentler slopes, on flat land areas and rocky slopes the vegetation was sparsely distributed which was mainly dominated by shrub species such as *Ephedra gerardiana*, *Arnebia euchroma* and *Poa attenuata* etc. The cover percentage of different life forms with respect to habitat was high along the riverine area, while herb and shrub percentages were more or less similar throughout the study area. The area around MTFRR and other prominent places are heavily degraded as seen by the nondegradable garbage sites, vehicular movements, anthropogenic pressure, and excessive trampling near defence camping sites. Overall, the riverine area and along small streams had the highest percent cover of grass, herbs and shrubs. The hill slopes around the of the study sites were mainly dominated by two species of *Artemisia*, *Ephedra gerardiana*, *Arnebia euchroma* etc.

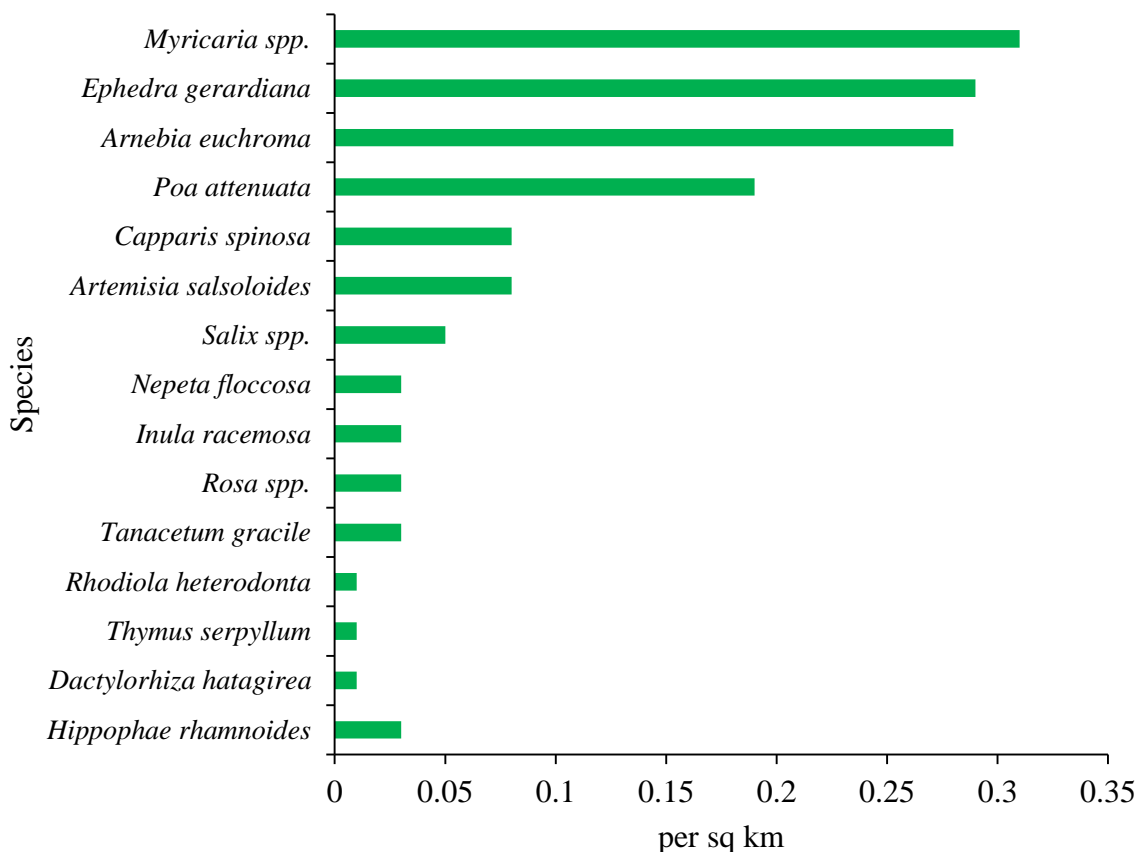
During the field survey, from 7th to 11th October, 2022, we observed total 15 species of plants from the MTFRR (Appendix 1). Out of 15 species 13 were found within the sampling plots. The area was dominated by the *Myricaria spp.* followed by *Ephedra gerardiana* and *Arnebia euchroma*, respectively. *Myricaria spp.* have the highest encounter rate among all in the landscape with 40 individuals followed by *Ephedra gerardiana* (35), *Arnebia euchroma* (32) and *Poa attenuata* (14), respectively. The streams were largely dominated by *Myricaria spp.*, and *Ephedra gerardiana*, while the valley was largely dominated by *Arnebia euchroma* and *Poa attenuate*.

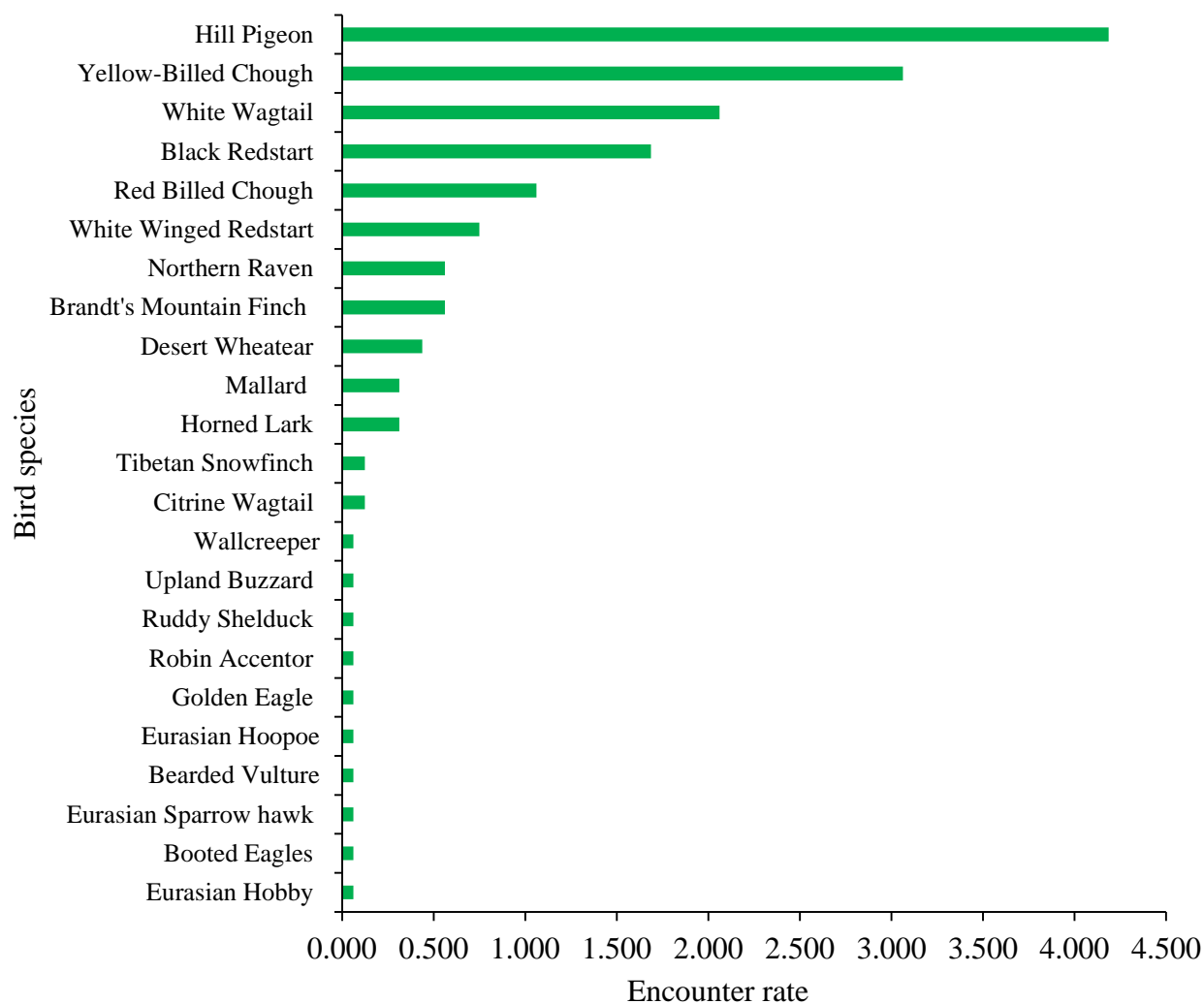
8.1.2. Faunal Diversity in MTFRR

Bird diversity

During the study a total of 24 species were encountered belonging to seven orders and 13 families. It accounts for 9.2% of the species known so far from Ladakh (Pfister 2004). A low diversity of birdlife can be attributed to extremely harsh climatic conditions, topography, low vegetative cover and scanty rainfall in Shyok valley. The correlation of bird diversity with topography, precipitation and an interaction between topography and latitude had already been

validated (Rahbek & Graves 2001). The classification of observed species revealed that, Passeriformes was the dominant order with a maximum number of species (13 species) followed by Accipitriformes (5 species). Columbiformes and Anseriformes were represented by two species each whereas, Falconiformes and Bucerotiformes by a single species only (Table 1). A total of 24 species of birds were recorded during the survey, of which 23 were recorded during the transect and Oriental turtle dove (*Streptopelia orientalis*) was captured in the camera trap (Table 2. Appendix 1). Species such as hill pigeon (*Columba rupestris*) have the highest encounter rate in the Shyok river valley with 4.2/km, followed by Yellow-Billed Chough (*Pyrrhocorax graculus*) (3.0/km), white wagtail (*Motacilla alba*) (2.0/km), Black Redstart (*Phoenicurus ochruros*) (1.6/km) and Red Billed Chough (*Pyrrhocorax pyrrhocorax*) (1.0/km) (Graph 2). Species such as northern raven, white wagtail, black redstart, horned lark and red billed chough were recorded near the army camps. One bearded vulture (*Gypaetus barbatus*) was also observed near the firing zone.





Graph 2: Encounter rate/km of birds in MTFFR

Table 1: List of bird recorded during the survey

Common Name	Scientific Name	IUCN	WPA
Order-Anseriformes Family-Anatidae			
Ruddy Shelduck	<i>Tahoma ferruginea</i>	LC	Sch IV
Mallard	<i>Anas platyrhynchos</i>	LC	Sch IV
Order-Accipitriformes Family-Accipitridae			
Bearded Vulture	<i>Gypaetus barbatus</i>	NT	Sch I
Eurasian Sparrowhawk	<i>Accipiter nisus</i>	LC	Sch I
Upland Buzzard	<i>Buteo hemilasius</i>	LC	Sch I
Golden Eagle	<i>Aquila chrysaetos</i>	LC	Sch I
Booted Eagle	<i>Hieraaetus pennatus</i>	LC	Sch I
Order-Falconiformes Family-Falconidae			

Eurasian Hobby	<i>Falco subbuteo</i>	LC	Sch IV
Order-Columbiformes Family-Columbidae			
Hill Pigeon	<i>Columba rupestris</i>	LC	Sch IV
Oriental Turtle-Dove	<i>Streptopelia orientalis</i>	LC	Sch IV
Order-Bucerotiformes Family-Upupidae			
Common Hoopoe	<i>Upupa epops</i>	LC	Sch IV
Order-Passeriformes Family-Alaudidae			
Horned Lark	<i>Eremophila alpestris</i>	LC	Sch IV
Order-Passeriformes Family-Motacillidae			
White Wagtail	<i>Motacilla alba</i>	LC	Sch IV
Citrine Wagtail	<i>Motacilla citreola</i>	LC	Sch IV
Order-Passeriformes Family-Tichodromidae			
Wallcreeper	<i>Tichodroma muraria</i>	LC	Sch IV
Order-Passeriformes Family-Fringillidae			
Brandt's Mountain-Finch	<i>Leucosticte brandti</i>	LC	Sch IV
Order-Passeriformes Family-Passeridae			
Tibetan Snowfinch	<i>Montifringilla henrici</i>	LC	Sch IV
Order-Passeriformes Family-Corvidae			
Red-billed Chough	<i>Pyrhocorax</i>	LC	Sch IV
Alpine Chough	<i>Pyrhocorax graculus</i>	LC	Sch IV
Northern Raven	<i>Corvus corax</i>	LC	Sch IV
Order-Passeriformes Family-Prunellidae			
Robin Accentor	<i>Prunella rubeculoides</i>	LC	Sch IV
Order-Passeriformes Family-Muscicapidae			
Black Redstart	<i>Phoenicurus ochruros</i>	LC	Sch IV
Guldenstadt's Redstart	<i>Phoenicurus erythrogaster</i>	LC	Sch IV
Desert Wheatear	<i>Oenanthe deserti</i>	LC	Sch IV

8.1.3. Photographic captures

During the survey, six mammalian species were recorded in MTFFR (Table 3. Appendix 1), of which blue sheep (*Pseudois nayaur*), Indian Field Mouse (*Mus booduga*) and Himalayan field rat (*Rattus nitidus*) were sighted very frequently and at multiple locations (Appendix 2). However, indirect evidence of Himalayan red fox (*Vulpes vulpes*) were seen during the transect walk. During the camera trap activity between 10 to 15 October 2022, 118 trap nights were processed, 423 images from 10 locations were obtained, of which we confirm the occurrence of red fox, two bird species oriental turtle dove and black redstart, free ranging dogs and a

domestic horse. The most frequent individual recorded was red fox. Out of 423 images we segregated 39 images of wild and domestic mammals, 12 images of birds, 22 blank images and 2 images of humans. Among the captured individuals of mammals and birds most images were belonging to red fox (n = 33), oriental turtle (n = 7), black redstart (n = 5), free ranging dogs (n = 4), domestic horse (n = 3), and human (n = 2). The maximum values of the relative abundance index were noted for the red fox (RAI = 6.9), followed by oriental turtle (RAI = 2.1), black redstart (RAI = 1.09), free ranging dogs (RAI = 1.08), domestic horse (RAI = 0.71), and human (RAI = 0.41) (Table 2). Based on the ‘relative abundance index’ analysis, the most abundant mammalian species in the landscape is red fox.

Table 2. List of Mammals reported during MTFFR field survey.

Species	Scientific name	IUCN	Sighting type	Number	RAI
Nubra Pika	<i>Ochotona nubrica</i>	LC	Sign around the burrows		NA
Blue Sheep	<i>Pseudois nayaur</i>	LC	Direct sighting	21	NA
Mountain Vole	<i>Alticola stoliczkanus</i>	LC	Sign around the burrows		NA
Red Fox	<i>Vulpes</i>	LC	Pug mark, scat and CT	31	6.9
Indian Field Mouse	<i>Mus booduga</i>	LC	Direct sighting	3	NA
Himalayan field rat	<i>Rattus nitidus</i>	LC	Direct sighting	2	NA
Snow Leopard	<i>Panthera uncia</i>	V	Direct sighting	1	NA

8.1.4. Landuse and Landcover of MTFFR

In support of the CVA result we did LULC analysis of the MTFFR area (table 3, figure 4). We used cross tabulation module detection method to detect land-use and land-cover type (LULC) in ArcGIS 10.9, through which a LULC map was produced. This map provides essential information about the nature and spatial distribution of land use. To analyse the pattern of land-use and land-cover in the study area, a temporal analysis was carried out 2022. The land use land cover map of MTFFR shows that 168.54 km² is barren land which is around 76% of the firing range, 14.31 km² of the area is dry river bed area which is around 12% of the area, 57.20 km² of the area is comes under snow cover area which is around 9.53% of the area. Areas like vegetation, waterbody and road areas covers 1.10 km² which is 1.74% of the total landscape. The result of LULC show that most of the land-cover of MTFFR lies in the barren category. This might be the reason of low HCVA values of the firing range.

Table 3: Total land cover area of MTFFR in km² and in percentage.

LULC type of MTFFR	Area of LULC of MTFFR in km ²	Area of LULC of MTFFR in Percentage
Barren	168.54 km ²	76.31%
Dry riverbed	14.31 km ²	12.42%
Road	0.13 km ²	0.21%
Snow cover	57.20 km ²	9.53%
Vegetation	0.67 km ²	0.43%
Waterbody	1.10 km ²	1.10%
Total area of firing range	241.99 km²	

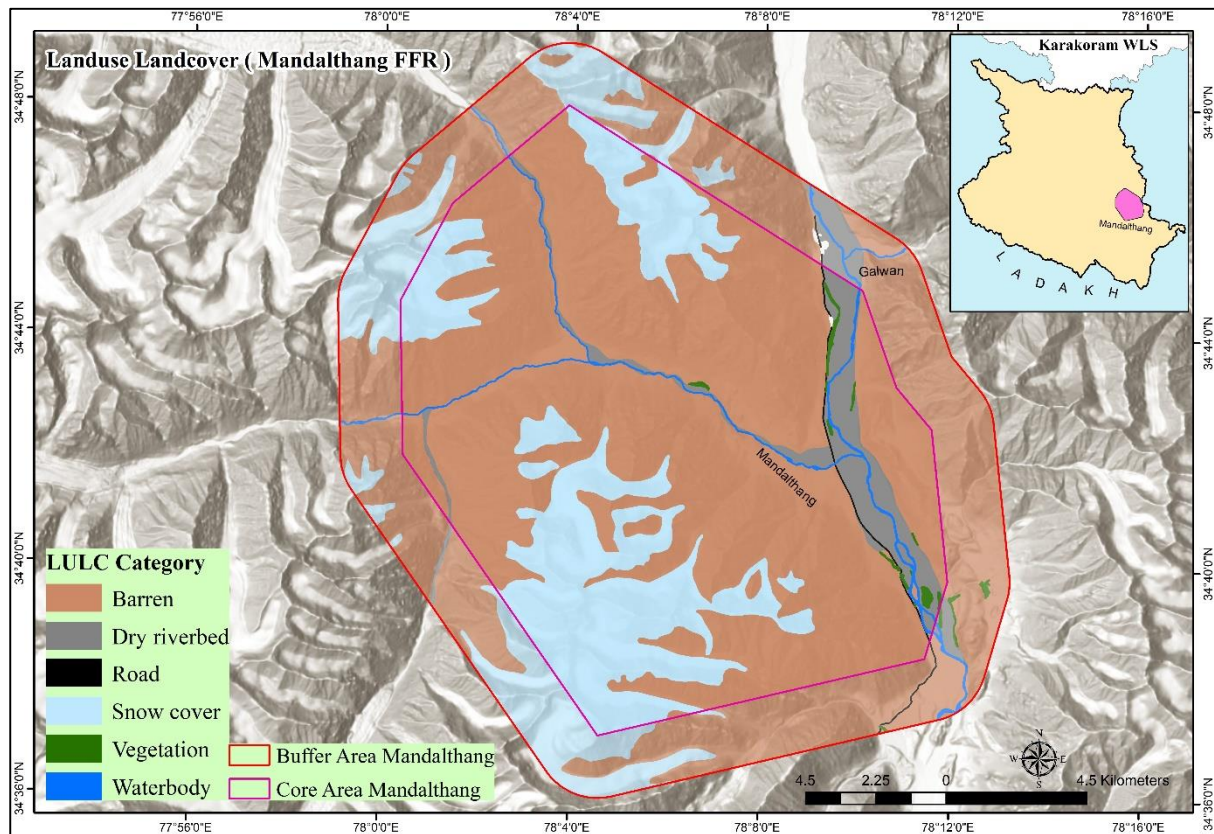


Figure 4: Map shows the LULC categories of MTFFR

8.1.5. Conservation Value Areas

MTFFR is the least explored area in the Karakoram region. The main headwater of the Shyok River, flows to the south of the area. Owing to its remoteness and inaccessibility in most of the area, very few studies have been conducted in the region. Most of the area in this landscape highly sensitive area, significant for the Indian Army and devoid of settlements. The area is a region in upper Shyok basin and is a less explored area due to the army presence and strategic reasons.

Based on the analysis we identified the priority conservation areas. The heat map given in figure 4 depicts the MTFFR area with moderately suitable conservation areas (figure 5). Each of these areas are significant for one or a combination of the conservation values. Based on the result and analysis of conservation values area we come to a conclusion that the areas of MTFFR comes under moderate to low values category. The figures 4-6 depict the values of the area. Figure 4 shows the landuse-landcover of the area. Figure 5 displays moderately suitable conservation areas which are predominantly in the river valley areas. Figure 6 show ecosystems and habitat that are within the MTFFR. This largely falls within the impact zone but may be only restricted to the riverine habitats.

8.1.6. Species of conservation significance found in and around MTFFR

Based on field survey and direct evidences we found three mammals and four avifaunal species for having conservation significance in and around the MTFFR (Table 4).

Table 4: Important mammalian and avian species selected for conservation area identification and their status under WPA, 1972, IUCN Red list and CITES

Sr. No.	Common Name	Scientific Name	Schedule WPA	IUCN Status
1	Snow Leopard	<i>Panthera uncia</i>	I	Vulnerable
2	Red Fox	<i>Vulpes vulpes</i>	II	Least Concern
3	Blue Sheep	<i>Pseudois nayaur nayaur</i>	I	Least Concern
4	Golden Eagle	<i>Aquila chrysaetos</i>	I	Least Concern
5	Booted Eagle	<i>Hieraaetus pennatus</i>	I	Least Concern
6	Bearded Vulture	<i>Gypaetus barbatus</i>	I	Near Threatened
7	Eurasian Sparrow hawk	<i>Accipiter nisus</i>	I	Least Concern

Snow leopard *Panthera uncia*. The endangered snow leopard is a large felid that is distributed over 1.83 million km² globally. Throughout its range it relies on a limited number of prey species in some of the most inhospitable landscapes on the planet where high rates of human persecution exist for both predator and prey. The snow leopard is an icon for conservation in the mountain regions of Asia. As a top-order predator, its presence and survival is also an indicator of intact, “healthy” eco-region. The snow leopard is listed as endangered by the

IUCN, and its abundance is declining across much of its present range. It is estimated that there are not more than 6500 mature individuals globally.

Red fox *Vulpes vulpes*, a mesopredator canid species, commonly referred to as *Whatse* is found throughout the Indian Himalayan region. Due to its generalist character, it can be found close to human settlements and in environments with few resources, like riverbeds and sand dunes. The habitat suitability of the species in MTFFR area was found to be suitable. This species typically visible from valley bottoms to elevations of up to 5000 m asl (Shawl et al., 2008). It preys on hare, pika, birds and rodents including marmots, and also feeds opportunistically on insects, eggs, carcasses, and plant products (Osborne et al., 1983; Pfister, 2004). This species is listed as Schedule II species in the WPA, 1972 and Least Concern by the IUCN, and Appendix III under CITES. Based on the analysis of HCVA, we found that the *Myricaria* patches along the River beds in and around MTFFR are hotspot of this species.

Blue sheep *Pseudois nayaur* Due to its habitat and adaptable diet, blue sheep is one of the most prevalent herbivores in the area (Namgail, 2009). It is one of the key prey species for Himalayan wolves and snow leopards (Fox et al., 1994). The species occurs at an elevational range of 4000 - 5500 m asl and prefers slope range of 15 - 50 degrees (Namgail, 2001). They were seen foraging on vegetation types such as *Aconogonum tortuosum*, *Ephedra* and *Juniperus* scrub, and slopes dominated by *Caragana* (Mallon, 1991). The habitat suitability of the species in MTFFR area was found to be suitable. This species is cited as a Schedule I species in WPA, 1972, Least Concern in the IUCN Red List, and in Appendix III of CITES. Based on the analysis of HCVA, we found that the ridges in and around MTFFR are hotspot of this species.

Golden Eagle *Aquila chrysaetos* locally called *Laknak* is a large, powerful bird of prey that feeds primarily on small-sized mammals. Their nest is a massive heap of grass lined sticks and twigs perched on a rock ledge at the base of an inaccessible cliff. It is a resident raptor throughout Ladakh in the elevations of up to 5,000 m and above. The species is listed under Schedule I of WPA, 1972, Least Concern under IUCN and Appendix II species of CITES. It is one of the most important raptors found in the region. The HCVA analysis showed influencing habitat suitability for the species in and around MTFFR.

Booted Eagle *Hieraaetus pennatus* locally known as *Kuz-mok* is a passage migrant, frequently seen flying over open wooded areas and mountainous semi-desert. It is frequently reported from Karakoram region and is fairly common in the lower valley bottoms of the landscape. It

is listed as a Schedule I species in WPA, 1972, and Appendix II under CITES. The CVA analysis showed lower valley bottoms as habitat suitability for the species in MTFFR.

Bearded Vulture *Gypaetus barbetus* locally referred as *Skiaklag* is a fairly large eaglelike vulture that is a common high-altitude resident across most of Ladakh, residing at elevations of 4,000 to 5,500 m asl or even higher, and descending to slightly lower areas in winters. Individual birds are generally observed gliding down rocky, steep mountainsides or soaring over valley bottoms and high-altitude plains. This species prefers rocky, steep habitat and is frequently observed in areas with greater food abundance (Pfister, 2004). The species is an important, scavenging raptor of the Karakoram landscape. It is listed as a Schedule I species in WPA, 1972, Near Threatened in IUCN Red List, and Appendix II under CITES. Based on the analysis of HCVA, we found that the ridges and valley bottoms in MTFFR are hotspot of this species.

Eurasian Sparrowhawk *Accipiter nisus* locally called *Chiptha* is a small raptor which is an occasional summer visitor breeding in the wooded valley bottoms. This raptor breeds in the in Karakoram region and it can be frequently observed in farmland, bush country and tree plantations (Pfister, 2004). It is listed as Schedule I species in WPA, 1972, and Appendix II under CITES. The CVA analysis revealed that area along riverine, human settlements and small slopes are hotspot of this species in MTFFR area.

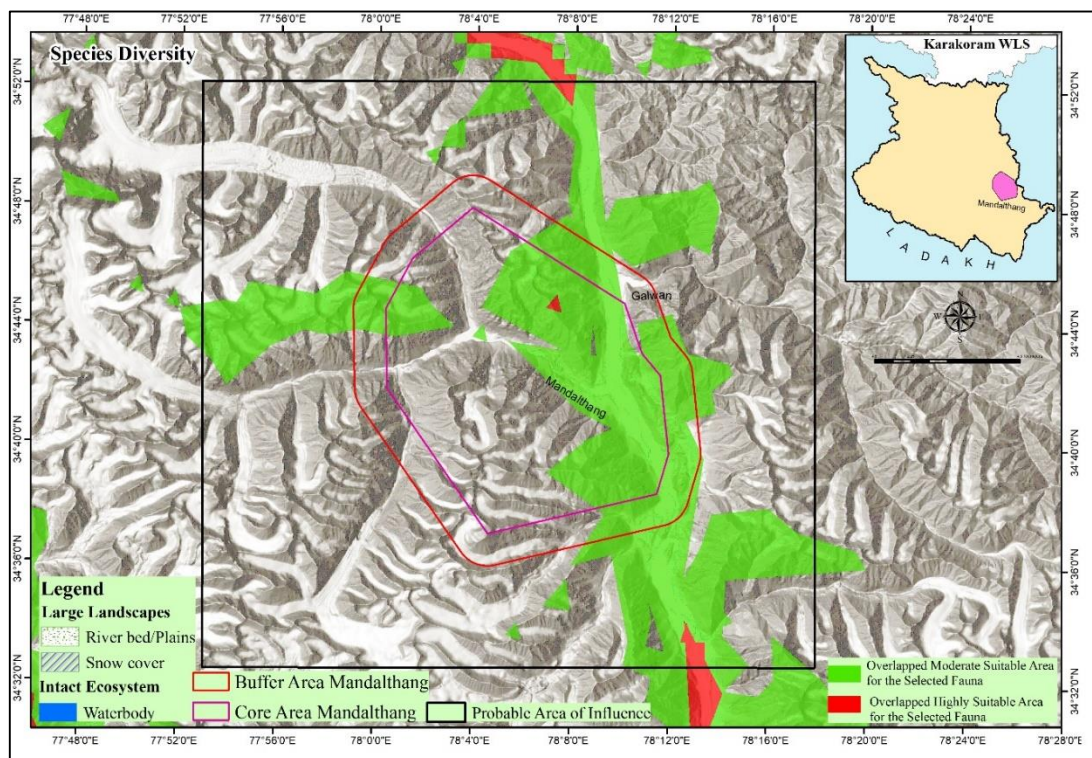


Figure 5: Conservation values area map of MTFFR in terms of species diversity

8.1.7. Conservation value area of Threatened Ecosystems and Habitats.

Two freshwater streams and a major river have been identified in the MTFFR landscape. These streams and river serve as a major source of drinking water and irrigation for the residing communities downstream along the Nubra and Shyok valleys. The other remaining area of the study site either have glaciers, barren slopes and important riverine habitat (figure 6). These glaciers are the source of water for streams and rivers and the riverine habitat provides shelters to many resident and migratory fauna. Hence, the streams, glacier, and riverine habitat in the area become crucial for the communities as well as wildlife inhabiting the region. The riverine habitat and shrubland ecosystem are important habitats for migratory and resident birds and small mammals like pica, red fox and voles. These include harsh climate, diversion of inflow or springs, and land cover and land use changes, excessive livestock grazing, and expansion of human settlements. The dependence of wild faunas and communities downstream on these ecosystems for agriculture, water, and livelihood generation is vital for their survival in such harsh terrain.

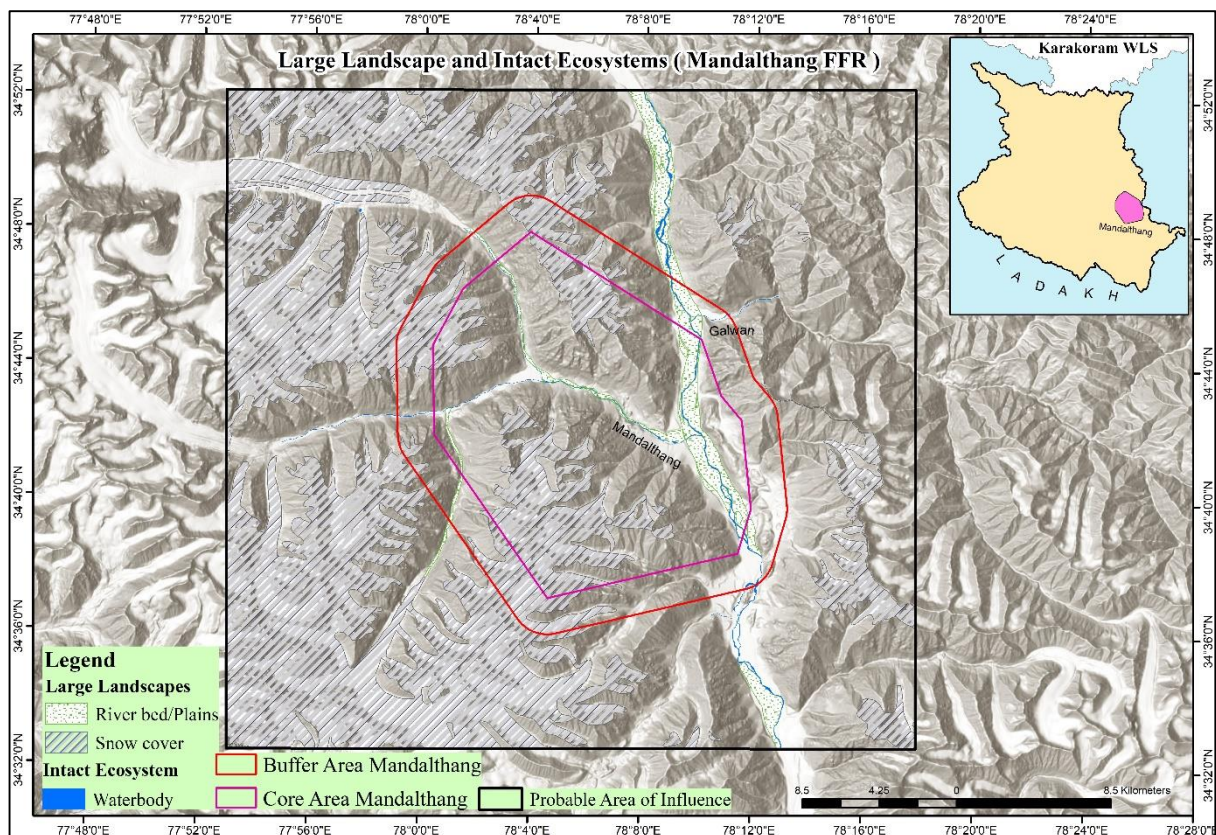


Figure 6: Map showing the Conservation value area of Ecosystems and Habitats

9. Potential threats to wildlife and mitigatory steps in the INTENSIVE AREA

From the field survey the threats and recommendations for the MTFFR area are listed. These include general recommendations for operational areas where army deployments may exist. As often with any human presence certain modifications can occur to the habitat than may in the future have cumulatively non-reversible impacts. These include *viz.*

- i) Need for awareness amongst various defence forces of environmental and wildlife values in such sensitive area
- ii) In all the army camp sites, priority may be given to proper disposal of waste, fuel leakage prevention, indiscriminate burning as various areas, disposal of used artillery shells or other chemicals, which may pollute the water and can harm wildlife
- iii) Adequate protocols are needed to prevent littering and food waste out of the riversides and wildlife habitat, which often encourage habituation and contamination of the pristine habitat
- iv) We found that the most of the important habitat are along the road sides which are often used by wildlife, therefore, adherence to slower speeds to prevent road related mortality among wildlife especially ungulate species is advised. As many animals live in these habitats and often cross roads for forage and drinking water. Also, the defence establishments may mainstream protocols in maintaining the pristine nature of the area and prevent littering along the roads through allied deployments by roadside works or other activities even. As often litter along the road side may attract wildlife to the roadside and can cause potential wildlife hazards. Management of garbage dumps area in the intended field sites is important, as these dumping sites attracts wildlife and also helps the free ranging dogs to increase their populations.

During the survey we recorded signs of mammals, twenty four bird species, and plant species, indicating good biodiversity in the MTFFR area. During the period of the survey, it was not possible to include all the faunal species that might be found in the area in different seasons. Based on our observations and available information, we identified the following potential

threats of MTFFR within the short scope of the assessment.

9.1. Direct threats

a) Whenever the firing is carried out, some amount of salvage is generated in terms of packing material, metal and wooden boxes, mill boards etc. Such salvages can disturb wildlife in terms of habitat and water contamination. These salvages need to be disposed and collected from the firing range timely to avoid threat to habitat and pollution/contamination of water. Army authorities in location also confirmed that salvage clearing is a standard drill followed after every firing practise.

b) Movement of vehicles in the vicinity of firing range, may disturb the natural habitat. Thus, the movement of vehicles in the area can be restricted to designated areas only with fixed routes.

c) Free ranging dogs: These have been observed in the area. These free ranging dogs may cause considerable harm to wildlife in terms of predation, genetic hybridization or disease spread. Few dogs were observed within the boundary of MTFFR around army camps. These are also proliferating due to the provisioning of much waste generated. A proper waste disposal mechanism is needed for maintaining the sanctity of the area.

9.2. Indirect threats

a) Linear barriers such as roads for connectivity, vehicular movement may disturb free movement of the wildlife in the habitat especially wolves, snow leopards and major prey species. However, DS-DBO road is an essential lifeline for the maintenance of forces in forward areas. Only a small portion (approx. 5-6 Kms) of road falls in MTFFR, therefore impact of road cannot be attributed to MTFFR.

b) The presence of blue sheep in the area indicates that there is a likelihood of infrequent occasional movement of Snow leopard and Himalayan wolf visiting the firing zone. An opportunistic sighting of snow leopard outside the MTFFR also confirmed the presence and possible movement of snow leopard which are known to have large home ranges. Since no such animals has been spotted in the intensive zone, the impact of firing is likely to be minimal to the larger landscape.

c) On-going activities, movement of vehicles and noise pollution disturb the mammals, breeding birds and other animals. However, the movement of vehicle & troops activity along DS-DBO road is unavoidable for the army, paramilitary, Border Road Organisation and others.

10. Proposed mitigatory steps against impacts of firing

a) Movement along the river streams and river beds can be restricted to absolute essentials by the army. The area of tank and heavy vehicles movement, army camps, and other training activities may be regulated to the permitted area.

b) The area of the target firing zone can be demarcated and stone walled or physically contained if possible to avoid the mammalian species entering the hazardous zone which can cause mortality.

c) Movement of heavy vehicles and use of weapons outside the permitted area can be completely avoided

d) Proper disposal of the post-training waste like lead content rounds, and chemical energy weapons should be done. An SOP with compliance from the concerned Forest Department is necessary for future and long-term monitoring.

e) Waste generated from the army camps must be adequately disposed. Though it was made aware that such mechanisms are in place already, a proper compliance is needed for ensuring such activities do not have cumulative effects at later stage.

f) A proper animal birth control measure must be placed by concerned department possibly collaboratively to prevent future escalation of the free-ranging dog populations.

g) Mis/fired weapon shells may be disposed of to avoid leakage of harmful chemicals into the water body. Wildlife Protection Department Leh, Department and the National/State Disaster Response Team may be notified immediately about any misfired shells outside the impact area to prevent wildlife hazards

h) Fabricated/dummy rounds and mortars may be used for training exercises to reduce the negative impact of fire-arms training (Doxford and Judd 2002, Goldsmith 2010).

10.1. Specific recommendations

The strategic importance of Mandal Thang field firing range for defence and security planning for Indian army in the Shyok valley has been already highlighted. However, it cannot be understated that the Karakoram landscapes harbours unique wildlife which are the natural heritage of the area. Considering the military sensitivity and the requirement of the Armed

Forces to be well trained, the need for MTFFR is well understood. The interests of other stakeholders' holders can be addressed with concerted efforts of all concerned.

The MTFFR is one of the strategic/sensitive field firing ranges for Indian Army for strategic defence infrastructure development in Shyok valley. While, it is important in terms of national security, a holistic and long-term plan be prepared by Armed Forces to encourage compliance and minimal damage to the fragile ecosystem of the area.

1. The increasing population of free ranging dogs all over in Ladakh is a major conservation issue. As, the Army is the only establishment with permanent presence in many hostile areas. It is advised that, in collaboration with concerned organisation, free-ranging dogs which are often seen in the vicinity of army establishment near the Galwan valley and along the DS-DBO road may be systematically removed through scientific and ethical means Trap-Neuter-Release i.e. possibly through an animal birth control measures or prevention of provisioning of food waste around such establishments.
2. It is suggested that special measures be undertaken to sanitise the intensive area of the impact zone periodically and compliance mechanism be set up for prevention of degradation of the area.
3. As the firing range is located at the bank of Shyok river, the Army may focus on the removal of ammunitions waste from range berms, to avoid the contamination of water sources.
4. As the area is hazardous after use, it must be contained with adequate safety measures and signage for human as well wildlife safety as far as practically possible.
5. As wild ungulates and other species are seasonal breeders, activities of heavy military firing during rutting or breeding may be avoided for safety and conservation measures.
6. Upon operation a long term periodic monitoring with inputs from reputed institute may be sought for investigation of impacts due to such activities in a cumulative manner incorporating other strategic needs as well.

10.2. General observations and actionable points

1. On consideration of all factors of it being of grave security issues, it is felt that while a limited/minimal impact on the larger landscape might take place due to firing in MTFFR that can be reduced by taking mitigatory steps, the strategic significance of MTFFR along the Eastern Borders of Ladakh for the training by Army and keeping national security is paramount.
2. The KWLS is a large PA with minimal manpower and resources. It is advised that continuous monitoring program along with various stakeholders be conducted for generating of in-depth information of the area and likely impacts in the future.
3. A regular awareness program in consultation with reputed organisations and government departments be conducted for mainstreaming a conservation and environmental considerations amongst army establishments.
4. Wildlife Institute of India suggests that there is a need of opening a dialogue process in order to acquire holistic approach to ensure concerns of all stakeholders. Such a process can be facilitated by a joint workshop/meeting of all the stakeholders such as Wildlife Protection Department, Wildlife Institute of India, Local administration and various defence agencies such as Indian Army and ITBP.
5. It is pertinent to highlight that the firing practices currently conducted in the MTFFR cannot be undertaken elsewhere due to lack of access in Eastern Ladakh. The area is operational for only six months in a year due to harsh climate and terrain. For the aforementioned reasons the re-notification of MTFFR for national needs and potential high security threat may be recommended.

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Annexure I

Notification of Karakoram Wildlife Sanctuary



GOVERNMENT OF JAMMU & KASHMIR
CIVIL SECTT: FOREST DEPARTMENT
(WILDLIFE PROTECTION)

105

NOTIFICATION

JAMMU, THE 19/03/1987

SRO: 152 :- Whereas, it appears to the Government that the area specified in Annexure 'A' to this Notification, has adequate ecological, faunal, floral, geomorphologic significance for purpose of protecting, propagating and developing Wildlife or its environment.

Now, therefore, in exercise of the powers conferred by section 17 of the Jammu and Kashmir Wildlife (Protection) Act, 1978, the Government hereby declare the said area as a sanctuary.

By order of the Government of Jammu and Kashmir.

Sd/-
(N.R.Gupta),
Secretary to Government,

No: Fst/WL/San/Kurakoram/87

Dated 19/03/1987.

Copy for information and necessary action to the :

1. Secretary to Government, Law Department.
2. Secretary to Government, Revenue Department.
3. Chief Wildlife Warden, Srinagar.
4. Deputy Commissioner of the concerned District.
5. Manager Government press for favour of publication in Government Gazette.
6. Stock File.

Sd/-
(Hamid-Ullah)
Deputy Secretary to Government
Forest Department.

STATUS AND SURVEY REPORT OF KARAKORUM (NUBRA-SHAYOK) WILDLIFE SANCTUARY.

Nomenclature:-

The lofty sky kissing mountains of Karakorum range runs along the north and pass further last of the proposed wildlife preserve and encompassing the entire catchments of Nubra river and a major part of the river Shayok. It is as such named after the Karakorum (Nubra- Shayok) wildlife sanctuary.

Situation:-

The area is bounded on North and west by the inter national boundary of China and Pakistan respectively. When its southern side encompasses the chain of micro catchments of Ladakh range independently the river Shayok followed by International Border of China borders draining into the Shayok River from Chalunka to Aghan and along the eastern side it. The tract is located between. $35^{\circ}-7^{\circ}$ to $35^{\circ}-78^{\circ}$ North longitude and $34^{\circ}-77^{\circ}$ to $34^{\circ}-70^{\circ}$ east latitude.

Boundaries:-

North	-- Cease-fire line of China from Indrecel up to Karakorum pass and further east.
West	--International boundary of Pakistan from Indracol to Turtuk along with Watershed of Saltora range.
South	--Contour of lofty mountain range of Ladakh whose micro Water catchments facing to north drain into river Shayok from Turtuk upto Digerla and southerly aspeated halles drain into the Indus River.
East	--Karakorum running along the actual line of control between India and China.

Area:-

The Karakorum (Nubra-Shayok) Wildlife sanctuary encompasses of an area of approximately ~~5000~~ ⁵⁰⁰⁰ Sq. Kms. and includes the entire catchments of river Nubra and a major portion of the Shayok River. It also involves the part of Siachan glacier falling in the Jurisdiction of our Country.

Approach:-

The area is accessible through the Khardongla pass, which is highest mortriable road of the world at a altitude of 18380 ft. from MSL.

Configuration:-

The topography of the area inconspicuously sloppy and mountains. Geology structure and rocks the tract beholds very rugged valleys, Rough, rocky precipitous stony with many mountain peaks. The rock consists of slates, Phyllis's, and schists. Quarizites, Crystalline line stone, dolomites.

The altitude ranges between 3000 mtr. to 6000 mtr. from MLS.

PROPOSED
KARAKARAM (Nubra-Shyok)
WILDLIFE SANCTUARY

(104)



Legend
Boundary Sanctuary
River Shyok
Boundary Zone

Notification of Mandal Thang Field Firing Range

RESTRICTED

70

Appx A

(Refer to Para 1 of
Rg Standing Orders)

Government of Jammu and Kashmir
Home Department
Civil Secretariat, J&K Srinagar/Jammu

Notification

Jammu, the 6th March, 2017

SRO 73 - In exercise of the powers conferred by sub-section (1) of section 9 of the Maneuvers, Field Firing and Artillery Practice Act, 1938, the Government of Jammu and Kashmir hereby declare the area measuring 4,80,000 Kanals situated at Mandalthang, Shayok under Khasra No. 1803 located in Darbuk Sub Division, District Leh, as an area for purposes of the said sub-section for a period of six years from the date of publication of this notification in the Government Gazette.

By Order of the Government of Jammu and Kashmir:

Sd.

(R.K. Goyal)IAS

Principal Secretary to Government
Home Department

Dated: 06-03-2017

No. Home/Land-Acq/27/2016

Copy to the:

1. Chief Executive Council/Chairman, Ladakh Autonomous Hill Development Council, Leh.
2. Chief Secretary, J&K, Civil Secretariat, Jammu.
3. Principal Secretary to Hon'ble Chief Minister.
4. Divisional Commissioner, Kashmir.
5. Commissioner/Secretary to Government, Revenue Department.
6. Secretary to Government, Department of Law, Justice & Parliamentary Affairs.
7. Deputy Commissioner, Leh.
8. Principal Director, Defence Estates, Northern Command.
9. Joint Director Information, Srinagar with the request to publish the notice in at least two leading local daily news papers.
10. HQ Northern Command C/o 56 APO.
11. Defence Estates Officer, Leh.
12. General Manager, Ranbir Government Press, Srinagar for publication.
13. Private Secretary to Principal Secretary, Home Department.
14. Incharge Website Home Department/GAD.
15. Stock File.

(Mushtaq Ahmad)KAS
Deputy Secretary to Government
Home Department

Annexure II

Table 5. Planned weapons to be fired and their maximum firing ranges in MTFFR.

S. No.	Weapon caliber	Round type	Firing range (max.)
1.	120 mm	Mortar	8.5 km
2.	120 mm	Rockets	40 km
3.	105 mm	FD Guns	21km
4.	130 mm	Guns	30km
5.	155 mm	Guns	40 km
6.	203 mm	RKTS	40 km

Table 6: Check list of birds found in Shyok valley

Common Name	Scientific Name	IUCN	WPA
Order-Anseriformes Family-Anatidae			
Ruddy Shelduck	<i>Tahoma ferruginea</i>	LC	Sch IV
Gadwall	<i>Anas strepera</i>	LC	Sch IV
Mallard	<i>Anas platyrhynchos</i>	LC	Sch IV
Order-Accipitriformes Family-Accipitridae			
Oriental Honey-Buzzard	<i>Perms ptilorhynchus</i>	LC	Sch I (Part III)
Black Kite	<i>Milvus migrans</i>	LC	Sch I (Part III)
Bearded Vulture	<i>Gypaetus barbatus</i>	NT	Sch I (Part III)
Himalayan vulture	<i>Gyps himalayensis</i>	LC	Sch I (Part III)
Cinereous Vulture	<i>Aegypius monachus</i>	NT	Sch I (Part III)
Eurasian Sparrowhawk	<i>Accipiter nisus</i>	LC	Sch I (Part III)
Upland Buzzard	<i>Buteo hemilasius</i>	LC	Sch I (Part III)
Golden Eagle	<i>Aquila chrysaetos</i>	LC	Sch I (Part III)
Booted Eagle	<i>Hieraaetus pennatus</i>	LC	Sch I (Part III)
Order-Falconiformes Family-Falconidae			
Common Kestrel	<i>Falco tinnunculus</i>	LC	Sch IV
Merlin	<i>Falco columbarius</i>	LC	Sch IV
Eurasian Hobby	<i>Falco subbuteo</i>	LC	Sch IV
Order-Galliformes Family-Phasianidae			
Tibetan Snowcock	<i>Tetraogallus tibetanus</i>	LC	Sch I (Part III)
Himalayan Snowcock	<i>Tetraogallus himalayensis</i>	LC	Sch IV
Chukar	<i>Alectoris chukar</i>	LC	Sch IV
Tibetan Partridge	<i>Perdix hodgsoniae</i>	LC	Sch IV
Order-Charadriiformes Family-Scolopacidae			
Common Redshank	<i>Tringa totanus</i>	LC	Sch IV
Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC	Sch IV

Common Greenshank	<i>Tringa nebularia</i>	LC	Sch IV
Spotted redshank	<i>Tringa erythropus</i>	LC	Sch IV
Common Sandpiper	<i>Actitis hypoleucos</i>	LC	Sch IV
Order-Columbiformes Family-Columbidae			
Rock dove	<i>Columba livia</i>	LC	Sch IV
Hill Pigeon	<i>Columba rupestris</i>	LC	Sch IV
Eurasian collared dove	<i>Streptopelia decaocto</i>	LC	Sch IV
Snow Pigeon	<i>Columba leuconota</i>	LC	Sch IV
Oriental Turtle-Dove	<i>Streptopelia orientalis</i>	LC	Sch IV
Laughing Dove	<i>Streptopelia senegalensis</i>	LC	Sch IV
Speckled wood pigeon	<i>Columba hodgsonii</i>	LC	Sch IV
Order-Cuculiformes Family-Cuculidae			
Common Cuckoo	<i>Cuculus canorus</i>	LC	Sch IV
Pied cuckoo	<i>Clamator jacobinus</i>	LC	Sch IV
Order-Apodiformes Family-Apodidae			
Alpine Swift	<i>Tachymarptis melba</i>	LC	Sch IV
Common Swift	<i>Apus apus</i>	LC	Sch IV
Little Swift	<i>Apus affinis</i>	LC	Sch IV
Order-Bucerotiformes Family-Upupidae			
Common Hoopoe	<i>Upupa epops</i>	LC	Sch IV
Order-Passeriformes Family-Alaudidae			
Greater Short-toed Lark	<i>Calandrella brachydactyla</i>	LC	Sch IV
Hume's Lark	<i>Calandrella acutirostris</i>	LC	Sch IV
Crested Lark	<i>Galerida cristata</i>	LC	Sch IV
Oriental Skylark	<i>Alauda gulgula</i>	LC	Sch IV
Horned Lark	<i>Eremophila alpestris</i>	LC	Sch IV
Tibetan lark	<i>Melanocorypha maxima</i>	LC	Sch IV
Order-Passeriformes Family-Hirundinidae			
Eurasian Crag-Martin	<i>Hirundo rupestris</i>	LC	Sch IV
Barn Swallow	<i>Hirundo rustica</i>	LC	Sch IV
Red-rumped swallow	<i>Cecropis daurica</i>	LC	Sch IV
Order-Passeriformes Family-Motacillidae			
White Wagtail	<i>Motacilla alba</i>	LC	Sch IV
Citrine Wagtail	<i>Motacilla citreola</i>	LC	Sch IV
Grey Wagtail	<i>Motacilla cinerea</i>	LC	Sch IV
Order-Passeriformes Family-Laniidae			
Long-tailed Shrike	<i>Lanius schach</i>	LC	Sch IV
Brown shrike	<i>Lanius cristatus</i>	LC	Sch IV
Order-Passeriformes Family-Cinclidae			
White-throated Dipper	<i>Cinclus cinclus</i>	LC	Sch IV
Brown Dipper	<i>Cinclus pallasii</i>	LC	Sch IV
Order-Passeriformes Family-Troglodytidae			
Eurasian Wren	<i>Troglodytes troglodytes</i>	LC	Sch IV

Order-Passeriformes Family-Prunellidae			
Alpine Accentor	<i>Prunella collaris</i>	LC	Sch IV
Altai Accentor	<i>Prunella himalayana</i>	LC	Sch IV
Robin Accentor	<i>Prunella rubeculoides</i>	LC	Sch IV
Brown Accentor	<i>Prunella fulvescens</i>	LC	Sch IV
Order-Passeriformes Family-Turdidae			
Tickell's Thrush	<i>Turdus unicolor</i>	LC	Sch IV
Dusky Thrush	<i>Turdus eunomus</i>	LC	Sch IV
Black-throated thrush	<i>Turdus atrogularis</i>	LC	Sch IV
Order-Passeriformes Family-Aegithalidae			
White-browed Tit Warbler	<i>Leptopoecile sophiae</i>	LC	Sch IV
Order-Passeriformes Family-Phylloscopidae			
Common Chiffchaff	<i>Phylloscopus collybita</i>	LC	Sch IV
Mountain Chiffchaff	<i>Phylloscopus sindianus</i>	LC	Sch IV
Plain Leaf Warbler	<i>Phylloscopus neglectus</i>	LC	Sch IV
Dusky Warbler	<i>Phylloscopus fuscatus</i>	LC	Sch IV
Order-Passeriformes Family-Paridae			
Great Tit	<i>Parus major</i>	LC	Sch IV
Ground-tit	<i>Pseudopodoces humilis</i>	LC	Sch IV
Order-Passeriformes Family-Tichodromidae			
Wallcreeper	<i>Tichodroma muraria</i>	LC	Sch IV
Order-Passeriformes Family-Emberizinae			
Rock Bunting	<i>Emberiza cia</i>	LC	Sch IV
Pine bunting	<i>Emberiza leucocephalos</i>	LC	Sch IV
Reed bunting	<i>Emberiza schoeniclus</i>	LC	Sch IV
Order-Passeriformes Family-Fringillidae			
Brambling	<i>Fringilla montifringi</i>	LC	Sch IV
Red-fronted Serin	<i>Serious pusillus</i>	LC	Sch IV
Plain Mountain-Finch	<i>Leucosticte nemoricola</i>	LC	Sch IV
Brandt's Mountain-Finch	<i>Leucosticte brandti</i>	LC	Sch IV
European Goldfinch	<i>Carduelis carduelis</i>	LC	Sch IV
Common Rosefinch	<i>Carpodacus erythrinus</i>	LC	Sch IV
Great Rosefinch	<i>Carpodacus rubicilla</i>	LC	Sch IV
Red-fronted rosefinch	<i>Carpodacus puniceus</i>	LC	Sch IV
Order-Passeriformes Family-Passeridae			
House Sparrow	<i>Passer domesticus</i>	LC	Sch IV
Spanish Sparrow	<i>Passer hispaniolensis</i>	LC	Sch IV
Tibetan Snowfinch	<i>Montifringilla henrici</i>	LC	Sch IV
Blanford's snowfinch	<i>Pyrgilauda blanfordi</i>	LC	Sch IV
Order-Passeriformes Family-Corvidae			
Black-billed Magpie	<i>Pica pica</i>	LC	Sch IV
Red-billed Chough	<i>Pyrrhocorax pyrrhocorax</i>	LC	Sch IV
Alpine Chough	<i>Pyrrhocorax graculus</i>	LC	Sch IV

Northern Raven	<i>Corvus corax</i>	LC	Sch IV
Order-Passeriformes Family-Muscicapidae			
Common Rock Thrush	<i>Monticola saxatilis</i>	LC	Sch IV
Blue throat	<i>Cyanecula svecica</i>	LC	Sch IV
Blue-capped Redstart	<i>Phoenicurus caeruleocephalus</i>	LC	Sch IV
Black Redstart	<i>Phoenicurus ochruros</i>	LC	Sch IV
Common Stonechat	<i>Saxicola torquatus</i>	LC	Sch IV
Common Redstart	<i>Phoenicurus phoenicurus</i>	LC	Sch IV
Plumbeous Water Redstart	<i>Rhyacornis fuliginosus</i>	LC	Sch IV
Guldenstadt's Redstart	<i>Phoenicurus erythrogaster</i>	LC	Sch IV
Blue-fronted Redstart	<i>Phoenicurus frontalis</i>	LC	Sch IV
Blue Whistling thrush	<i>Myophonus caeruleus</i>	LC	Sch IV
Isabelline Wheatear	<i>Oenanthe isabellina</i>	LC	Sch IV
Desert Wheatear	<i>Oenanthe deserti</i>	LC	Sch IV
Blue Rock Thrush	<i>Monticola solitarius</i>	LC	Sch IV

Table 7. Major mammalian species found in Shyok valley.

S. No	Name	Scientific Name	Local Name
1.	Ibex	<i>Capra ibex</i>	Skin
2.	Ladakh Urial	<i>Ovis vignei</i>	Shapu
3.	Tibetan Argali	<i>Ovis ammon</i>	Nyan
4.	Blue Sheep	<i>Pseudois nayaur</i>	Napo
5.	Snow Leopard	<i>Panthera uncia</i>	Shan
6.	Lynx	<i>Lynx lynx</i>	Yi, Eeh
7.	Stoat	<i>Mustela erminea</i>	Lakimo
8.	Stone Marten	<i>Martes foina</i>	Kogar
9.	Tibetan Wolf	<i>Canis lupus</i>	Shangkhu
10.	Tibetan Wild-Dog	<i>Cuon alpinus</i>	Sidda-ki
11.	Eurasian otter	<i>Lutra Lutra</i>	Chusham
12.	Red Fox	<i>Vulpes vulpes</i>	Wadse
13.	Himalayan Marmot	<i>Marmota himalayana</i>	Phiya
14.	Wild Yak	<i>Bosmutus</i>	Dong
15.	Woolly Hare	<i>Lepus oiostolus</i>	Ribong
16.	Tibetan Antelope	<i>Pantholops hodgsonii</i>	Stzos

Table 8. Major Plant species found in Shyok valley.

S.No	Scientific Name	Local Name
1.	<i>Anaphalis triplinervis</i>	Phulumentok
2.	<i>Arnebia euchroma</i>	Demok
3.	<i>Aconitum heterophyllum</i>	Bona-Karpo
4.	<i>Aconitum violaceum</i>	Bona-Nakpo
5.	<i>Dactylorhiza hatagirea</i>	Ambolakpa
6.	<i>Physo chlaina</i>	
7.	<i>Capparis spinosa</i>	Capra
8.	<i>Caragana versicolor</i>	Tama
9.	<i>Carum carvi</i>	Kosnyot
10.	<i>Cicermit crophyllum</i>	Seri
11.	<i>Delphinium brunonianum</i>	Lunde-kaown
12.	<i>D.heterophyllum</i>	Zinkzer,Zypsi
13.	<i>Echinops cornigerus</i>	Aczema
14.	<i>Ephedra gerardiana</i>	Chhapat
15.	<i>Geranium pratense</i>	Gugchuk
16.	<i>Heraclum pinnatum</i>	Spru
17.	<i>Hippophaer hamnoides</i>	Sastalulu
18.	<i>Iris lactea</i>	Tesmamentok
19.	<i>Juniperus indica</i> <i>Iris lactea</i>	ShukpaTesmamentok
20.	<i>Lancea Tibetica</i>	Raikse Shukpa
21.	<i>Leontopodium nanum</i>	PaluMakpen
22.	<i>Nepeta floccosa</i>	ShamaloloPalu
23.	<i>Oxyria digyna</i>	Shamalolo
24.	<i>Oxytropis macrophylla</i>	Lamanchu
25.	<i>Myricaria sp.</i>	Umbu
26.	<i>Oxytropis macrophylla</i>	Stagshanakpo

Annexure III

Plates of mammals recorded during the survey



Blue sheep (*Pseudois nayaur*) © Arif



Indian Field Mouse (*Mus booduga*) © Ajaz



Red Fox (*Vulpes vulpes*) © Ajaz

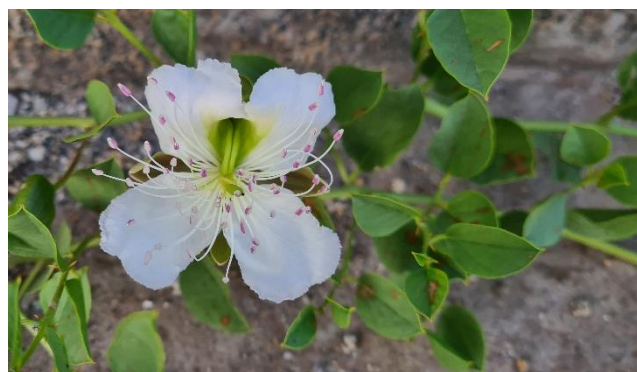


Mountain Vole (*Alticola stoliczkanus*) © Ajaz

Plates of plants recorded during the survey



Nepeta floccosa



Capparis spinosa



Ephedra gerardiana



Tanacetum gracile

Plates of Birds recorded during the survey



Robin Accentor (*Prunella rubeculoides*) © Ajaz



Eurasian Hobby (*Falco Subbuteo*) © Arif



Brandt's Mountain Finch (*Leucosticte brandti*) ©Aiaz.



Bearded Vulture (*Gypaetus barbatus*) © Ajaz



Yellow-Billed Cough (*Pvrrhocorax graculus*) ©Aiaz.



Horned Lark (*Eremophila alpestris*) © Ajaz



Northern Raven (*Corvus corax*) ©Aiaz



Golden Eagle (*Aquila nipalensis*) © Ajaz



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