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Distribution of Common Leopard (*Panthera pardus*) and Human-common Leopard Conflict in Lachhrat Forest Range, Azad Jammu and Kashmir, Pakistan

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SUMMARY

Leopards belong to the Felidae family and the Genus *Panthera*, which includes five species of leopard. In Pakistan, the two species found are the Common Leopard (*Panthera pardus*) and the Snow Leopard (*Panthera uncia*). The objectives of this study are to determine the current distribution and population status of the Common Leopard in the Lachhrat Forest Range, and to assess the human-leopard conflict in the area. The line transect method, pugmark tracing technique, and questionnaire survey were used to assess the population status and distribution of the common leopard. Random transects were laid out in each locality to cover every type of land use and habitat, in order to avoid biases. Initial information was collected from the heads of families, especially those who own or have previously owned livestock, to account for human-leopard conflict. The study was conducted in the LFR of district Muzaffarabad, Azad Kashmir, Pakistan. A total of twenty transects were laid down, with the majority (n=11; 55%) not showing any signs of leopards, while a total of 22 signs were recorded in the remaining 9 (45%) transects. The most commonly documented signs were scrapes (10; 47%), followed by pugmarks (7; 33%), and scats (5; 22%). In response to a question about the percentage of human-leopard conflict in the study area, the majority (n=103, 55%) reported a high conflict intensity (60%), followed by moderate conflict intensity (30%) (n=60, 32%), and 9% (n=17) stated that there was no such conflict. 3.47% (n=7) did not respond to the question.

Keywords: Diversity, Population, Leopard, Kashmir, Conflict

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INTRODUCTION

Leopards, belonging to the widely distributed Felidae family, are part of the Genus *Panthera*, which contains five leopard species. In Pakistan, the Common Leopard (*Panthera pardus*) and the Snow Leopard (*Panthera uncia*) are found. Of these two species, the Common Leopard is the most commonly found in both forests and open country (Prater, 1998; Qamar et al., 2010; Chattha et al., 2013; Kabir et al., 2013). The leopard is a strong and agile cat, capable of climbing trees and carrying prey up to three times its own mass. With its strong limbs, the leopard can easily jump

forward more than 6 meters and uphill more than 3 meters (Pocock 1932; Brakefield, 1993; Plessis and Smit, 2005; Marker, 2009).

Common leopard is the most commonly spread of all the wild cats in the world (Nowell and Jackson, 1996). It is found almost in every kind of habitation: from tropical forest to desert and to temperate regions (Kitchener, 1991). Fossil indication, some as old as 1.5 to 2.0 million years (Hemmer, 1976; Brain 1981), proposes that leopards were once more broadly distributed than today. The topographical distribution of leopard covers all over Africa, central Asia, south-east Asia and north Amur valley in Russia. Leopard is found through the Indian sub-continent apart from deserts, the Sundarbans mangroves, and thickly established areas (Khan 1986; Jhonsingh et al., 1991). It remains in CITES as its wide hunting had miserable its population in several parts of Africa (Myres, 1976). Due to reduction in its population common leopard is classified as a threatened species in the IUCN Red list data book.

The Common Leopard (*Panthera pardus*) is found throughout Africa and Asia ((Al-Johany, 2012). In Pakistan, the common leopard spreading ranges from low elevations Himalayan moist temperate forest to brushwood forest of Kirath hills in Sindh, Kalat, Makran in Baluchistan, and mountain forests of Punjab, Khyber-Pakhtoonkhwa and Azad Jammu and Kashmir (AJ&K) (Qamar et al., 2010; Chatha et al., 2103; Kabir et al., 2013). In the northern mountainous region, it is found in the Murree Hills, Swat, Kohistan, Dir, Chitral, Abbottabad, Kaghan valley, Gilgit, Margalla, Hills National Park and Machira National Park, Neelum Valley in AJ&K. (Kabir et al., 2013; chatha et al., 2015). In Azad Jammu Kashmir, the leopards are spread from Dudyal (Mirpur) in the south to Neelum Valley in the north. (Kabir et al., 2010). These are mostly rocky areas having the agro-pastoral economy (Qamar et al., 2010).

According to sheikh and Molur (2005) Common Leopard is critically endangered in Pakistan. The entire population of leopards in Pakistan is still unknown and incomplete work is accessible at the state level. In 1998-99 a study was conducted in Rawalpindi to estimate the population size, its distribution pattern, and habitation preference. In Rawalpindi Region the total population estimates within a 281km2 habitat was 5.058+-4.496, representing that 1-9 leopards live in its spreading range (M. Anwar Maan & A. Aleem Ch, 2010). Reflection of the study predicted that the population of leopard was arbitrarily distributed, display no preference for a habitat. A census was conducted by The NWFP Wildlife Department in 1997 and has put the total number of leopards at 76 out of which, 24 were thought to be Abbottabad Region.

In over-all, leopard home ranges may be small as 8.8 km² in a territory with rich prey. (Grassman, 1999) to the maximum of 25 Km^2 in a prey poor area (Maan and. Chaudhry, 2000). Leopards are regarded as top Predator (Treves and Karanth, 2003).

Like the other species Carnivores have the accepted constitutional rights to breath in this world but human-carnivores conflict is usual phenomenon and it exceeds their loss is at shocking rate. Rapid growth of human population, maximum of the natural habitats has been changed to farmed land or inhabited zones, in turn upsetting the wildlife including leopard. Reducing habitats turn into the main cause of

conflict among people and leopard (Bhatia et al., 2103). Human-leopard conflict is an emerging issue both for society and government. Though effective managing plan of species reduces attacks on people and livestock, as well as leopard protection (Athreya et al., 2004; Dar et al., 2009). Management of leopard is more tough due to their widespread range that penetrates human dominated parts (Dar et al., 2009; Kabir et al., 2013). The saturation of leopard into the human sites may have several difficulties and conflicts but main horror induces due to its richness (Quammen, 2003) lead to attacks on humans (Loe, 2004). It is frequently reported that the existence of predators in the human lands basis livestock destruction (Patterson et al., 2004). Attack on livestock is frequently triggering payback killings of key species by farmers. Several studies define that the destruction can be prohibited by implementing suitable administration approaches (Ogada, 2003; Kabir et al., 2013). Livestock depredation is a source of human-leopard conflict universal (Madhusudan, 2003; Namgail et al., 2004; Qamar et al., 2010; Kabir et al., 2013) Hardly there may be any untouched space for the carnivore outside the protected zones. Still, the level of fight is high, the species if have wide range and highly adoptable in different habitat like common leopard (Daniel, 1996: Dar et al., 2009; Shukla, 2002).

The existence of common leopard in occupied land will differentially thrive to predation on livestock. (Karanth et al., 2004; Dickman, 2005; Qamar et al., *2010*). Conflict evident in and round rural cultivated land where peoples are restricted by inadequate resources and information in dealing with conflict. It is strongly esteemed that the conflict can be fixed by the boldness, collaboration and concerns of the local public (Linnell et al., 2001; Constant et al., 2015). To lessen conflict there would be a compulsory understating about predator's species. This situation is more thoughtful in Pakistan where carnivore population has been significantly condensed (Dar et al., 2009; Qamar et al., 2010; Chattha et al., 2013; Kabir et al., 2013). Various studies documented human– wildlife war in the area with dominant human population (Bagchi and Mishra 2006; Gehrt et al., 2010; Loveridge et al., 2010). Conflict is not restricted to the boundaries of protected zones or rural landscape (Moyer et al., 2008; Macdonald, 2010; Gehrt et al., 2011) and outside protected areas but (Jhala et al., 2009; Singh et al., 2010; Athreya et al., 2011).

Predictably understood result from war between people and wildlife for resources, human-leopard conflict is now understood to be affected by peoples' perceptions of what level of connection is tolerable (Dickman, 2010; Peterson et al., 2010). Observations of Human-leopard conflict may be as vital as the ecology of the species in shaping the levels of maltreatment (Madden, 2004; Peterson et al., 2010), media is also playing role to minimize the conflict and results of some studies exposed that the media impacts public sensitivities of tolerable risk posed by the existence of wild animals (Gore et al., 2005; Gore and Knuth, 2009; McQuail, 2010).

Among carnivores' leopards (*Panthera pardus*) are the wide-ranging species and can make its home in a variety of habitats. Though, the species has practiced a 37% decrease in its old range all over southern Africa over the past 100 years (Ray et al., 2005; Chattha et al., 2013; Constant et al., 2015). Habitat deprivation and shattering, depletion of natural prey species, sick accomplished harvests, banned trade of leopard skins and human–leopard conflict have subsidized to the decline in

population of specie (Ray et al., 2005; Henschel 2008; Qamar et al., 2010; Kabir et al., 2013; Balme et al., 2010; Packer et al., 2011).

Leopards in Azad Kashmir are facing an increasing threat due to the conflict with local residents. This has become a significant issue and has gained national attention. As a result, the government is under pressure from rural communities who are seeking compensation for their livestock losses caused by the leopards (Dar et al., 2009; Qamar et al., 2010; Constant et al., 2015). The population status, distribution range, and the extent of the human-leopard conflict in the Lachhrat Forest Range (LFR) were previously unknown. Therefore, the purpose of this study is to estimate the distribution range and population status of the Common Leopard, as well as to evaluate the human-leopard conflict in the LFR. The main objectives of this study are to determine the current distribution and population status of the Common Leopard in the Lachhrat Forest Range, and to assess the human-leopard conflict in the study area.

MATERIALS AND METHODS

STUDY AREA

Lachhrat Forest Range (LFR) located in Himalayan region of Pakistan, Azad Jammu and Kashmir and lies at 34^0-36^0 N latitude and 54^0-77^0 E longitude located in between Jhelum and Neelum valley starting from Muzaffarabad. LFR covers an area of 30991 acres, at an altitudinal level between 900 m to 3500 m above the sea level (asl). Study area comprising forest compartment number 1 to 25 (GoAJK 2015) (Figure 1).

The annual rainfall is 1530.7 mm (Pakistan Meteorological Department, 1990; Termizi and Rafique, 2001; GoAJK 2015). Important mammalian species exist in area include leopard (*Panthera pardus*), Black bear (*Ursus thibetanus*), Asiatic jackal (*Canis aureus*), Red fox (*Vulpesvulpes*), and Yellow throated martin (*Martes flavi-gula*) (Termizi, 2001). LFR includes 3 Union Councils viz., Noraseri, Panjgran and Punjkot. The area of LFR is steep and rocky with thick vegetation. The area consists of high ridges, with steep slopes, plane places usually found at the banks of the Neelum river (Termizi, 2001; GoAJK, 2015).

The weather of study area fluctuates according to the feature and elevation. The area has variation in temperature. Lower parts have subtropical condition, while at the elevation of 1400 m (asl) and above, the climate is moderate in summer and extreme cold from winter. Snow fall starts from November and covers northern aspect and higher mountains late in spring (March-April) (Termizi and Rafique, 2001; GoAJK 2015).

LFR is marked by fresh water springs and shattered by numerous constant watercourses with cold and clean water. There is a plenty of springs in the area which join nets of side nallahs that join the main streams. All nallahs and streams are encountered with, the major along the Neelum River, being northern and north-western and along the Jhelum Southern and South western (Termizi, 2001; GoAJK, 2015).

The area covers sub alpine region with large coverings of moist temperate forest as well as diversity of angiosperms, gymnosperms, and other plants. The important plant species are *Cedrus deodara, Pinus wallichiana, Abies pindrow,*

Picea smithiana, Aesculus indica, Viburnum nervosum, Saussurea lappa, and Pyrus pashia (Termizi, 2001).

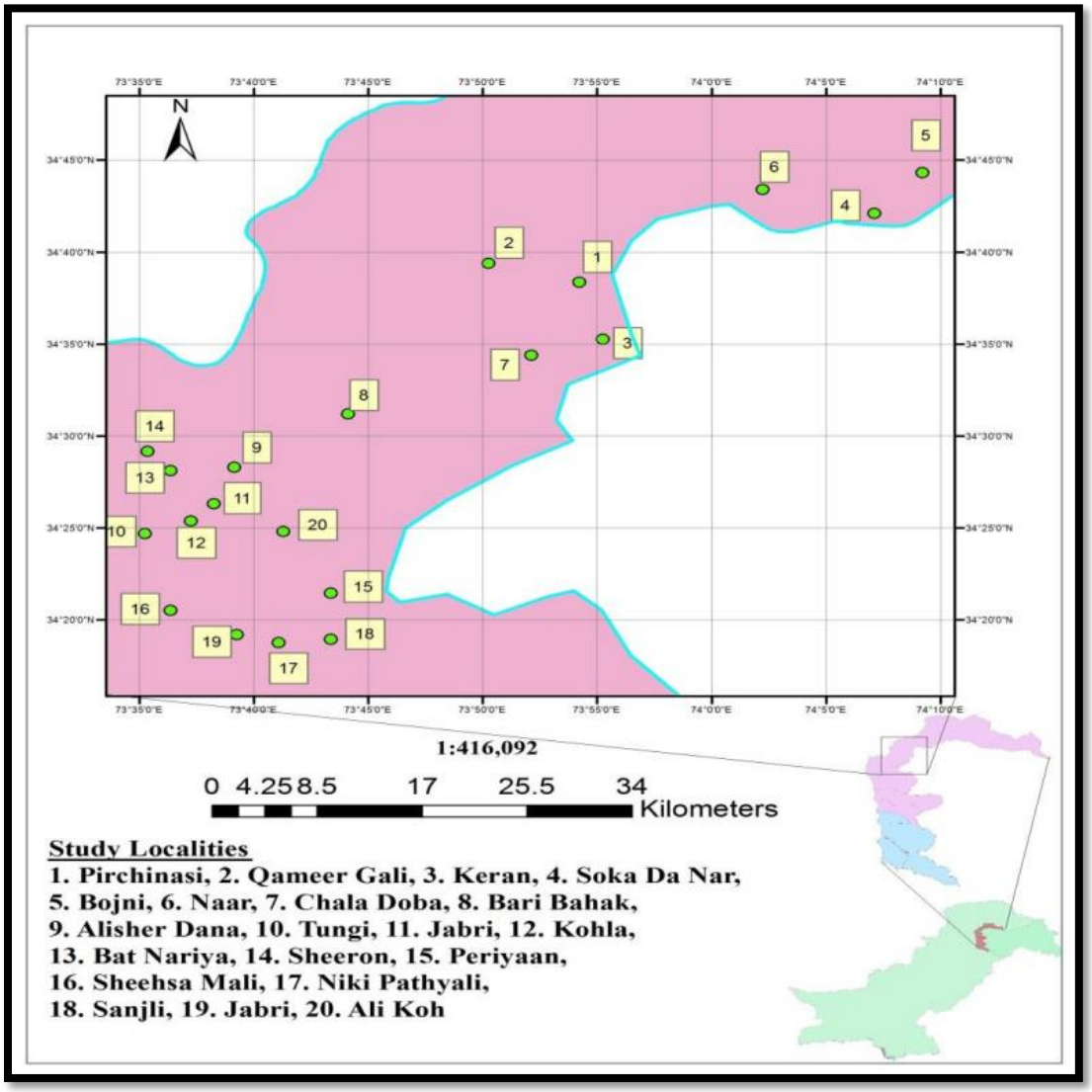

Figure 1: Location map of study area (Lachhrat Forest Range).

For convenience, the study area was divided into four study zones (A, B, C and D) which in turn divided in to twenty study localities (Fig. 2.1). The zone A situated at 34°38.371 N; 73°54.211 E at an altitudinal range of 2000 to 2800 m and comprised of 5 localities, i.e. Pir Chinasi, Grang Nala, Soka da Naar, localities were in moist temperate forest. Zone B situated at 34°32.288 N, 73°50.311 E with altitude ranges from 2100 to 2200 m and was divided into 4 localities, i.e. Kheter, chambran, Hotar, and Bojni. This zone having evenly distributed moist temperate forest with steep sloops, while Khor Mang with pasture land and mountainous. Zone C situated at 34°42.912 N, 73°55.280 E with altitude ranging from 2100 to 2400 m and compromised on 6 localities, i.e. Naar, Khoty Roara, Gati, Niki Mohri, Batnariyaan, Sheroon, Area is moist temperate dense forest with long dense shrubs measuring up

to 3 meters tall. Zone D located at 34°63.961 N, 73°43.365 E altitude ranging from 2400 to 3400 m. this zone was comprised of 5 localities, i.e. Keraan, Pir simar, Phaman Dana, Pathyalli, and Ali-Koh (Table 1).

Table 1: Physical appearance of the study localities in Lachhrat Forest Range during 2016-17.

Sr.	Localitie	Dominant vegetation	General habitat	Coordinates	Elevation (m)
Zone A					
1	Pirchansi	*Pinus wallichiana, Quercus incana, Picea smithiana, Taxus wallichiana, Betula utilis, Cedrus Deodara, Indigofera heterantha, Vibernum nervosum, Polygonum amplexicaule, Cymbopogan martini, Bergenia ciliate*	Moist temperate Sloppy with thick ground vegetation	34°38.371 N 73°54.211 E	2780
2	Grang Nala	*Pinus wallichiana, Quercus incana, Taxus wallichiana, Vibernum nervosum, Juniperus communis, Bergenia stracheyi, Podophyllum emodi, Cymbopogan martini, Euphorbia* spp.	Moist temperate with steep slopes and dense ground	34°38.710 N 73°56.311 E	2420
3	Soka Da Nar	*Pinus wallichiana, Abies Pindrow, Indigofera heterantha, Geranium*	Dense ground vegetation	34°36.280 N 73°47.245 E	2620
4	Ali Sher da Dana	*Aesculus indica, Prunnus cornuta, Vibernum nervosum, Salix denticulate, Vitis vinifera, Aconitum heterophyllum, Poa annua,Berbri saristidae Thymus serpyllum, Malva* spp.	coniferous forest, subalpine scrubs	34°25.440 N 73°36.352 E	2220
5	Periyaan	*Prunnus cornuta, Aesculus indica, Viburnum erubeseens, Bistorta* spp. *Rhodendron hypenanthum, Rumex nepalensis, Poa annua, Salix denticulate, Thymus serpyllum, Urtic adioica, Viscum album*	Sub alpine scrubs	34°28.513 N 73°36.355 E	2350
Zone B					
6	Kheter/ Chambr an	*Aesculus indica, Juniper communis, Prunnus cornuta, Qurcus incana, Vibernum* spp. *Salix denticulate, Poa annua, Vitis vinifera, Viscum album*	Slopes and mountains and dense ground vegetation	34°32.288 N 73°50.311 E	2130
7	Hotar	*Prunnus cornuta, Aesculus indica, Viola* spp. *Salix denticulate, Thymus serpyllum, Viscum album, Polygonum amplexicaulis*	Pasture land	34°44.743 N 73°42.280 E	2030
8	Bojni	*Cedrus deodara, Prunnus cornuta Aesculus indica, Qurcus incana Salix*	Ground carpeted with	34°38.371 N 73°43.211 E	2456

			thick vegetation		
9	Khormang	*Denticulate,Poa annua, Abies pindrow, Malva spp. Vitis vinifera,Vibernum* spp.	Pasture land	N34°33.671, E 73°44.850	2150
Zone C					
10	Naar	*Cedrus deodara, Aesculus indica, Juglans regia, Arundo donax , Poa annua, Celtis australis, Adiantum incisum, Thymus serpyllum, Rhodendron hypenanthum*	Dense forest With long dense shrubs	34°42.912 N 73°55.311 E	2150
11	Khotyroar	*Betula utilis,Vibernum nervosum, Juglans regia, Celtis australis, Poa annua, Viscum album, Viburnum erubeseens,*	Dense forest with shrubs	34°39.832 N 73°48.230 E	2230
12	Gati	*Abies pindrow, Juglans regia, Viburnum erubeseens, Bistorta* spp. *Poa annua, Adiantum incisum, Arundo donax, Viscum album*	Dense forest with thick vegetation	34°34.371 N 73°43.211 E	2430
13	Niki Mohri	*Cedrus deodara, Taxus wallichiana, Juglans regia, Vibernum nervosum, Poa annua, Thymus serpyllum, Adiantum incisum*	Steep sloop and thick vegetation with thick forest	34°39.901 N 73°49.812 E	2110
14	Batnariyaan	*Pinus wallichiana, Quercus incana, Cedrus deodara, Viburnum erubeseens, Bergenia ciliate, Adiantum incisum, Thymus serpyllum*	Hilly area with small mountain patches	34°33.820 N 73°48.853 E	2340
15	Sheeroon	*Cedrus deodara, Betula utilis, Vibernum nervosum, Senecio* spp. *Thymus serpyllum, Viscum album, Polygonum amplexicaulis.*	Steep and mountainous	34°19.857 N 73°41.728 E	2380
Zone D					
16	Keeran	*Prunnus cornuta , Viburnum erubeseens, Adiantum incisum, Bistorta* spp. *Polygonum amplexicaulis, Vitisvinifera, Viscum album, Viola* spp.	Slopes and mountains and dense ground vegetation	34°63.961 N 73°43.365 E	2980
17	Pir Simar	*Prunnus cornuta, Juglans regia, Berbaris, Indegofera &Vibernum* spp. *Salix denticulate, Viscum album, Rhodendron hypenanthum,*	Moist temperate with strewn sloppy and Rocky	34°46.320 N 73°42.315 E	3350
18	Phaman Dana	*Prunnuscornuta, Juglansregia, Berbaris, Indegofera and Vibernum* spp. *Bistorta* spp., *Rumexnepalensis.*	Thick forest	34°52.473 N 73°48.360 E	2740

19	Pathyali	*Prunnus cornuta, Juglans regia, Viburnum erubeseens, Indegofera & Vibernum* spp., *Polygonum amplexicaulis.*	Dense vegetation with no forest	34°18.793 N 73°41.083 E	2850
20	Ali-Koh	*Abies pindrow, Pinus wallichiana, Juniperus communis, Indigofera heterantha, Vitis vinifera.*	Sloppy and rocky	34°24.822 N 73°41.283 E	2460

METHODOLOGIES

Population Estimation and Distribution

To assess population status and distribution of common leopard, line transect method, Pugmark tracing technique and questioner survey were used. To avoid any sort of biasness, random transects were laid in each locality in such a manner that it covers every type of land use and habitat.

Soft terrain, such as areas near water and muddy spots, were carefully inspected for footprints to confirm the presence of the species (Mooty and Karns 1984; Kabir, 2013). The coordinates of pug marks, scats, and scratches were recorded using Global Positioning Systems (ETREX E 20). The sizes of the pugmarks (heel pad length, whole length, and width) were documented at each site where these marks were discovered. Additionally, preliminary information regarding the distribution of the common leopard was obtained through informal discussions with local residents and herders. These discussions provided insight into the species' distribution and population size in the study area (Jackson, 1989; Jackson, 1996; Kabir, 2013).

Human -Leopard Conflict

To account the human and common leopard conflict initial information were collected from the head of the family mainly those having livestock or involved with livestock previously. Monthly based 13 surveys were conducted from March to November in 2017, each locality of the study area. Due to harsh condition and high snow fall surveys could not be conducted in December to start of February 2017. A structured self-administered questionnaire survey was used (Punch, 2006) to gather information on human-leopard conflict following Gurung (2008) (Annex-I). Surveys were carried out in the study localities with the help of field staff of the Wildlife and Fisheries Department, GoAJ&K, local herders and hunters. Altitude and coordinates (including transect measurements) were recorded by using GPS device (Garmin, Etrex 30x). Indirect evidences such as scats, pug marks, and hair etc. were also noted to estimate population size of common leopard in LFR.

While scheming the transects, the resource map of the area was consulted provided by Azad Kashmir Forest Department. A total of twenty different localities were selected in study area, multiple visits were carried out in each locality in different time and season in 2016 -17. Overall twenty transect were planned based on different habitats in the study area covering total area of 4.98 km^2. Transect length varied from shortest 0.5 km to longest 2 km with an average length of 1.175 km.

Sixty meters on both sides of the transect was also observed for signs of the leopard (Annex II).

RESULTS

The study was carried out in the LFR of district Muzaffarabad Azad Kashmir Pakistan. A total of twenty transect were laid down, majority (n=11; 55%) transects did not account for any signs of the leopard where as a total of 22 signs were recording in remaining 9 (45%) transects. The scrapes were most abundantly documented with 10 (47%) followed by pugmarks 7 (33%) and scats 5 (22%) (Annex II).

RESPONDENT'S INFORMATION

A total of 187 person was interviewed in the study area majority are males (n=162; 86.63%) as compared to females (n=25; 13.36%). Out of total respondents Most (n=120; 67.17%) of the people were farmers (n=62; 51.66), labor (n=38, 31.7%) and nomads (n=20, 16.6%) maximum (n=80, 66.66%) were illiterate, least (n=40, 33.33%) under metric and others include private job holders (n=27; 14.43%), government employees (n=24; 12.83%) and shopkeepers (n=16; 8.55%) and. All of them are resident to study area.

INDIRECT SIGNS AND EVIDENCES COLLECTION FOR POPULATION ESTIMATION AND DISTRIBUTION.

Out of 20 localities only 9 (45%) localities accounted sings while other 11 (55%) localities there were no sign found. Out of total 22 sings, 10 scrapes (45.45%), followed by 07 (31%) pugmarks, and 05 (22.72%) scats were noted (Figure 2).

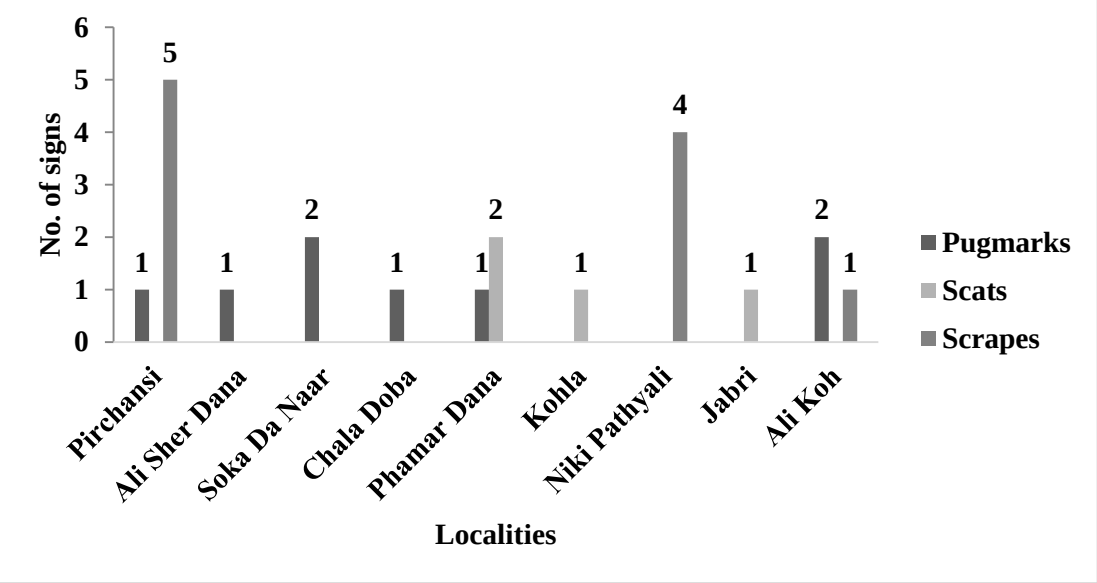

Figure 2: Sign number in each locality in study area during 2016-17.

Highest density overall (sing/km) was noted on scarps (0.42) followed by pug marks (0.298) and scats (0.212) respectively (Figure 3).

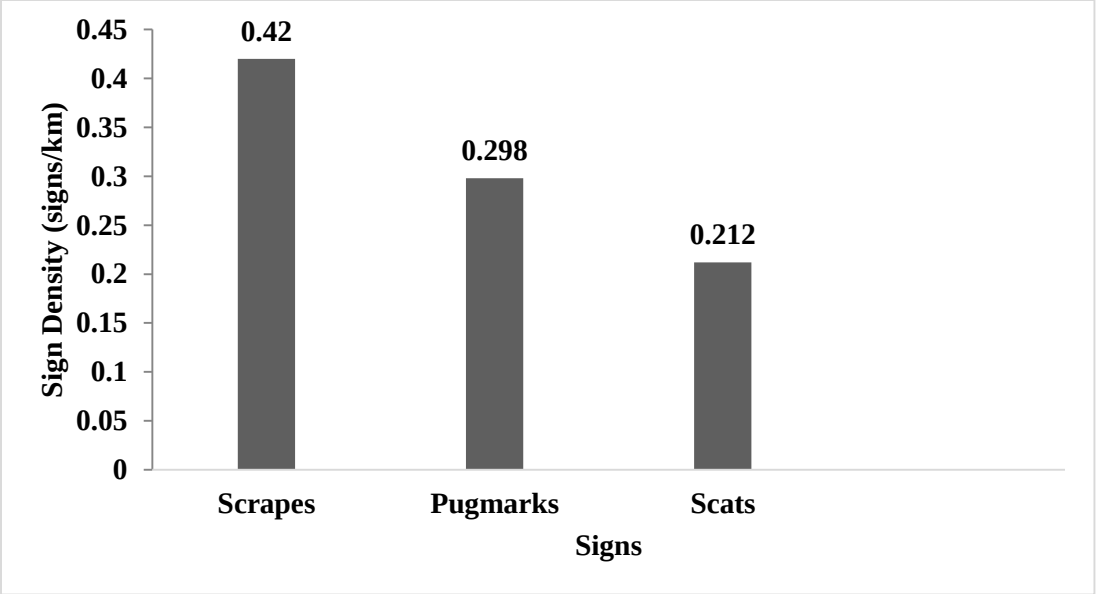

Figure 3: Overall density of signs in study area during 2016-2017.

During survey in study area coordinates and elevation of each sign was noted using GPS device (Annex I). Physically dimensions of pugmarks (Heel pad length, greatest length, greatest width) were noted and photograph of each pugmark was taken in each site where the marks were detected. This gives assessment about the number of individuals that exist in the study site only (Figure 4, 5, 6).

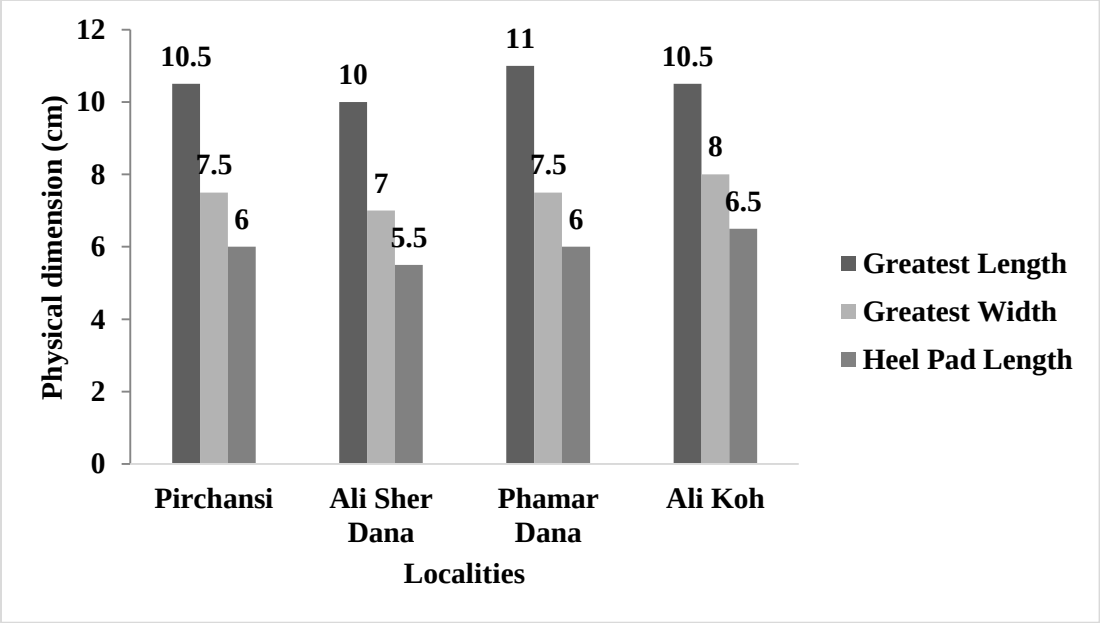

Figure 4: Physical dimensions of the front Feet recorded in study area during 2016-17.

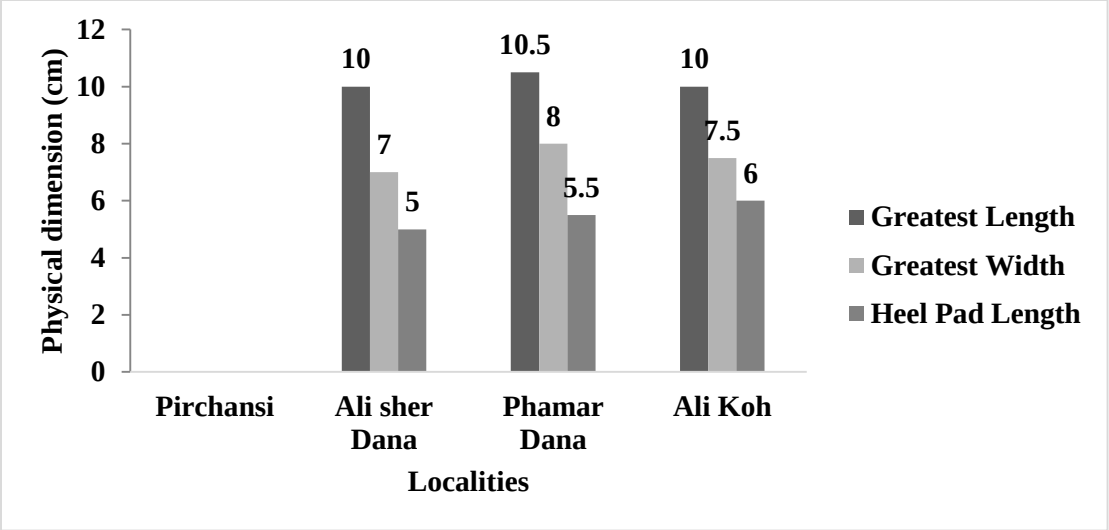

Figure 5: Physical dimensions of hind Feet recorded in study area during 2016-17.

Physically dimension of scats (greatest length and diameter) was also recorded with photographs in each transect where scats encountered (Fig. 3.6).

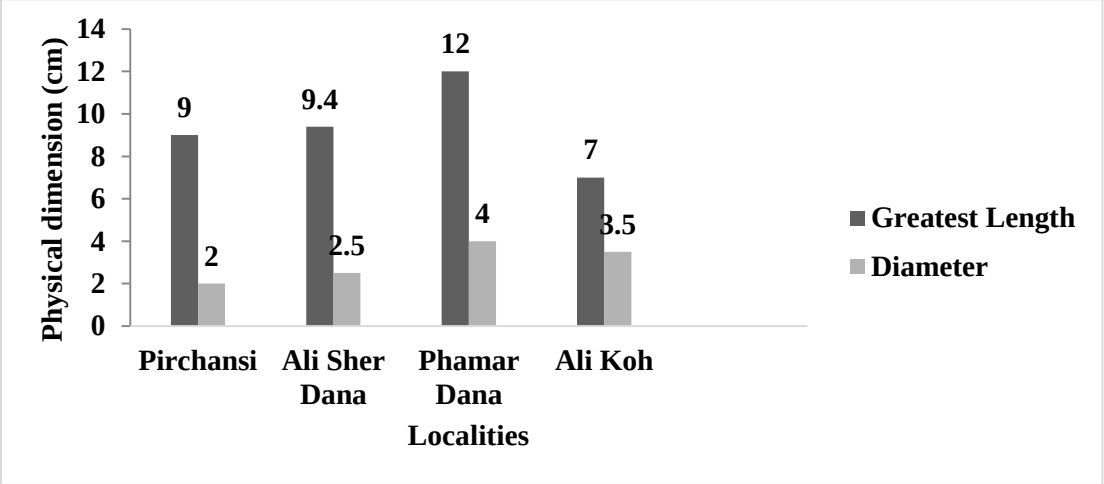

Figure 6: Physical dimensions of the Scats recorded in study area during 2016-17

SIGHTING RECORD EVIDENCE COLLECTION

Initial information about leopard existence got from native and familiar head of family that live nearby forest. Often leopard had been noticed by local peoples in the study area (Annex I).

The topographical coordinates of noticing places were noted. In the year of 2016, leopards were sighted at 9 different locations and throughout 2016-17 at 29 places. leopard records were higher (n=4; 44.44%) in the months of July followed by May (n=3; 33.33%), while least (n=2; 22.22%) sightings were recorded in June. while in 2017, leopard was seen at 20 different location, noticing was maximum in the months of June (n=9, 45%), May (n=4; 20%), April (n=3, 15%) and January while minimum (n=1; 5%) was recorded in October as compared to the rest of the year. The

sighting of leopard was higher in villages than the sighting in the forest area. Out of total 35% sightings were recorded near the water sources (Figure 7).

Figure 7: Sighting record of Leopard during different months of 2016-2017 in the study area.

In response of a question related with noticing of leopard in study area a total of 27 (14.43%) respondents see the leopard during study period, however majority (n=152; 81.28%) people did not seen leopard in their surroundings during study period, out of total respondent 8 (4.27%) did not response the question (Figure 8).

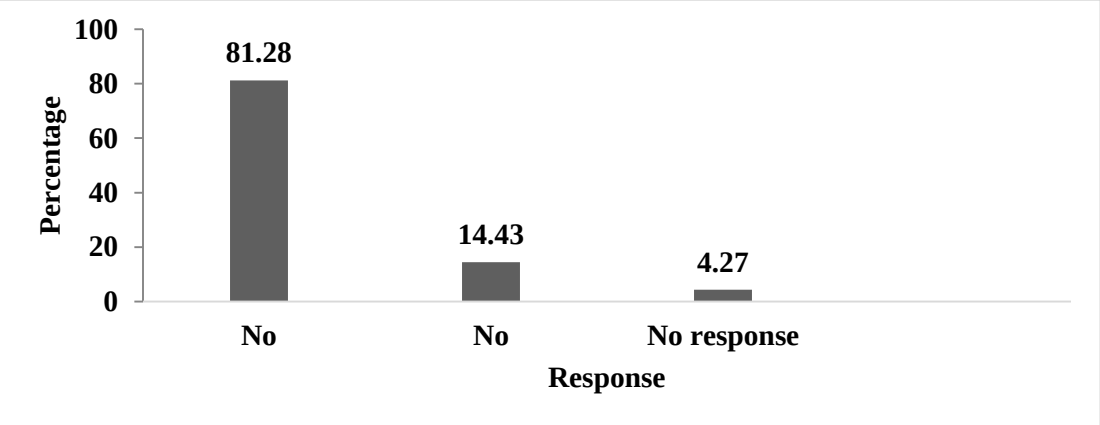

Figure 8: Sightings of common leopard reported by local inhabitants in study area during 2016-17.

Many people claimed to saw the leopard especially who lived near the potential habitat of Common Leopard at Pirchansi, Khether, Dana, Pathyali, Ali koh and keraan.

Maximum sighting was noted in Phamar da Dana locality (n=9; 31%) followed by Pirchansi (n=7, 24%), Mohri (n=6, 20%), Sheeron (n=4, 13%) and Ali Koh (n=2, 6%), while minimum (n=1, 3.44%) sighting was recorded in Ganya locality (Figure 9, 10).

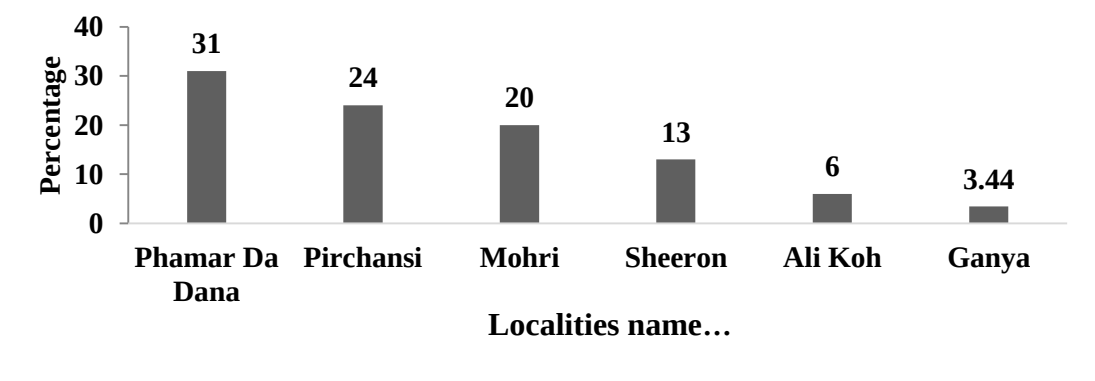

Figure 9: Sighting of Leopard in different localities in study area during 2016-17.

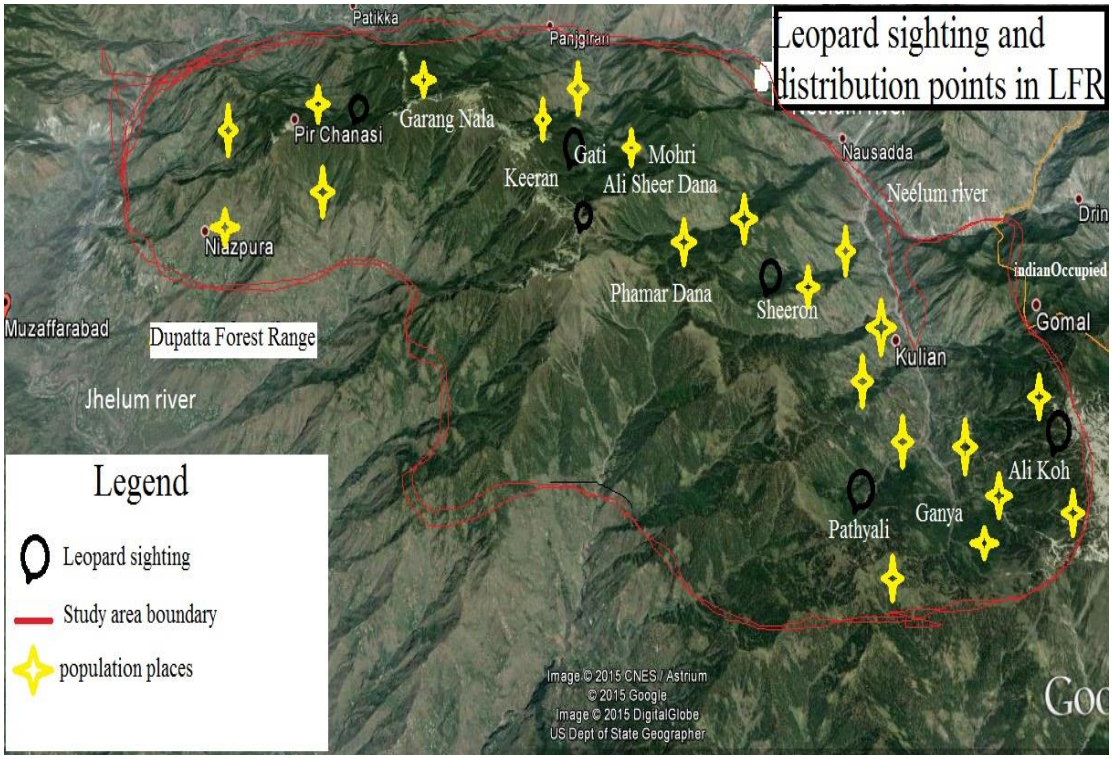

Figure 10: Map of Sighting and distribution of common leopard in the study area during 2016-17.

Out of total sightings, 48.27 % (n=14) were noted in morning, as compared to evening (n=7, 24.13%) and day time (n=5, 17.24%) while least 10.34%(n=3) sightings were recorded night time (Figure 11).

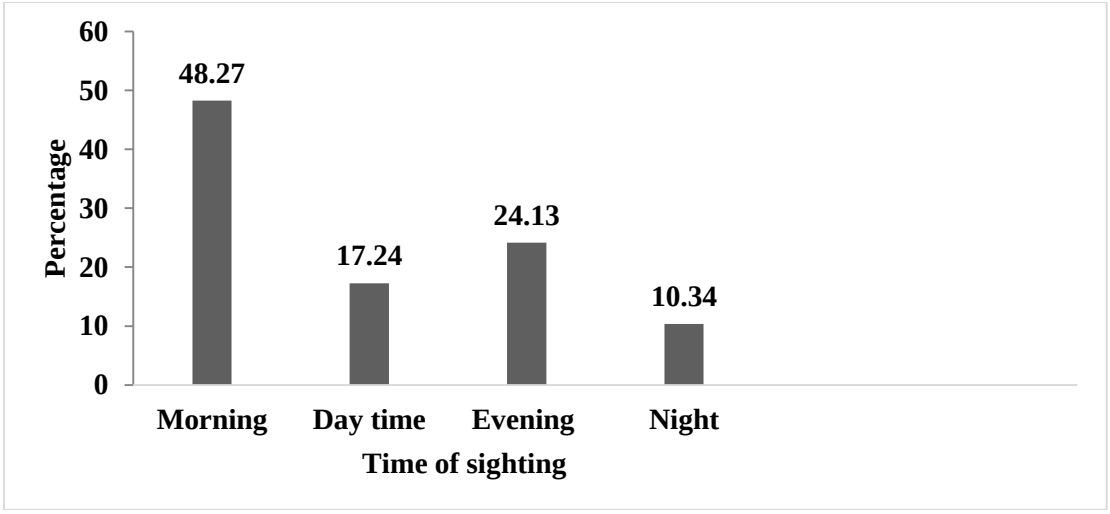

Figure 11: Time of sighting Common Leopard in study area during 2016-2017.

In reply of another question related to the killing of leopard, maximum 91.97% (n=172) respondents said that they did not kill any leopard and least (n=5, 2.67) respondents admitted that they have killed leopard during study period while

5.34% (n=10) people did not respond this question (Figure 12). Overall 3 leopards were killed by local people during study period, two leopards were killed separately while one leopard was killed through joint venture.

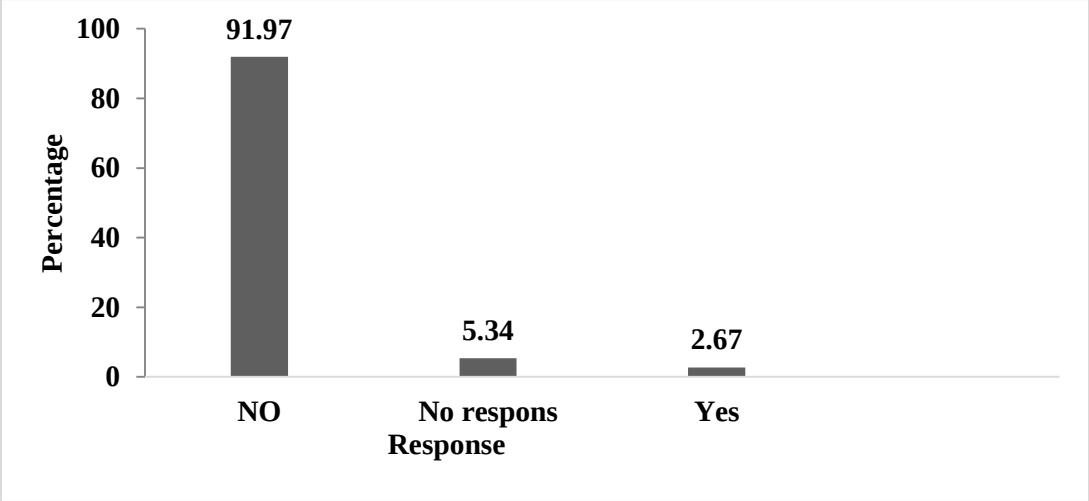

Figure 12: Responses of the people on whether they killed a leopard or not in study area during 2016-17.

POPULATION CENSUS

Through minute examination pugmarks of the specific leopards can be distinguished from others, even when the wide outline of different pugmarks looks similar. Different localities showed different pug marks pattern. In Pirchansi pug marks greatest length of front track measured 10.5 (cm) and greatest width 7.5 (cm) with 6 cm heal pad, the heal pad was overall circular. while hind tracks were absent due to grassy plains. Scats shows greatest length of (9cm) with diameter of 2 (cm). All sings found in Pirchansi and nearby showed close resemblance. Sighting and indirect evidence results support that there would be one male leopard in Pirchansi locality.

At Ali Sher Dana estimated population is at least one female it is due to sighting record and we got greatest length of front tracks were approaches 10 (cm) with greatest width of 7 (cm) while hind tracks recorded with greatest length of 9.5 cm and width 7 (cm) heal pad was measured as 5 (cm). length of scats was measured up to 8 cm with diameter of 2.5 cm. so we concluded that there is one female leopard is present in the Ali sher Dana. In Phamar Dana enough indirect evidences were found most of evidences were different from each other, greatest length of front and hind track was recorded 11 cm and 10.5 cm with greatest width of 8 and 7.5 cm. heal pad showed size variations from 5.5 to 6 cm. scats also showed size variations greatest length reaching from 10 t0 12 cm with greatest diameter of 4 cm. from indirect evidences and sighting records it would be concluded that there are two individual leopard are present in Phamar dana and periphery because sighting of two different leopard with different body size small and large was also reported in periphery of the locality by local people during study period.

Direct sighting of leopard was reported by survey team in Ali koh and other evidences which are different from other localities indicate that at least one male leopard is present in Ali koh.

Some localities overlap each other, individual leopard can go into periphery from its core habitat, so first of all we didn't counted the evidences of such individual which are same in nearby localities, we counted all evidences in a specific locality but omitted all the duplicated evidences to count overall population of leopard in study area. The total estimated population of leopard in the study area is the sum of all the evidences found in different localities which comes out as 5 leopards disturbed in different localities, one male leopard in Pirchansi, while at least one female leopard is present in Ali sher da Dana and periphery, in Phamar Dana estimated population is two one male and one female which is strictly confined to the locality and one male leopard is also estimated in Ali koh (Table 2).

Table 2: Indirect evidences and estimated population detail in study area during 2016-17.

Localities	Pug Marks						Scats		sex		
	Width (cm)	Heel Pad Length (cm)	Length (cm)	Width (cm)	Heel Pad Length (cm)	Length (cm)	Diameter (cm)	Male	Female	Estimated population
Pirchansi	10.5	7.5	6	-	-	-	9	2	1		1
Ali sher Da Dana	10	7	5.5	1 0	7	5	8	2.5		1	1
Phamar Dana	11	7.5	6	10.5	8	5.5	1 2	4	1	1	2
Ali Koh	10.5	8	6.5	1 0	7.5	6	7	3.5	1		1
			Total						4	1	5

HUMAN COMMON LEOPARD CONFLICT ASSESMENT

Questioner survey provide enough data for calculation intensity of human-leopard conflict in the study area. Feedback to a question about the percentage of human-leopard conflict in study area, maximum (n=103, 55%) said that there is high conflict (60%) followed by moderate conflict (30%) intensity (n=60, 32%) and 9% (n=17) were of the view that there is no such conflict, while 3.47% (n=7) did not respond to question (Figure 13).

Figure 13: Response of local people about intensity of human-leopard conflict in study area during 2016-17.

It was important for us to investigate whether any organization or government is interested in solving the problems of livestock depredation in study area, in response of this question maximum respondents (n=172, 92%) said no one is interested to help us and minimum (n=11, 5.88%) said yes government is interested while 2.13% (n=4) did not respond (Figure 14).

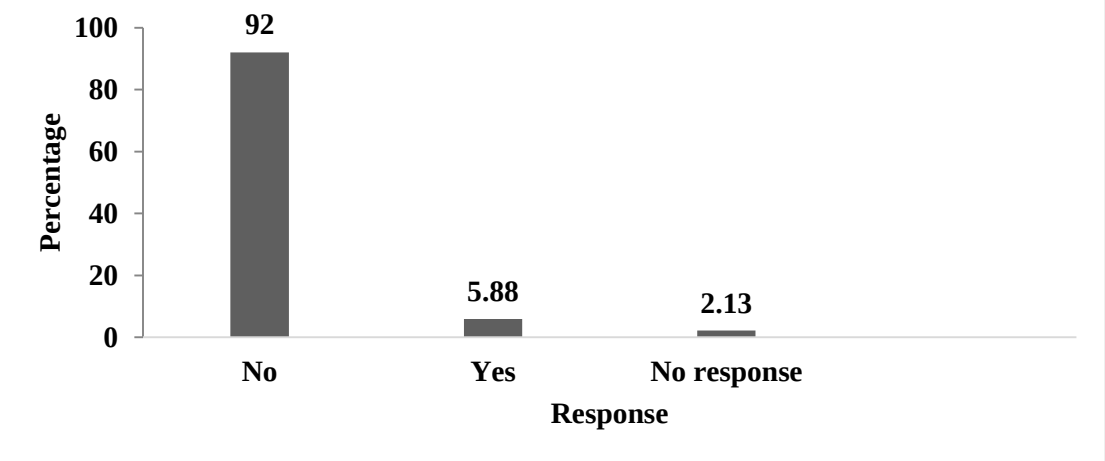

Figure 14: Response of local people about government and organizations in study area during 2016-17.

A question was asked to investigate whether the body parts of the leopard are used in local medicine, maximum (n=105, 56.14%) said there is no such medical importance of leopard body part. Out of total respondents 32% (n=60) answered that the fat of the leopard has got an outstanding medicinal potential, while 9% (n=17) don't know about the importance of body parts a total of 2.7% (n=5) show no response. (Figure 15).

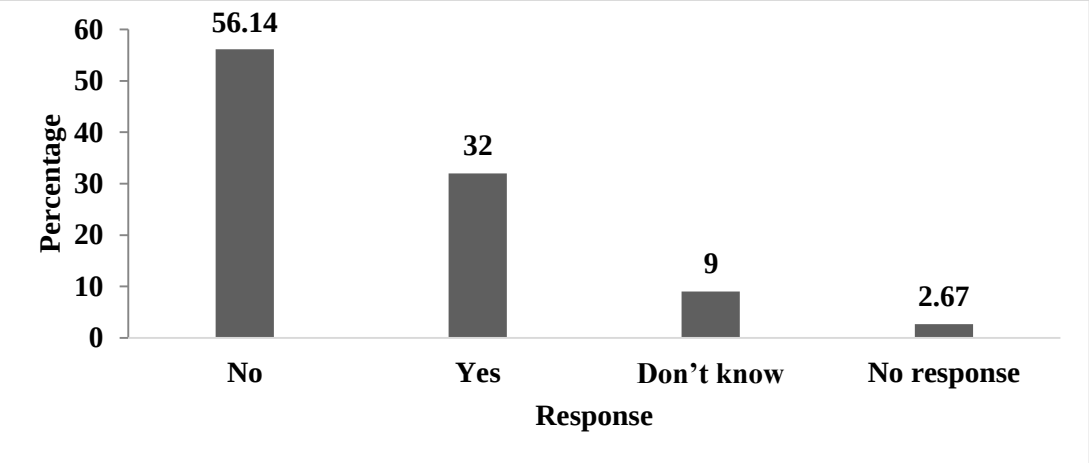

Figure 15: response of people about leopard's body parts being used as medicine in study area during 2016-17.

Feedback to a question on anti-predation strategy, maximum (n=92, 49.19%) respondents have not adopted any preventive measures. 19.87% (n=37) hhs used to burn the fire in the forest, A total of 17.11% (n=32) respondents kept watch dogs. 6.4% (n=12) hhs use marriage bomb blast, 4.27% (n=8) said that the leopard should be trapped and killed by gun fire to stop the depredation, 3.2% (n=6) hhs threatens the leopard by beating drums, while 1.34% hhs do not know any specific strategy against livestock depredation by the leopards. This shows that maximum (49.19%) people of the area have not yet adopted any preventive measures against the livestock depredation (Figure 16).

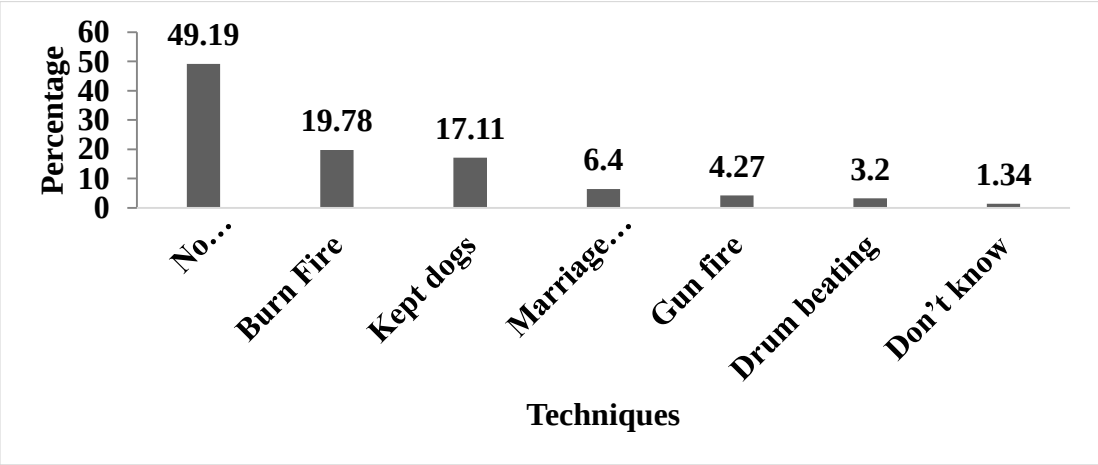

Figure 16: Preventive measures adopted by people against the leopard in study area during 2016-17.

In answer of question related to killing of livestock in the area maximum respondents (n= 98, 52.40%) hhs had no incidents of their livestock being killed or injured by the leopard. 24% (n=45) claim about killing of their livestock and 17.64%

(n=33) claims about injury of their livestock while 5.88% (n=11) did not response (Figure 17).

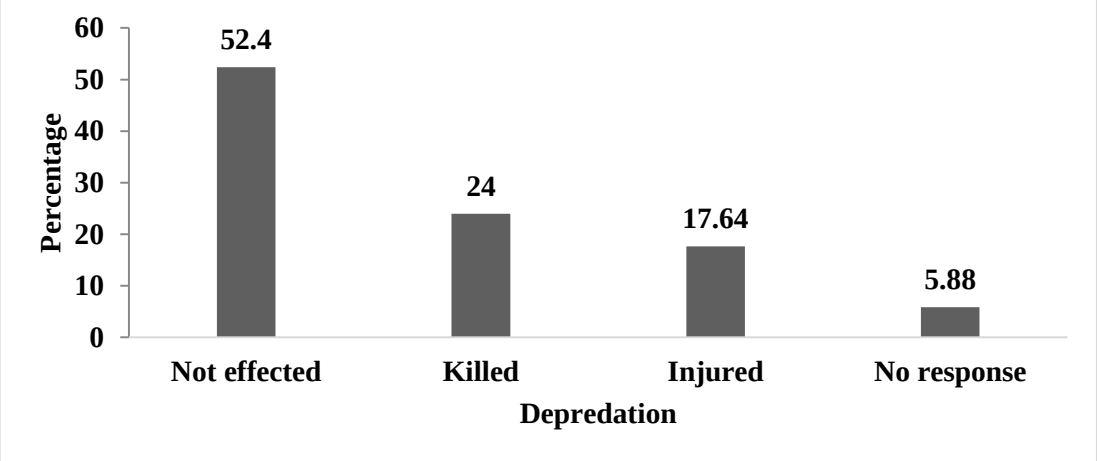

Figure 17: Numbers of Hhs whose cattle are injured/killed by the leopard in study area during 2016-17.

Data showed livestock type preference for depredation maximum depredation was noted on goats (n=36, 49.31) followed by sheep (n=24, 32.87%), oxen (n=4, 47%), dogs, (n= 4,5.47%) cows (n=2, 2.73%) and donkey (n=2, 2.73%) respectively. While minimum depredation was noted on equine (n=1, 1.36%). No depredation was noted on buffalos. (Figure 18).

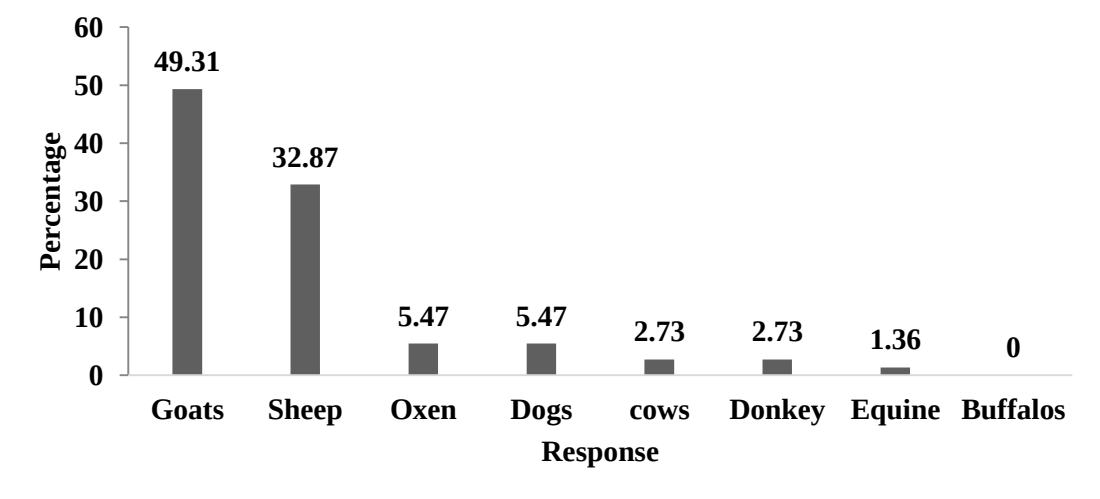

Figure 18: Showing livestock preference in study area during 2106-17.

Attacking sites of leopard varied according to type of livestock. Maximum attack (n=38, 52%) were reported in the forest followed by pastures land (n=22, 30.13%), in village (n=6, 8.21%) and 6.84% (n=5) in open pen, while minimum (n=2, 2.73%) attack was recorded in closed pen (Figure 19).

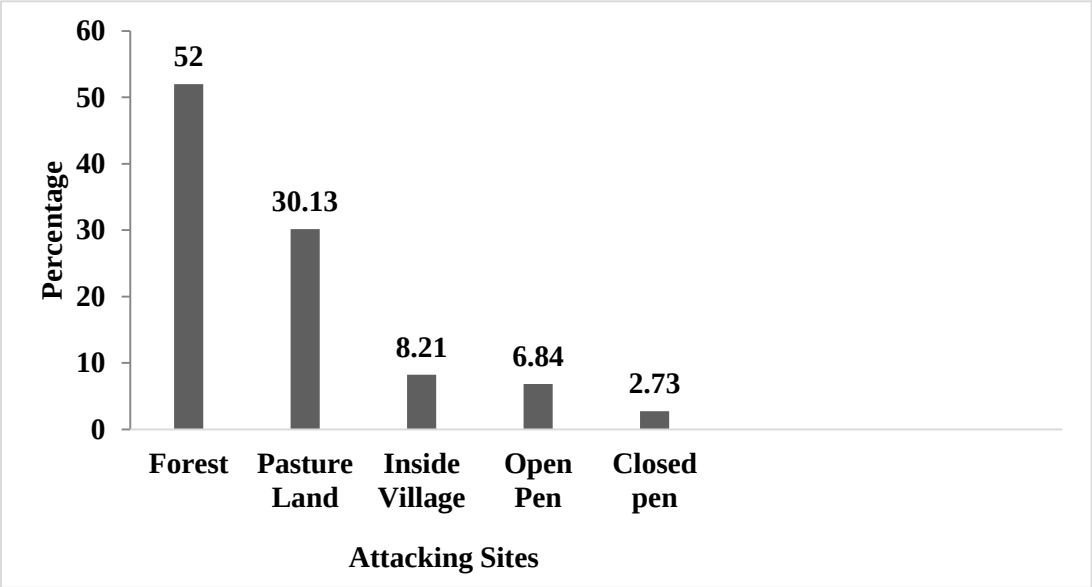

Figure 19: Attacking sites of leopard in study area during 2016-17.

Seasonal variation in the pattern of livestock attack was noted, highest (n=33, 45.20%) attack was noted in summer followed by spring, (n=20 ,27.39%) and autumn (n=12, 16.43%) while minimum (n=8, 10.95%) depredations noted in winter season (Figure 20).

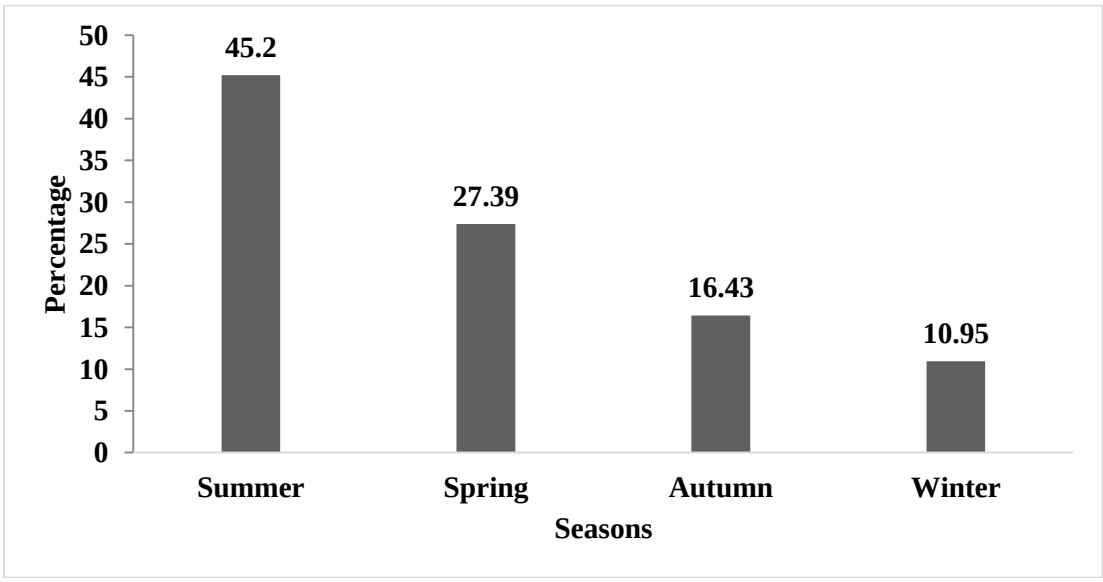

Figure 20: Comparison of different seasonal livestock depredation in study area during 2016-17.

Being a nocturnal predator mainly, maximum (n= 45,61.64%) attacks were recorded at night as compared to day (n=28, 38.35%) time (Figure 21).

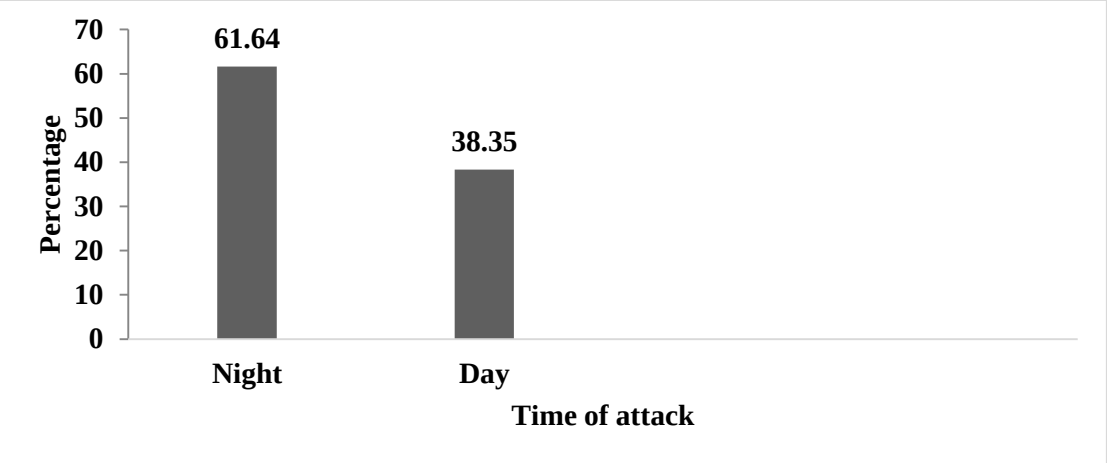

Figure 21: Comparison of livestock depredation in different times in study area during 2016-17.

Overall livestock depredations in the study periods lead to an economic loss worth of 0.806 million PKR to the local people. (PKR= 0.288m) of this loss resulted on the depredation on goats followed by sheep (PKR= 0.0.156m), oxen (PKR= 0.1520m), cows (PKR=0.0.084), equine (PKR=0.06m) and donkey (PKR=0.046m) while minimum (PKR= 0.02m) loss was happened due to the depredations on domestic dogs (Figure 22).

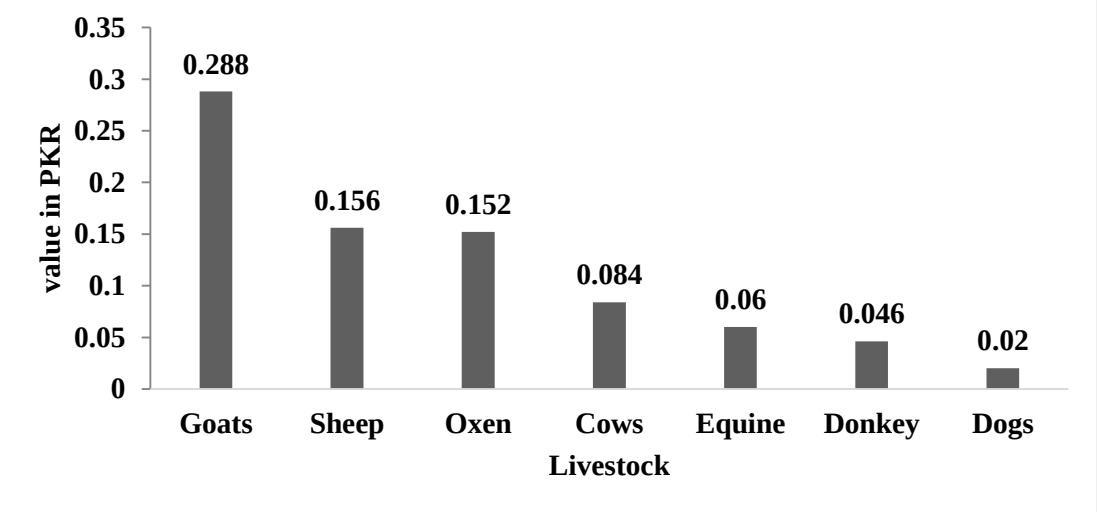

Figure 22: Economic loss due to leopard depredation in different villages of the study area during 2016-2017.

Leopard conservation is not supported as maximum (n=128, 68.44%) people replied that the conservation of the leopard not need due to livestock depredation. A total of 13.36% (n=25) people said that conservation of leopard required to promote ecotourism in the area and biodiversity conservation (n=8, 4.27%). Least 2.67% (n=5) respondents thought its conservation is necessary to maintain balance in ecosystem. however, 8.5% (n=16) people do not know the benefits of leopard conservation and 2.67% (n=5) of respondents did not respond the question (Figure 23).

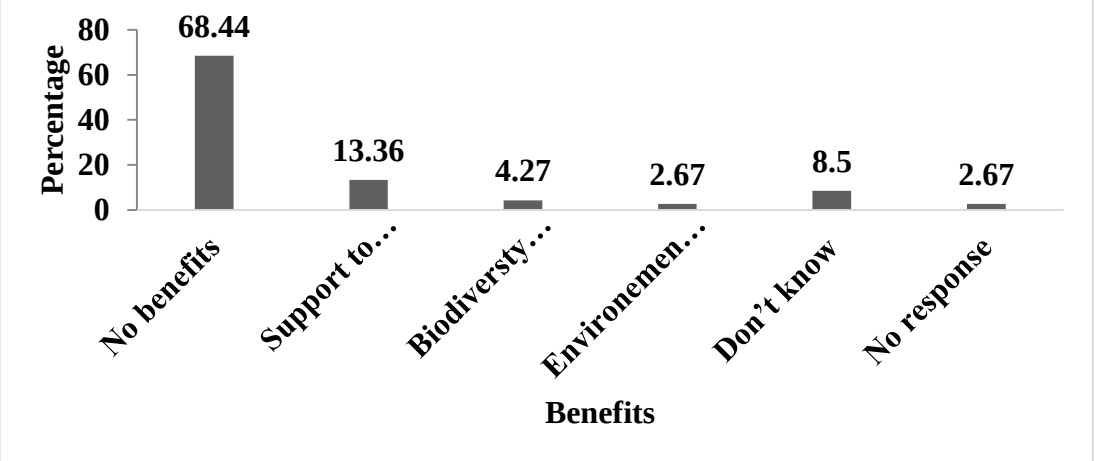

Figure 23: Response of people about Benefits to conserve leopard in study area during 2016-17.

DISCUSSION

POPULATION CENSUS

To know about animal, species richness (or abundance, population size) and density are constraining of critical importance to studies that how animals adapts to their environments as well as to studies that try to discuss protection issues upsetting these species. (Termizi and Rafique, 2001). Big cats are usually well-thought-out to be among animals that are endangered most by human influences. for understanding structure and activity of any natural population estimation and distribution is a primary step.

Indirect evidences such as Pugmarks dimensions are best source for estimating sizes of small populations of big Cats (Gusset, 2005, Sharma, 2003). So, we conclude that our leopard count is precise and consistent. For recognition of individual leopard Track length has showed itself as much more reliable character (Kabir, 2013, Sharma, 2005, Riordan, 1998, Grigione, 1999).

The gathering of information was started continuously on scheduled basis by means of transects that covered the complete forest range. Path measurements for estimation of leopard population and distribution range, data collection was led scientifically and dimensions were gained from paths on comparable slant and substrate conditions to reduce the associated errors. questioner survey and 20 transects were conducted which gave sufficient evidences for population census and distribution of leopard in the area such as direct sighting, pugmarks, scrapes, and scats. Out of 20 transect in 9 transects signs of leopards were encountered, though It is not possible to estimate an accurate number of leopard in any area. Throughout observation of sings and sighting record indicates that leopard density in LFR is remarkably high. The density of signs noted was 1.05 signs per transect. The highest density was recorded in transect 1 and 20 with density of 5 and 4 respectively. The density of scrape was the highest with 0.42 signs/km. The overall density of pugmarks, scats and scrapes came out to be 0.298, 0.212 and 0.42 per km respectively in 20 transect.

The encountered pug's marks in study area have overall circular shape with greatest length 11 (cm) and 7.5 width of front track, 10.5 (cm) hind track with 8 (cm) width while heel pad measure 6.5 (cm). Early study of Kabir 2013, Henschel and Ray, (2003) also recorded that Pugmarks have an overall round shape. An adult leopard could have a pugmark that approaches 7 cm in girth and 11.5 cm in length, with the main pad at 4-7.5 cm.

Greatest length of scats recorded in study area 7-12 (cm) with diameter of 2-4 (cm) which support the early study made by Kabir, (2013) in MNP. The leopard scats are elongated with one end often pointed, normally in numerous pieces each ranging from 6 – 13 (cm) in length and 2.5- 4 (cm) in diameter. Scats are hard to identify unless they found in close association with leopard tracks. (Henschel and Ray, 2003; Nowell, 1999).

In 2016 Leopard noticing was higher in the months of July 44.44% (n=4), May 33.33% (n=3), and June 22.22% (n=2). While in 2017, leopard noticing was maximum in the months of January June 45%(n=9), May 20% (n=4), April 15% (n=3), January 15% (n=3) and October 5%(1) (Fig. 3.14). The sum of sighting was higher nearby villages than the sighting in the forest area. Out of total sightings encounters, 48.27% (n=14) noted in morning, 24.13% (n=7) at the evening 17.24% (n=5) in the day time and 10.34% (n=3) in the night time (Fig. 3.17). Present study supports the previous study made by Kabir *et al* (2010) that also indicate the same type of leopard behavior in MNP.

Two techniques were used to estimate the population size of leopard in study area i.e. pugmarks survey and walk and count method. Based on data, it could be concluded that 04-05 leopards are present in study area occupying an area of 30000 acre. As a new initiative, this study gives initial data on population status and distribution of leopard in LFR. The leopard has an important job in environmental balance being a top predator. So, healthy and dynamic population density of the leopard might be used as sign for protection and management of the other species in the area.

DISTRIBUTION

The persons who lived near the core habitat of Common Leopard at Phamar Dana, Pirchansi locality mostly saw the leopard. Sighting of leopard has been increased may fold in villages as compared with past. One factor for this type of leopard behavior may be due to reasons that its victim species population has decreased in its core habitat that force leopard to visit villages. Other factor may be results of higher level of increasing human population and habitat degradation of leopards that compelled leopard to come down in lower altitude for search of food to fill full leopard appetite.

The leopard habitat is being used frequently and constantly by the resident for their fuel and feedstuff collection. It is obviously evident from the sighting record that, leopard's population in and around the LFR peripheries is arbitrarily dispersed, based on the sighting and indirect record it is concluded that in LFR leopard are distributed in different localities mainly Pirchansi, Ali sher Dana, Phamar Dana and Ali koh. These localities showed a good habitat for leopard occupancy.

CONFLICT ASSESMENT

Lachhrat Range Forest consists upon a variety of altitudes, slopes and aspects of mountains which would be supportive to high diversity of species. Human settlements in LFR harboring agro-pastoral economy and hence are more at the mercy of on natural properties for their survival. Such dependence result in exploitation of natural resources (Wang and Macdonald, 2006; Sangay and Vernes, 2008). Leopard was found to be responsible for 94.1% of livestock loss in MNP (Dar, 2009).

Throughout the study 73 livestock were killed by common leopard during the study period. maximum depredation was recorded on goats (n=36; 49.31%) followed by sheep (n=24; 32.87%) oxen, cows (n=4; 5.47%), dogs (n=4; 5.43%) and donkey (n=2; 2.73%), while least depredation was noted on equine (n=1; 1.36%). Results of Present study support the past study made by Ayaz (2005), Zaman (2010), and Dar (2009). Their study results also showed maximum depredation on goats followed by sheep in (MNP). This could be due to two main reasons that resemblance of *caprine* with goats which is a natural prey of leopard, goats often choose to browser under bushes which are common in LFR, same type of habitat leopard prefer to ambush the prey. Secondly, dragging of small animals is easy and quick to a safe place as compare with large animals such as cows, horses (Sangay and Vernes, 2008).

Seasonal variations were recorded on livestock depredation. A significant difference was noted between summer and winter months on depredation. in summer maximum depredation was recorded followed by spring, winter and autumn. A reason for this type of seasonal depredation is that local people moved to higher altitude in summer season in LFR where their livestock's keep in open pin because of non-availabilities of housings and got back to their permanent houses at the end of summer season. Presence of human resulted in disturbance of natural habitat and pushing away of natural prey of leopard hence leopard prey on their animals. Human presence resulted in pushing the natural prey species of the leopard away from their habitat hence leopard prey on their livestock. Moreover, livestock are abundant and easy target to capture as compared to wild prey. Minimum depredation was recorded in autumn the reason for minimum depredation in autumn could be due to absence of livestock at higher altitude because people left at the end of summer and moved back with their livestock to lower altitude so leopard natural prey returns to their natural habitat while in winter weather becomes harsh and snow fall start at higher altitude which compelled leopards to move near human settlements that again resulted in depredation of livestock. Same type of depredation pattern was recorded by Dar, (2009) and Kabir, 2013 in MNP.

Early study by Zaman (2010) and Dar, (2009) reported maximin depredation at night time as compared with day present study also record same type of depredation maximum depredation was noted at night as compared to day time. It is mainly due to the nocturnal habit of the leopard. Secondly it could be due to in night time and mostly in summer and spring seasons, watch and ward conditions are very poor. In study area People typically rest upon watch dogs during night. This is an open chance for leopard to attack livestock as dogs can often be useless in preventing leopard attacks during night (Kolowski and Holekamp, 2006).

High economic loss was recorded due to leopard in different villages of LFR. Loss was predicted based on market price of killed animals. Results exposed that

maximum loss PKR= 0.288m (35%) was of goats followed by sheep PKR= 0.156m (19.35%), oxen PKR= 0.0.152m (18.85%), cows PKR=0.084, (10.42%) equine PKR= 0.06m (7.44%), donkey and PKR=0.046 (5.70%) while minimum loss was recorded on dogs (PKR= 0.02m). almost same livestock depredation was documented by Chatha, 2013 (goat 2.08 (50.50%), sheep 1.17 (28.53%), cow/ox 0.23 (5.63%), buffalo 0.10 (2.58%) horse/donkey 0.07 (1.75%), dog 0.19 (4.80%) and chicken 0.25 (6.18%).) in MNP. According to Dar, (2009), Kabir (2013) human leopard conflict was found to be an acute problem in MNP.

CONCLUSION

The outcomes of transect and hence reflection of other signs sightseeing accounts exposed a healthy population of the leopards in the range. Invasion and low density of wild prey, amount of the livestock destruction is growing which is a basic cause of killing of leopard. So, natural prey species must be well-maintained stopping their poaching, habitation damage and human influence is at peak in main area. Overgrazing effect in war with wild ungulate that are major prey of leopard. The removal of livestock from leopard habitat also increases the volume of good browsing offered for wild prey specie. There should be rotating foraging in the area. Poor steering performs, unsafe encloses secret shelters are among the major contributing aspects for the livestock victims.

REFERENCES

Ahmad, A. 1994. Protection of snow leopards through grazier communities. Some example from WWF Pakistan s project in Northern Areas. In: Proc. Seventh International Snow Leopard Symposium Fox J. L. and Du Jizeng (eds.), p. 265-272. International snow leopard trust, Seattle, Washington, USA.

Al-Johany, A.M.H. Distribution and conservation of the Arabian Leopard (Panthera pardus nimr) in Saudi Arabia, Journal of Arid Environment, 68, 2007, pp. 20-30.

Aryal, R.S. 2003: Leopard in crisis, an article published in The Kathmandu Post, 8th January. Bailey, T.N. 1993. The African leopard: a study of the ecology and behavior of a solitary felid, Columbia Univ. Press, New York.

Athreya V. 2006. Is relocation a viable management option for unwanted animals– the case of the leopard in India. Conservation and Society 4, 419-423.

Athreya V. and A.V. Belsare 2007. Human-leopard conflict management guidelines. Kaati Trust, Pune, India.

Ayaz, M. 2005. Management Plan of Machiara National park, Protected Areas Management Project, Department of Wildlife Fisheries Azad Jammu and Kashmir. pp 138.

Bagchi, S. and C. Mishra. 2006. Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*). Journal of Zoology 268:217–224.

Baldus, R. D. 2004. Lion Conservation in Tanzania Leads to Serious Human-Lion Conflicts with a Case Study of a Man-eating Lion Killing 35 People. *Tanzania Wildlife Discussion Paper*, 41: 1-63.

Balme G.A., L . Hunter, P . Goodman, H . Ferguson, J . Craigie, R . Slotow. 2010. An adaptive management approach to trophy hunting of leopards *Panthera pardus*: a case study from KwaZulu-Natal, South Africa. In: Biology and conservation of wild felids. Oxford University Press, Oxford, pp 341–352.

Bhatia, S., V . Athreya, R . Grenyer and W . Macdonald. 2013. Understanding the Role of Representations of Human–Leopard Conflict in Mumbai through Media-Content Analysis. Conservation Biology, Volume 00, No. 0, 1–7 C 2013 Society for Conservation Biology DOI: 10.1111/cobi.12037.

Bhatnagar, P. S. 2012 b. Some aspects of Felinehuman conflict in India. J. Environ. & Sociobiol. 9(2): 115-119.

Brakefield, T. 1993. Big Cats: Kingdom of Might. Voyageur Press: Stillwater, Minnesota. CoP13 Inf. 47, 2004: UK Cites Management Authority, a letter to all the delegates and observers.

Chattha, S. A., I. Shazia and R. Zara. 2013. Human-leopard conflict in Machiara National Park (MNP), Azad Jamu and Kashmir (AJ and K), Pakistan. J. Glob. Innov. Agric. Soc. Sci., 2013, 1(1): 17-21.

Constant, N. L., Z. Bell and R. Hill. 2015. The impacts, characterisation and management of human–leopard conflict in a multi-use land system in South Africa. Biodivers Conserv (2015) 24:2967–2989.

Daniel, J.C. 1996. The leopard in India - A natural history. Natraj Publishers, Dehradun. DNPWC. 1973: Department of National Parks and Wildlife Conservation Act.

Dar, N.I., R. Minhas, Z. Qamar and Z. Linkie. 2009. Predicting the patterns, perceptions and causes of human–carnivore conflict in and around Machiara National Park, Pakistan. Biological Conservation, 142, , pp. 2076-2082.

Dar, N.I., R. Minhas, Q. Zaman and M . Linkie. 2009. Predicting the patterns, perceptions and causes of human–carnivore conflict in and around Machiara National Park, Pakistan. Biol. Conserv. (2009), doi:10.1016/j. biocon. 2009.04.003.

Dickman, A. J. 2008. Key determinants of conflict between people and wildlife, particularly large carnivores, around Ruaha National Park, Tanzania. London: University College London.

Gehrt, S. D., J. Brown and C. Anchor. 2011. Is the urban coyote a misanthropic synanthrope? The case from Chicago. Cites and Environment 4:1–23.

Gehrt, S. D., S. Riley and B. Cypher. 2010. Urban carnivores: ecology, conflict and management. JHU Press, Baltimore, Maryland.

Gittleman, J. L., S . Funk, D. Macdonald and R . Wayne. 2001. Why 'carnivore conservation'? In *Carnivore conservation*: 1–8. Gittleman, J. L., Funk, S. M., Macdonald, D. and Wayne, R. K. (Eds). Cambridge: Cambridge University Press.

GoAJK, 2015. Working and management plan AJK forest Department Muzaffarabad.

Gore, M., and B. Knuth. 2009. Mass media effect on the operating environment of a wildlife-related risk-communication campaign. Journal of Wildlife Management 73:1407–1413.

Gore, M.L., W. Siemer, J. Shanahan, D. Scheufele and D. Decker. 2005. Effects on risk perception of media coverage of a black bear related human fatality. Wildlife Society Bulletin 33:507–516.

Graham, K., A. Beckerman and S. Thirgood. 2005. Human-predator-prey conficts: ecological correlates, prey losses and patterns of management. *Biol. Conser*., 122 (2): 159-171.

Grassman Jr., L.I. 1999. Ecology and Behavior of the Indo-Chinese leopard in Kaeng Krachan National Park, Thailand, Natural History Bulletin Siam Society. 47: 77-93.

Grigione, M. M . Burmanb, P. Bleich, B. Pierce.1999. Identifying individual mountain lions Felis concolor by their tracks: refinement of an innovative technique, Biological Conservation, 88: 25-32.

Gurung, B. B. 2008. Ecological and sociological aspects of human-tiger conflicts in Chitwan National Park, Nepal. Ph.D. Thesis. University of Minnesota, USA.

Gurung, L.B. 1995. An assessment of crop and livestock depredation due to wildlife in Gokarna and surrounding areas, M.Sc thesis in Zoology, Tribhuvan University, Kathmandu, Nepal.

Gusset, M. and N. Burgener, N.2005. Estimating larger carnivore numbers from track counts and measurements, African Journal of Ecology, 43:320-324.

Hamilton, P.H. 1976. The movements of leopards in Tsavo National Park, Kenya, as determined by radio-tracking. M.S. thesis, Univ. of Nairobi, Nairobi.

Hassan, S.A. 2004. Compilation of Baseline Data for Ornithological studies in Machiara National Park, AJandK, PAMP.

Hayward M.W., P. Henschel, O'Brien, M. Hofmeyr, G. Balme and G. Kerley. 2006. Prey preferences of the leopard (*Panthera pardus*). Journal of Zoology 270, 298-313.

Hayward, M.W. P. Henschel, J. Brien, M. Hofmeyr, G. Balme, G. Kerley. 2006. Prey preferences of the leopard *(Panther Pardus*), Journal of Zoology, 270: 298313.

Henschel, P. and J. Ray. 2003. Leopards in African Rainforests: Survey and Monitoring Techniques, WCS Global Carnivore Program.

Henschel. 2005. Leopard food habits in Lope National Park, Gabon, Central Africa. African journal of Ecology, 43: 21-28.

Hilty, J. A., C. Brooks, E. Heaton and A. Merenlender. 2006. Forecasting the effect of land-use change on native and non-native mammalian predator distributions. *Biodivers. Conserv*. 15: 2853–2871.

Iftikhar, N. 2006. Wildlife of Azad Jammu and Kashmir. Department of Wildlife, Azad Jammu and Kashmir. Alsheikh Press Muzaffarabad.

Iftikhar, N. A. 2006 Wildlife of Azad Kashmir (in Urdu). Al-Sheikh press Muzaffarabad AJK.

IUCN/SSC. 2005. Guidelines for using the IUCN Red List categories and criteria. Available from http://www. iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines. Jackson, R.M. 1984. The snow leopard. The plight of the cats: Proceedings of the meeting and workshop of the IUCN/SSC Cat Specialist Group at Kanha National Park, Madhya Pradesh, India, 9-12 April 1984. Unpublished Report, Pp. 197-198, IUCN/SSC Cat Specialist Group. Bougy, Switzerland.

Kabir, M., M.S. Awan, and M. Anwar. 2013. Distribution range and population status of common leopard (Panthera Pardus) in and around Machiara National Park, Azad Jammu and Kashmir. *International Journal of Conservation Science*, *4*(1).

Karanth, K. U., J. D. Nichols, N. S. Kumar, W. A. Link and J. E. Hines. 2004. Tigers and their prey: Predicting carnivore densities from prey abundance. PNAS. 101: 4854-4858.

Karanth, K. U., M. Sunquist, and K. Chinnappa. 1999. Long-term monitoring of tigers: lessons from Nagarahole. In *Riding the tiger*: tiger conservation in human-dominated landscapes: 114–122. Seidensticker, J., Christie, S. and Jackson, P. (Eds). Cambridge: Cambridge University Press.

Karanth, K.U. and M. Madhusudan. 2002. Mitigating human - wildlife conflicts in Southern Asia. *In* Making parks work: identifying key factors to implementing parks in the tropics. Terborgh J., van Schaik C.P., Rao M & Davenport L.C. (Eds) Covelo, Island Press, California, pp. 250264.

Karanth, K.U., J. Nichols, J. Seidensticker, E. Dinerstein, E., J. Smith, S. McDougal, A. Johnsingh, R. Chundawat, V. Thapar. 2003. Science deficiency in conservation practice: the monitoring of tiger populations in India, Animal Conservation, 6, 2003, pp. 1-10.

Kolowski, J. M. and K. Holekamp. 2006. Spatial, temporal and physical characteristics of livestock depredation by large carnivores along a Kenyan reserve border. *Biol. Conserv*., 128: 529–541.

Linnell, J. D. C. Andersen, T. Kvam, H. Andr´en, O. Liberg, J. Odden and P. Moa. 2001. Home range size and choice of management strategy for lynx in Scandinavia. Envi. Manage. 27: 869–879.

Löe, J.E. R. 2004. Large Carnivore and Human safty: A review. Ambio. 33: 283-288. Loveridge, A. J., Wang, S. Frank, L. and Seidensticker, J. 2010. People and wild felids: conservation of cats and management of conflicts. Pages 161–195 in D.W Macdonald and A. J. Loveridge, editors. The biology and conservation of wild felids. Oxford University Press, Oxford, United Kingdom.

Maan, M.A. and A. Chaudhry. 2000. Common leopard (*Panthera pardus*) our endangered heritage needs special conservation, Tiger paper, 27: 14–16.

Madden, F. 2004. Creating coexistence between humans and wildlife: global perspectives on local efforts to address human-wildlife conflict. Human Dimensions of Wildlife 9:247–257.

Madhusudan, M. D. and C. Mishra. 2003. Why big, fierce animals are threatened: conserving large mammals in densely populated landscapes. In Rangarajan M, Saberwal V (eds.), Battles over nature: the science and politics of conservation in India. Permanent Black, New Delhi. pp. 31-55.

Marker L.L. 2002. Aspects of Namibian Cheetah (*Acinonyx jubatus*) Biology Ecology and Conservation Strategies. PhD. University of Oxford.

Marker, L.L. and A. Dickman. 2005. Factors affecting Leopard (Panthera pardus) spatial ecology, with particular reference to Namibian farmlands, South African Journal of Wildlife Research, 35, 2005, pp. 105-115.

McQuail, D. 2010. McQuail's mass communication theory. 6th edition. Sage, London.

Minhas, R. A. 2008. Annual Wildlife Survey Report of Machira National Park, pp 31.

Mishra, S. 1997. Livestock depredation by large carnivores in the Indian trans- Himalaya: conflict perceptions and conservation prospects. *Environ. Conserv.*, 24: 338-343.

Mooty, J.J. and P.D. Karns. 1984: The relation between white tailed deer track count and pellet survey, Journal of wildlife management 48; 275-279.

Moyer, M. A., J. McCown and K. Oli. 2008. Scale-dependent habitat selection by female Florida black bears in Ocala National Forest, Florida. Southeastern Naturalist 7:111–124.

Namgail, T. J., L. Fox and Y. Bhatnagar. 2007. Carnivore-caused livestock mortality in trans Himalaya. Envi. Manage. 39: 490-496.National Park, Pakistan. *Biol. Conserv.*, 142: 20762082.

Nowell, K. and P. Jackson. 1996. Wild Cats, Status Survey and Conservation Action Plan, IUCN, Gland, Switzerland, 1996.

Ogada, M. O., Woodroffe, R. Oguge, N. O. and Frank, L. G. 2003. Limiting Depredation by African Carnivores: The Role of Livestock Husbandry. Conserv Bio, 17: 15211530.

Oli, M. K., Taylor, I. R. and Rogers, M. E. 1994. Snow leopard (*Panthera uncial*) predation of livestock: an assessment of local perceptions in the Annapurna conservation area, Nepal. *Biol. Conserv*., 68: 63–8.

Packer C., H. Brink, B. Kissui, H. Maliti, H. Kushnir and T. Caro. 2011. Effects of trophy hunting on lion and leopard populations in Tanzania. Conserv Biol 25:142–153.

Pakistan Meteorological Department. 1990. Temperature and Rainfall Records in Muzaffarabad from 1961-1990. Islamabad, Pakistan.

Patterson, B. D, S> Kasiki, S. Selempo and R. Kays. 2004. Livestock predation by lions (Pantheraleo) and other carnivores on ranches neighboring Tsavo National Parks, Kenya. Biol. Consev. 119: 507-516.pdf, dated 7/6/2011.

Peterson, M. N., J. Birckhead, J. Leong, K. Peterson and T. Peterson, T. R. 2010. Rearticulating the myth of human-wildlife conflict. Conservation Letters 3:74–82.

Plessis, H.D. and G. Smit. 2005: The development and final testing of an electrified leopard proof game fence on the farm Masequa.

Pocock, R.I. 1932. The leopards of Africa. Proc. Zool. Soc., Lond. 1932: Poudel, G.C. 2002: Common Leopard in Chitwan valley: An ecological study, The wildlife 46, pp 23-24 May.

Prater, S.H. 1998. The book of Indian animals, published by Bombay Natural History Society

Punch, K. F. 2006. Introduction to social research: quantitative and qualitative approaches. Sage publications. London, Thousand Oaks and New Delhi.

Quammen, D. 2003. Monster of God: the man-eating predator in the jungles history and the mind. W.W. Norton, New York.

Roberts T.J. 1997. The Mammals of Pakistan Oxford University Press: New York.

Roberts, T. J. 1997. The mammals of Pakistan: The revised edition. Oxford University Press, Karachi. 525 pp.

Saberwal, V. K., J. Gibbs, R. Chellam and A. Johnsingh. T. 1994. Lion-human conflict in the Gir Forest, India. *Conserv. Biol*., 8: 501–7.

Sangay, T. and K. Vernes. 2008. Human–wildlife conflict in the kingdom of Bhutan: patterns of livestock predation by large mammalian carnivores. *Biol. Conserv*., 141: 1272–1282.

Seidensticker, J., M. Sunquist and C. McDougal. 1990. Leopards living at the edge of the Royal Chitwan National Park, Nepal. In. Conservation in developing countries: problems and prospects. Eds. J. C. Daniel and J. S. Serrao. 415- 423. Bombay Natural History Society and Oxford University Press.

Sharma, S. Jhala, Y. Sawarkar, V.B. 2003. Gender discrimination of tigers by using their pugmarks, Wildlife Society Bulletin 31:258-264.

Sharma, S., V. Jhala and V. Sawarkar. 2005. Identification of individual tigers (*Panthera tigris*) from their pugmarks, Journal of Zoology, 267:9-18.

Sheikh, K.M. and S. Molur. 2005 Status and Red List of Pakistan's Mammals, based on conservation assessment and management plan for mammals, IUCN, Pakistan, 2005, pp. 344.

Shukla R. 2002. Leopards in the backyard. B. R. Publishing Corporation, New Delhi.

Sillero-Zubiri, C., M. Laurenson. 2001. Interactions between carnivores and local communities: conflict or co-existence? In: Gittleman, J. L., Funk, S. M., Macdonald, D. W., Wayne, R. K. (eds), *Carnivore Conservation*. Cambridge University Press, Cambridge, pp. 282-312.

Termizi, S.S.H. and C. Rafique. 2001. Forestry Statistics of Azad Kashmir. Forest Department, Azad Jammu and Kashmir, Muzaffarabad.

Treves, A and K. Karanth. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide, Conservation Biology, 17:1491-1499.

Wang, S.W. and D. Macdonald. 2006. Livestock predation by carnivores in JigmeSingyeWanchuck National Park Bhutan. Bio. Conser. 129. 558-565.

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Appendix I

Questionnaire Survey on population census, distribution and Human-Common Leopard Conflict.

Form No: _____ Date: _____
Researcher: Muhammad Jahangir M. Phil Scholar Department of Zoology, MUST
Aim: Study of the Human-Common Leopard Conflict in Lachhrat forest range
Note: ***Information gained will purely be used for research purposes. Personal information will not be depicted anywhere.***
Village: _____ Forest Compartment: _____ Altitude_____
GPS N_____ E_____ General Habitat: _____
About Respondent
Name: _____Age: _____Gender: _____Tribe: _____
Occupation: _____Monthly income: Rs: _____ No of dependents: _____
Education: i) None ii) Primary iii) Secondary iv) Intermediate v) Graduate, vi) Master, vii). Other _____
Crops
Total property/ Land: _____ Cultivatable Area_____ (Kanal) Arid___ Non-Arid
Pasture land: _____ Crop: _____ Amount: _____(Kg) Earning _____
% of Total earning: _____ **3)**
Livestock
Total Composition of Livestock You Own.

(Show age in letters: A=<6m, B=6m-1Yr, C=1=1.5 Yr, D=1.-2 Yr, E=2.1-2.5 Yr, E=2.5 3Yrs, F=>3 Yrs.)

Type	Male	Female	Age					
Goats								
Sheep								
Cows								
Equine								
Buffalo								
Dog								
Poultry								

Livestock Attacked and killed (Denote Injured with **I** and killed with **K**)

Type	Male	Female			Age							
Goats												
Sheep												
Cows												
Equine												
Buffalo												
Dog												
Poultry												

Location of livestock attack?

No. of Attacks: Once: Twice: Thrice: Others: mention the no _____
Attacking Site: Coordinates_____ UC/Village: _____ Altitude: _____

Do you know the following information about the leopard?

No. of leopards during attack (if known)	Sex of leopard (if known)	Age of leopard (if known)

Place of incident/predation?

Inside village (near house): ____ Open Pen_____ Closed Pen_____ during grazing *outside* the village (private land): _____during grazing *inside* the village (private land): _____ in Reserve Forest: _____
if any other (please write): _____ **7)**

Were the livestock guarded at time of attack?
Yes ____No____ if yes, please specify

Type of guard	Human	Dog	Human & Dog	No Guard
No. of guards				

Explain time and date of attack

Time____: _____ Day_____ Night_____ Date: _____ (dd/ mm/yy) **9)**

What was season of attack?
Summer_____ Winter _____Fall _____ Spring _____

What action you had taken against predator? What was response of predator being the predator killed or injured by you?
Noise: Follow Leopard Gun Fire Marriage Bomb blast Do nothing others. _____

What was total economic loss (estimated market price in PKRs) due to predation?

Livestock value	Buffalo	Cow	Sheep	Goat	Donkey	Poultry	Dog	Other	Total
Killed									
Injured									

Frequency of common leopard attack/kill increased or decreased in last 15 years? Yes_____ No_____ if yes describe how much increased: _____

13) Reasons for the increase?

i) Habitat loss ii) leopard population has increased iii) wild prey species declined

iv) increase in livestock numbers v) if others (please write) _____

Do common leopard attacks have any seasonal or spatial pattern? Yes ____ No____ Why_____

Explain the seasonal and spatial associates of the common leopard attacks i) Seasonal_____

ii) Geographic_____

Do you think there is any link between leopard attack and Lachhrat Forest Range?

i) Yes ii) No if yes, explain briefly the links _____ Estimated leopard population in this area: Male_____ Female_____ Cubs_____

leopard Hunting.

Did you hunt a leopard? Yes no If yes, How? _____-

Did you trap a leopard? Yes no if yes, how leghold trap, pitfall other___

Do you know about any leopard trade in this area? _____

If Yes, can you quantify in terms of animals and amount_____ PKRs.

Leopard has any medicinal use? _____

Do you know anything about the biology of the common leopard and its behavior?

i) Yes ii) No iii) don't know

What features/ characteristics do you like/dislike about the common leopard? _____

Is the common leopard protected under national law?

i) Yes ii) No iii) don't know

Do you think it is important to protect common leopards? If yes, Why? _____

Who is responsible for the management of common leopards where you live? 29) What do you think is the most effective method to reduce leopard attacks on livestock?

How does human-common leopard conflict make you feel?

Would you participate in a common leopard conservation program in the area?
Do you think it is important to protect the Wildlife of Licharat Forest Division? Why?
What the other predators beside common leopard in your area?

Other predators& economic loss	Sheep n&v	Goat n&v	Poultry n&v	Others n&v	Total n&v
Asiatic Jackal					
Red Fox					
Others					

How do you communicate with the wildlife authorities?

What do you think about various Department/ NGOs working for natural resource conservation?
Are you satisfied with Department/ NGO's work?

According to your opinion how predation should be managed?

A) Repel leopard using disruptive stimulant (chemical or light or sound, including humans and/or dogs) B) Modify habitat C) Translocation D) Lethal control E) Do nothing.