INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 7, No. 2, p. 96-105, 2015

RESEARCH PAPER OPEN ACCESS

New record of distribution and population density of Golden Marmot (*Marmota caudata)* from District Neelum, AJ&K, Pakistan

Baseer ud Din Qureshi[1*], Maqsood Anwar[2], Iftikhar Hussain[3], Mirza Azhar Beg[4]

[1,2&3]*Department of Wildlife Management, PMAS-University of Arid Agriculture Rawalpindi, Pakistan*

[4]*Department of zoology, PMAS- University of Arid Agriculture Rawalpindi, Pakistan*

Key words: Long tail marmot, *Marmota caudata*, Golden marmot, Neelum valley, Alpine zone.

http://dx.doi.org/10.12692/ijb/7.2.96-105 Article published on August 10, 2015

Abstract

Purpose of this research was to collect information about population density and distribution of golden marmot (*Marmota caudata*) from Neelum valley, Azad Jammu and Kashmir. Line transect method was used and data were taken from eight selected sites through distance sampling. Width of transect was 200 m while length varies from 0.5 to 5 Km adjusted according to the terrain of the site. All sampling transects were taken in alpine zone between altitude of 3120 m (Shounter) to 3884 m (Lawat Patlian) representing an area of approximately 918 km^2. The patchy distribution of golden marmots was recorded from alpine zone of district Neelum within the altitudinal range of 3120 m to 3884 m asl. Population density of golden marmot was highest at Noori Nar (0.473 individual ha-1, 95%CI: 0.213-1.052) while lowest at Baboon (0.10 individual ha-1, 95% CI 0.057-0.185). Effective width of transect was 52.73 m (Baboon), 54.55 m (Bloar Kassi, 46.93 m (Janwai), 57.47 m (Lawat), 57.63 m (Noori Nar) 57.83 m (Shakar Garh) and 55.32 m from Shounter. Golden marmots were sporadically distributed within the alpine zone of district Neelum. Their density varies from one habitat to another which ranges 0.10 animals per hectare to 0.473 animals per hectare.

* **Corresponding Author:** Baseer ud Din Qureshi ✉ baseerqureshi@gmail.com

Introduction

Marmots are large Holarctic rodents with marked adaptations for living in cold climates. Hibernation, increased size, suppression of reproduction, and sociality are among the evolutionary responses to the selective pressures of harsh environments (Armitage, 2000) such as those of the periglacial zone in which marmots are believed to have evolved (Zimina and Gerasimov, 1973). The genus *Marmota* appeared in North America about 9.5 million years ago and crossed the Bering Strait to colonize Eurasia at the end of Pliocene or in the beginning of Pleistocene (Mein, 1992; Steppan *et al.*, 1999). The increasing abundance and diversification of the fossils during the Pleistocene witnessed the marmot radiation in the Palaearctic (Lyapunova *et al.*, 1992; Mein, 1992, Armitage, 2000;). However, the fossil record is often fragmentary and of uncertain attribution and thus of little help in supporting hypotheses on the vagaries of marmot evolution (Rumiantsev and Bibikov, 1994).

Despite a large number of eco-ethological studies on marmots and the centrality of this taxon for understanding the evolution of mammalian society, the phylogeny of the genus *Marmota* has not been studied. The lack of a reliable phylogeny may undermine attempt to take into account the lack of independence in inter-specific comparisons due to phylogenetic relationships. (Felsenstein, 1985; Harvey and Pagel, 1991), thus, preventing meaningful tests for hypotheses on the evolution of highly social behaviors (Blumstein, 1998). Bio-geographic questions of great interest for understanding the faunal interchange across the Bering Strait, such as the disputed geographic origins of Alaskan marmot (*Marmota broweri*) and black-capped marmot (*Marmota camtschatica*), have remained unanswered. *Marmota broweri* has been considered by different authors either as a recent offshoot of a Palaearctic lineage returned to the Nearctic (Hoffmann and Nadler, 1968) or as a subspecies of North American *Marmota caligata* (Hall, 1981). *Marmota camtschatica* has been considered a possible member of the North American marmot group which became isolated from its Palaearctic relatives when Beringia was covered by the ocean (Lyapunova *et al.*, 1992).

Currently, 14 species of marmots (genus *Marmota)* restricted to the northern hemisphere, are recognized (Barash, 1989). Six species occur in western North America, only the range of woochunk (*M. monax)* extends into eastern Canada and the United States (Kenagy, 1986). Two species i.e. *M. Marmota* and *M. bobac* occur in Europe, the remaining six Palearctic species occur in Asia (Armitage, 2000). The Demographic relationships of individual colonies appear to be density-dependent. Major cause of dispersal is social pressure and colonial social organisation is more adaptive than the solitary (Armitage, 1981).

Except porcupine (*Hystrix indica*), Golden or long-tailed marmot (*Marmota caudata)* is the heaviest rodent found in Pakistan. This marmot is marked with long course hairs covering all the upper part of body. The long-tailed marmot is confined to the alpine scrub of alpine meadow zone and never being found below the tree line. It is usually found between 3200 m and 4850 m elevation in broken rocky ground interspersed with small patches of grass and dwarf or creeping juniper. It is not found in very arid mountain regions nor in steep precipitous cliffs (Roberts, 1997). There is quite variation in the ground color of this species with three more or less discrete populations recognizable in Pakistan. Male and female specimens have been collected from Kaghan valley slightly over 4.6 Kg of weight. The Golden marmot occurs in district Hazara in the northern part of Kaghan valley, in Chilas District of Gilgit and in Astor around the slopes of Nanga Parbat, in Chitral from western border with Afghanistan. In northern Hunza and particularly in Khunjrab National Park, Golden marmot is also plentiful. The red marmot (*Marmota caudata aurea*) is common throughout the Deosai plateau in Baltistan, south of the Indus River up to Burzil and extending to Swat Kohistan in the higher alpine valleys. This species does not occur in the rest of the Himalayan range except in the northern part of Kashmir (Roberts, 1997).

Previously no scientific information was available concerning presence of Marmota spp. in Azad Jammu and Kashmir. Distribution, altitudinal and spatial range of distribution from the study area about golden marmot was not documented earlier. As scientific information is pre-requisite for future conservation planning and management about concerned species. The present study, therefore, was designed to provide data on the distribution of marmot species and their population size in district Neelum of AJ&K.

Materials and methods

Study area

Study was conducted in district Neelum of Azad Jammu and Kashmir (AJ&K), Located at 34°. 28 to 34°.48 N and 73°. 44 to 74°. 58 E, covering an area of 3621 km^2 (ERRA, 2007; P&D, 2013). Altitude of the study area ranges from 900 m to 6325 m above sea level (asl) (Mahmood *et al.* 2011). The area is also known as Neelum valley due to presence of River Neelum. River Neelum drains from southern slopes of the Nanga Parbat massif which originates from glaciers and permanent snow fields (McVean and Robertson, 1969). This mountainous valley is divided by the Neelum River that enters AJ&K from Tao Butt and flows down to Muzaffarabad to join River Jhelum(Qureshi, 2000). Study area is characterized by rugged topography (Malik *et al.*, 1996), soil is loamy to sandy loam, capable of retaining moisture, helping in good growth of forests. Majority of the area is covered with thick vegetation (Dar, 2003). There are lateral valleys adjoining the main valley, forming a spur-like surface. The interlocking pattern of mountains presents a variety of aspects (Khan *et al.*, 2006). The area represents mountainous terrain of high elevated, glaciated peaks and cold desert which constitute major portion of the range resulting long severe winter starting from November to end of April and a very short mild summer from mid-June to mid-August (Ishtiaq *et al.*, 2013).

Methodology

Line transect method was used to collect data on distribution and population density of golden marmots. Data were taken along transects laid for distance sampling having width of 200 m and length from 0.5 to 5 Km. Length and orientation of transects was adjusted according to the terrain of the site. All transects were taken in alpine zone between altitude of 3120 m (Shounter) to 3884 m (Lawat Patlian) and covered an area of approximately 918 km^2. All transects were walked slowly by single observer between 7 am to 7 pm. Sighting angle was recorded using compass and distance to the animal was recorded using measuring tape. These angles were used to convert the sightings to perpendicular distances from the transect, which was the requirement for Distance Sampling analyses. Marmots were also pointed out by their alarm calls they uttered by seeing observer in its home range. Sampling was carried out from July to September 2011 and 2012. Population density of the each site was calculated separately.

Software and data analysis

The program DISTANCE version 6.0 (Thomas *et al.*, 2010) was used to estimate the population density of marmots. The following priori models (Key function/ series expansion) were used to arrive at density estimates: Uniform/cosine, half normal / hermite polynomial, Hazard rate /simple polynomial. Model selection was at the minimum of Akaike Information Criterion (AIC), as AIC provides a relative measure of fit. Distance also provides the DAIC values, which are AIC values with the AIC of the best fitting model subtracted. Thus DAIC = 0 for the best model (Thomas *et al.*, 2010). The density estimation was made by pooled data of all individuals encountered at transects.

Results

Habitat of golden marmot; alpine zone considered for distance sampling extended from Commu (34°33' 52. 55"N, 73°39'23.38"E) to Bloar Kassi (34°48'10.87"N, 74°49'7.99"E), covering an area of 918 km^2 (Fig.1.). A total of 59 transects were laid out of which Golden marmots were found in 43 transects. A total of 551 individuals were observed from Baboon, Bloar Kassi, Janwai, Lawat, Noori Nar, Shakar Garh and Shounter

(Table 1). Estimated population density was 0.10 individual ha^{-1} (95% CI: 0.206 and 1.08) from Baboon to 0.473 individual ha^{-1} (95% CI: 0.07 and 0.29) Lawat Patlian (Table 2).

Table 1. Marmot presence along line transects record from study area.

Name of site	No of transects	Total length of transect (km)	Total Animal seen	Average animal seen per transect
Baboon	6	15	72	4.8
Bloar Kassi	4	10	75	7.5
Janwai	4	11	70	6.36
Lawat	8	12.5	63	5.04
Noori Nar	7	15.5	111	7.16
Shakar Garh	8	18	64	3.55
Shounter	6	12.75	96	7.52
Total	43	94.5	551	5.82
Average		13.535	78.714	
SD		2.785	17.978	

Table 2. Summary of candidate model used and model fit in line transect analysis of golden marmot (*Marmota caudata aurea)***.**

Name of site	Population estimation model	No. of Parameters	ΔAIC	AIC	ESW/EDR (m)	Density/ hectare	95 % confidence limit	
							Lower	Upper
Baboon	Uniform / cosine	1	0	272.99	52.73	0.102	0.057	0.185
	Half normal /hermite polynomial	1	0.3	273.29	54.12	0.1	0.054	0.185
	Hazard rate /simple polynomial	2	1.72	274.7	59.22	0.099	0.052	0.187
Bloar Kassi	Uniform / cosine	1	0	239.58	54.55	0.472	0.206	1.08
	Half normal /hermite polynomial	1	0.44	240.02	54.47	0.471	0.205	1.081
	Hazard rate /simple polynomial	2	1.93	241.51	53.93	0.499	0.209	1.192
Janwai	Uniform / cosine	1	0	239.88	46.93	0.319	0.122	0.833
	Half normal /hermite polynomial	1	0.56	240.45	46.08	0.323	0.123	0.851
	Hazard rate /simple polynomial	1	0.56	240.45	46.08	0.323	0.123	0.851

Table 2. Continued

Name of site	Population estimation model	Number of Parameters	Δ AIC	AIC	ESW/EDR (m)	Density/ hectare	95 % confidence limit	
							Lower	Upper
Lawat Patlian	Uniform / cosine	1	0	224.29	57.47	0.328	0.15	0.378
	Half normal/ hermite olynomial	1	0.39	224.69	59.3	0.232	0.141	0.382
	Hazard rate / simple polynomial	2	2.05	226.34	65.9	0.237	0.141	0.399
Noori Nar	Uniform / cosine	1	0	385.37	57.63	0.473	0.213	1.052
	Half normal /hermite polynomial	1	0.57	385.94	59.97	0.456	0.204	1.02
	Hazard rate / simple polynomial	2	2.74	388.11	68.98	0.457	0.205	1.02
Shakar Garh	Uniform / cosine	1	0	228.33	57.83	0.152	0.077	0.298
	Half normal /hermite polynomial	1	0.23	228.56	60.65	0.15	0.077	0.292
	Hazard rate /simple polynomial	2	1.89	230.22	55.41	0.157	0.059	0.422
Shounter	Uniform / cosine	1	0	329.36	55.32	0.224	0.106	0.472
	Half normal / hermite polynomial	2	1.48	330.85	54.56	0.228	0.107	0.487
	Hazard rate / simple polynomial	2	2.03	331.4	57.74	0.219	0.1	0.482

The 'conventional distance sampling, analysis engine was used which models detection probability as a function of distance from transect. The detection probability of an animal decreases with increasing distance from Transect line. Detection probability depends on the factors within the habitat. The detection probabilities were high at Shakar Garh (0.71) (Fig. 6.) while lowest at Shounter (0.55) (Fig. 7.). Depending on the terrain and other habitat factors like boulders, rock out corps along with weather conditions, detection probability varies from site to site (Fig.1-7.)

Population density was the highest at Noori Nar (0.473 individual ha-1) while lowest at Baboon (0.10

individual ha-1). Baboon had significantly low population density than two other sites, Bloar Kassi and Noori Nar also (Table 2). Effective width of the transect directly linkes with the detection of the animals. Effective strip width (ESW) of transect was 57.83 m from Shakar Garh while 46.93 m from Janwai (Table 2).

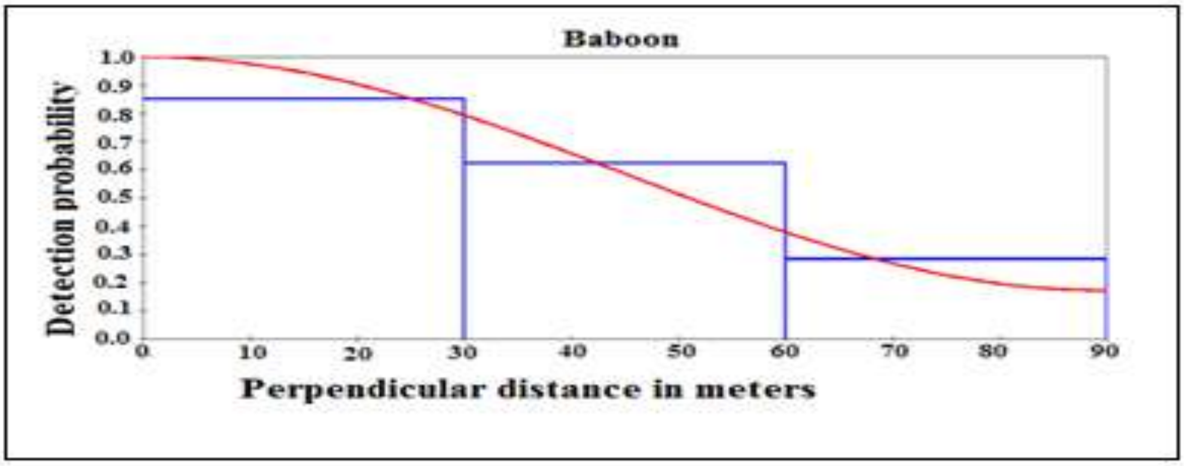

Fig. 1. Distance function curve for *Marmota caudata area* in Baboon**.**

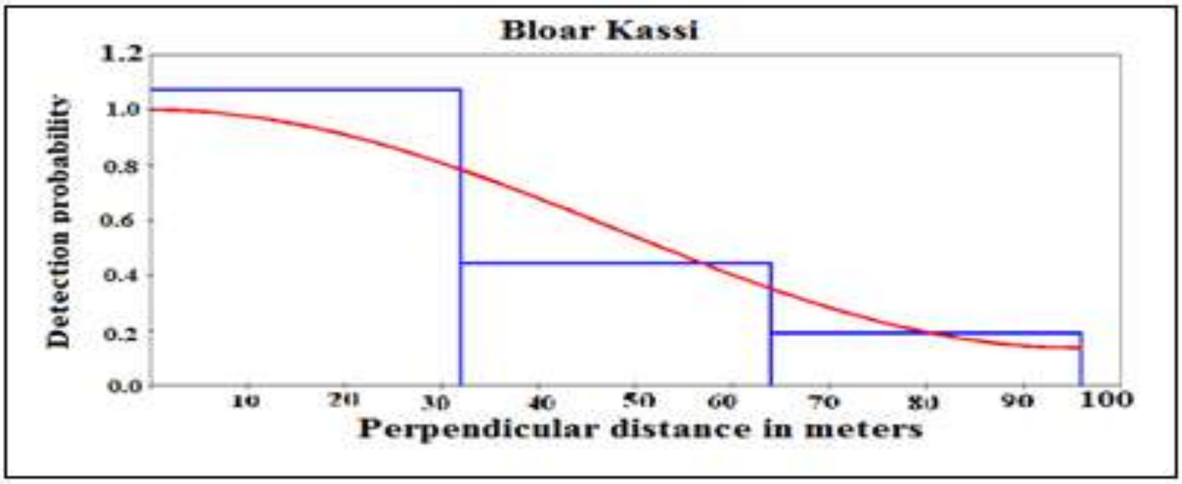

Fig. 2. Distance function curve for *Marmota caudata aurea* in Blor Kassi.

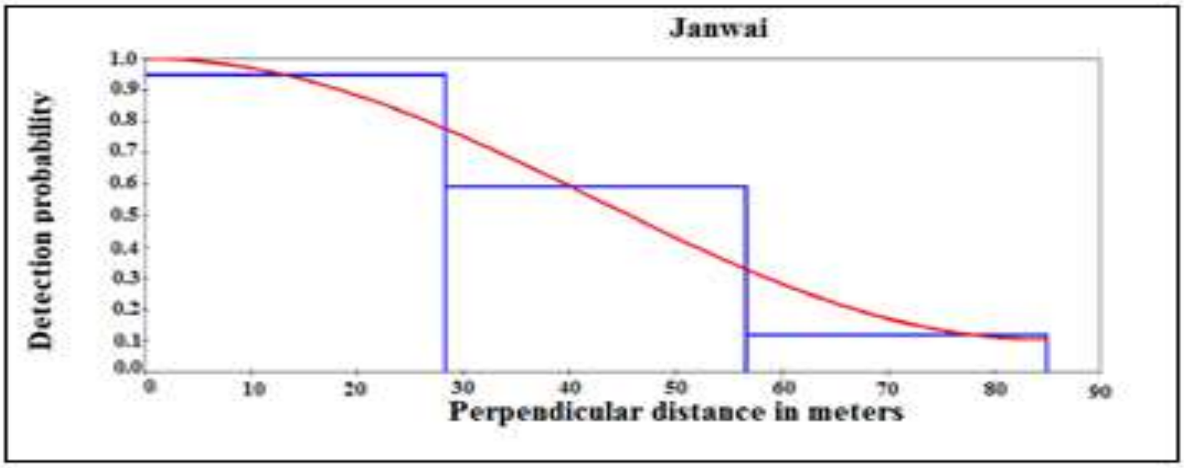

Fig. 3. Distance function curve for *Marmota caudata aurea* in Janwai.

Results revealed 2-5 animals per social group in study area.

Avarage animals seen at the transect were highest highest at Shounter (7.52 animals/transect) and lowest at Shakar garh (3.55 animals/transect) (Table1).

Discussion

Out of 10 selected sites Golden marmots were found to be existing at seven study sites , including Baboon, Lawat Patlian, Noori Nar, Shounter, Janwai, Shakar Garh and Bloar Kassi (Fig. 8.). Along with the altitude there are a number of factors responsible for the patchy distribution of marmots. Major factors are food availability, predatory pressure, aspect and type of soil that marmots prefers to construct the burrows. In the study area golden marmots exist in a narrow range of altitude.

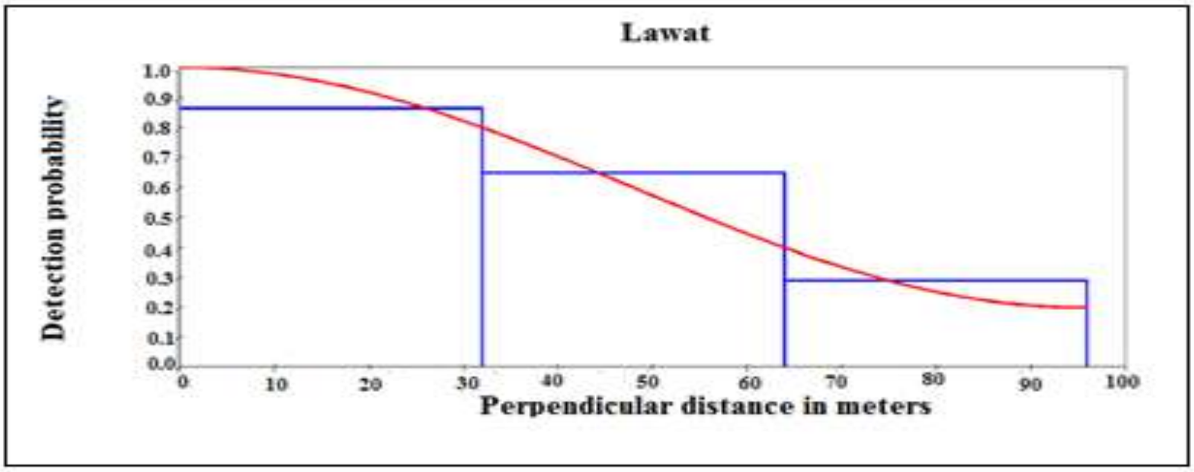

Fig. 4. Distance function curve for *Marmota caudata aurea* in Lawat.

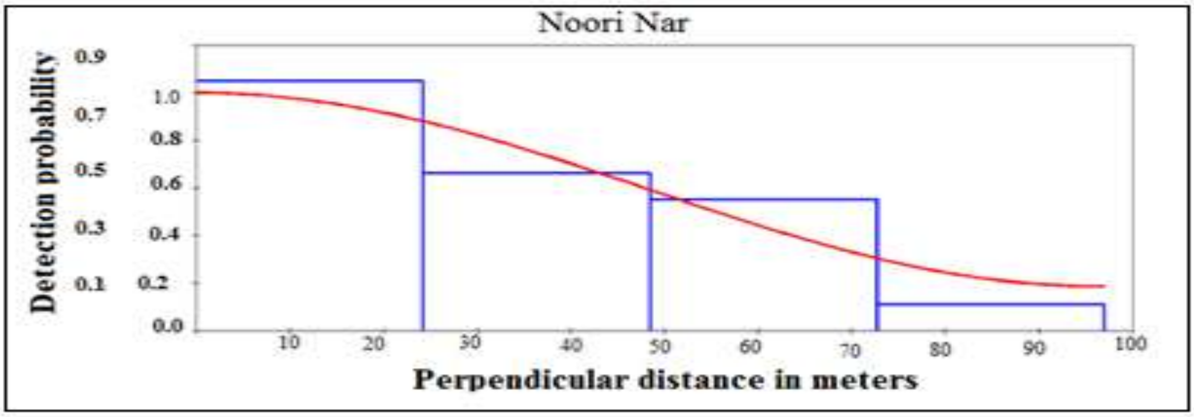

Fig. 5. Distance function curve for *Marmota caudata aurea* in Noori Nar.

Altitudinal range of their distribution was from 3120 m asl. (Shounter) to 3884 m asl. (Lawat Patlian) (Fig. 9.). Population of Golden marmot was distributed in the study area sporadically from Baboon to Bloar Kassi except Commu, Seen Gull and Mianwich study sites that have same topography apparently. Out of these three sites where population of marmots were not present, Commu previously had population of marmots in year 2000 that seems to be collapse during recent years. All populations of marmots were recorded around the base of rocky cliffs where soil was loose and made up of the moraine. Such type of soil patches were mostly found at sharp slopes which definitely flush down with water and snow. Early expose of these soil patches from snow provides environment to forage plants of marmots for early growth. All recorded colonies of marmots were found at slopes or near initiation of the slopes. A single colony from shounter and a colony from Noori Nar were found at the plain part of terrain. In the study area marmots were distributed T in ecoregion of alpine meadows having grasses and herbs. The results are congruent with Bibikov (1967) who stated that large size and high energy requirements result in a mosaic distribution of marmots within a given area and favors the evolution of a highly complicated population structure.

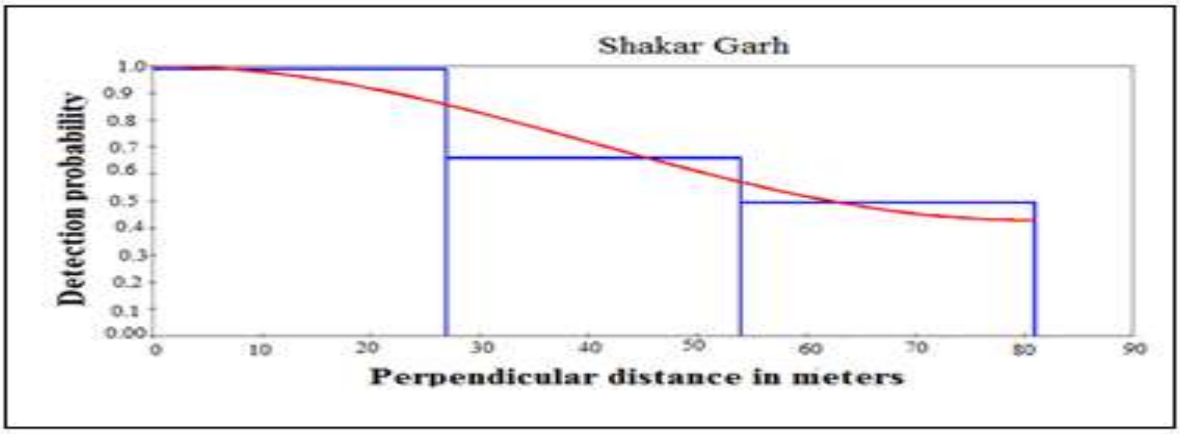

Fig. 6. Distance function curve for *Marmota caudata aurea* in Shakar Garh.

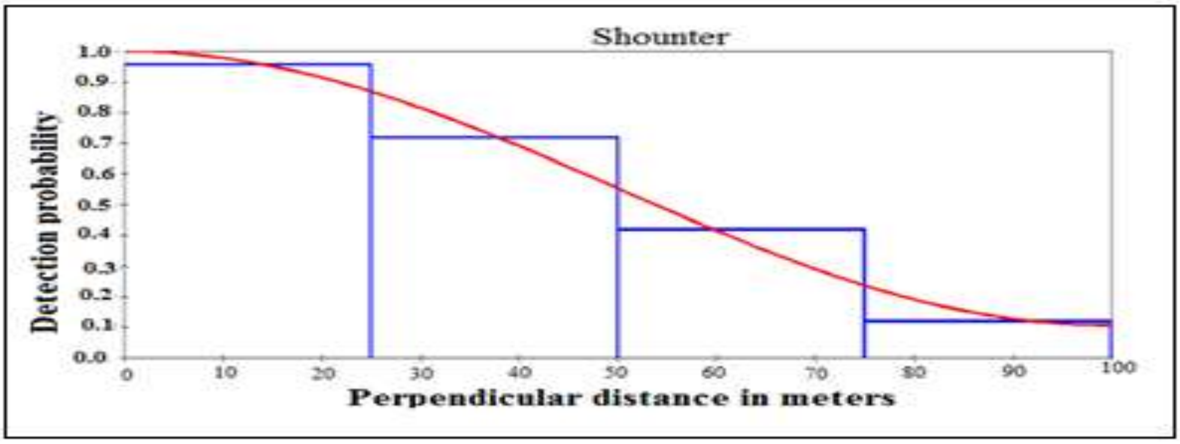

Fig. 7. Distance function curve for *Marmota caudata aurea* in Shounter.

Marmots like slopes of glacial moraine and loose soil at the base of mountains for burrowing system. Such type of soil is suitable to excavate the burrows and have low water holding capacity. Marmot burrows were located on well drained exposures, but low marshy areas, run-off streams, and other sources of water were found within the home range of marmots. Proximity to wet areas provide an additional source of better vegetation. Svendsen (1974) also noted the soil at marmot sites was very coarse and porous; water from snowmelt and rain sinks into the ground and there was little surface runoff.

During early season just after emergence marmots looks lathargic; a probable effect of hibernation while whole of the social group spends much time for sunning. By the passage of time they become active and pass much time for foraging and less for sunning. Marmots use the boulders for sunning and to watch their territory and medium sized rocks to excavate burrows beneath it. Rocky outcrops and boulders were commonly found in the habitat of marmots. These habitat factors effect on the detection probability of the animal. The detection probability varies from site to site depending upon the terrain and other visibility hindering factors (Fig.1-7).

Marmots mostly use rocks to burrow beneath, for lookouts, and for sunning. Our results are also supported by Zimina and Gerasimov (1973) who reported that marmots inhabit the areas of massive accumulation of large boulders and screes, broken rock or pebbles with fine grained deposits of moraines. The open areas occupied by colonies become snow free earlier than han adjacent coniferous forest areas. Which helps to make available the food resources for marmots during the period of above ground. Because during the time of 4-5 months they have to recover the loss of metabolic processes during last hibernation and to prepare their body for next hibernation while adults have to breed just after hibernation even before emergence.

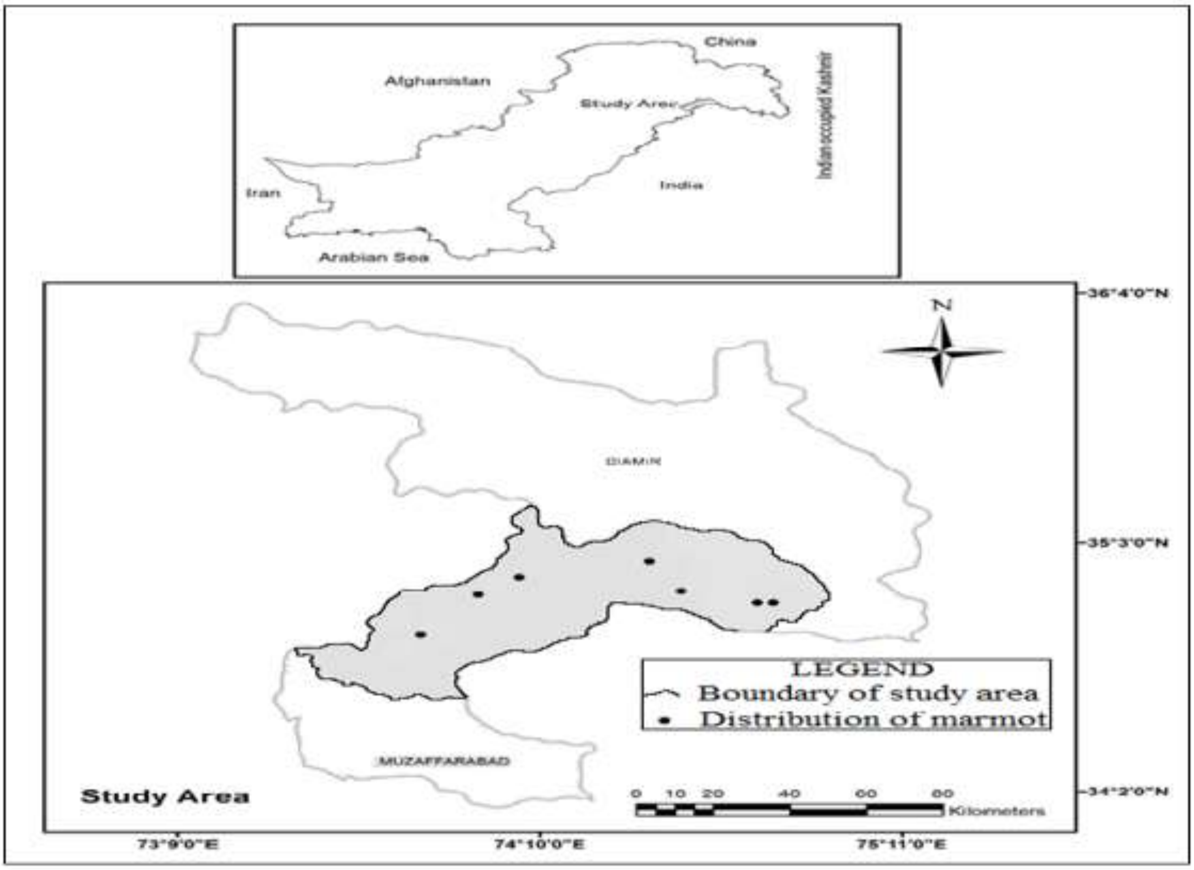

Fig. 8. Distribution map of Golden marmot in district Neelum, AJ&K during 2011-12.

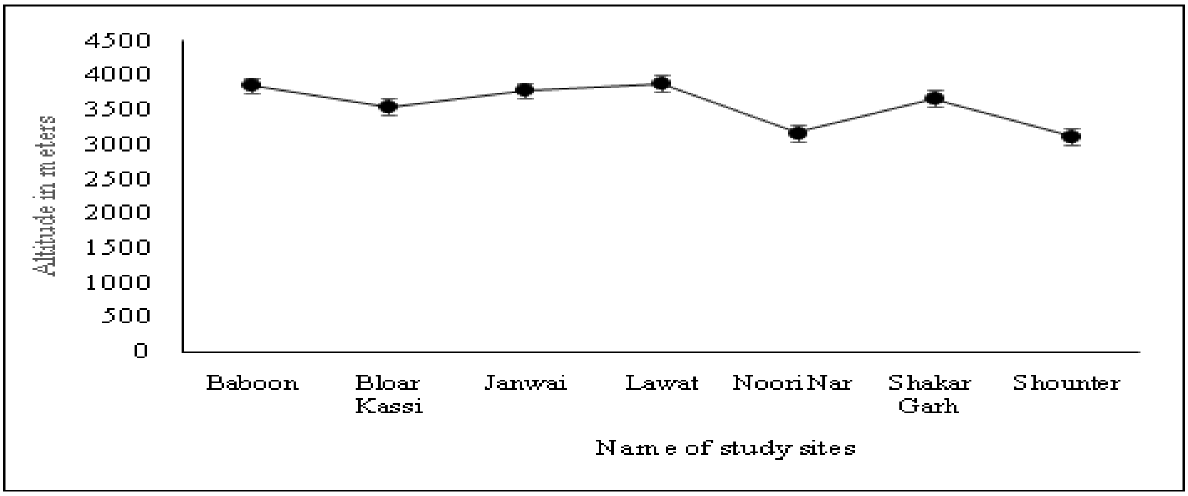

Fig. 9. Altitudinal range of distribution of Golden marmot in district Neelum, Azad Jammu and Kashmir.

There are a number of intrinsic and extrinsic factors that determine the density of a population. It was beyond the scope of this study to determine the role of these factors.

Conclusion

The study reveals that site Baboon had significantly low population density than two other sites, Bloar Kassi and Noori Nar while Shakar Garh and Bloar Kassi have no significant defference in population denisty . Lawat Patlian, Shounter and Janwai have no significant defference among population denisties. Size of social group was 2-5 animals. The detection probability was high at Shakar Garh while lowest at Shounter. We recorded the food plants and determine the food preference (paper in press). Which shows that Bloar Kassi and Noori Nar have good quality of food resources than other sites. These food resources might be a reason for colonization and population density.

Acknowledgement

We thank IDEA WILD, USA for providing partial support in kind of equipment to complete this research work.

References

Armitage KB. 1981. Sociality as a life history tactic of ground squirrels. Oecologia **48,** 36-49. http://dx.doi.org/10.1007/BF00346986

Armitage KB. 2000. The evolution, ecology, and systematics of marmots. Oecologia **9,** 1-18.

Barash DP. 1989. Marmots: social behavior and ecology. California, USA: Stanford University Press, p. 368.

Bibikov DI. 1967. Gornye surki Srednei Azii i Kazakhstana (Mountain Marmots of Middle Asia and Kazakhstan). Moscow: Nauka Publishing House, p.199.

Blumstein DT. 1998. Life history consequences of social complexity: A comparative study of ground-dwelling Sciurids. Behavioral Ecology **9,** 8-19.

Blumstein DT, Arnold W. 1998. Ecology and social behavior of Golden Marmots (Marmota caudata aurea). Journal of Mammalogy **79,** 873-886. http://dx.doi.org/10.2307/1383095

Dar ME. 2003. Ethnobotonical uses of plants of Lawat district Muzaffarabad Azad Jammu and Kashmir. Asian Journal of Plant Sciences **2,** 680-682. http://dx.doi.org/10.3923/ajps.2003.680.682

Felsenstein J. 1985. Phylogenies and the comparative method. American Naturalist **126,** 1-25.

Hall RE. 1981.The Mammals of North America **1.** New York, USA: John Wiley and Sons, 690 P.

Harvey PH, Pagel MD. 1991. The comparative method in evolutionary biology. Oxford University Press. p. 235.

Hoffmann R, Nadler C. 1968. Chromosomes and systematics of some north American species of the genus Marmota (Rodentia: Sciuridae). Experientia **24,** 740-742. http://dx.doi.org/10.1007/BF02138351

Ishtiaq M, Iqbal P, Hussain T. 2013. Ethnobotanical uses of Gymnosperms of Neelam valley and Muzaffarabad of Kashmir. Indian Journal of Traditional Knowledge **12,** 404-410.

Kenagy GJ. 1986. Strategies and mechanisms for timing of reproduction and hibernation in ground squirrels. In: Heller HC, Muscacchia XJ, Wang LCH, Ed. Living in the cold: physiological and biochemical adaptations. New York, Elsevier, p. 383-392.

Khan AA, Qureshi BD, Awan MS. 2006. Impact of musk trade on the decline in Himalayan musk deer Moschus chrysogaster population in Neelum Valley, Pakistan. Current Science **91,** 696-699.

Lyapunova EA, Boyekor GG, Voronstov NN.

1992 Marmota camstschtica pall Nearctic element in palearctic Marmota founa., Torino, 185-191 P.

Mahmood A, Malik RN, Shinwari ZK, Mahmood A. 2011. Ethnobotanical survey of plants from Nelum, Azad Jammu and Kashmir, Pakistan. Pakistan Journal of Botany **43,** 105-110.

Malik RH, Schouppe M, Fontan D, Verkaeren J, Martinotti G, Shaukat AK, Qureshi S. 1996. Geology of the Neelum valley, district Muzaffarabad, Azad Kashmir, Pakistan. Geological Bulletin University of Peshawar **29,** 91-111.

McVean DN, Robertson VC. 1969. An ecological survey of land use and soil erosion in the West Pakistan and Azad Kashmir catchment of the River Jhelum. Journal of Applied Ecology **6**, 77-109. http://dx.doi.org/10.2307/2401302

Mein P. 1992. Proceeding of the first international symposium on alpine marmot and genus Marmota. Taxonomy. Torino, 6-12 P.

Roberts TJ. 1997. The Mammals of Pakistan. Oxford University Press. Karachi. p. 525.

Rumiantsev VY, Bibikov DI. 1994. Marmots in Europe: history and prospects. In: Rumiantsev VY, Ed. Actual Problems of Marmots Investigation. Moscow, ABF. p. 193-214.

Steppan SJ, Akhverdyan MR, Lyapunova EA, Fraser DG, Vorontsov NN, Hoffmann RS, Braun MJ. 1999. Molecular Phylogeny of the Marmots (Rodentia: Sciuridae): Tests of Evolutionary and Biogeographic Hypotheses. Systematic Biology. **48**, 715-734. http://dx.doi.org/10.1080/106351599259988

Svendsen GE. 1974. Behavioral and Environmental Factors in the Spatial Distribution and Popualtion Dynamics of a Yellow-Bellied Marmot Population. Ecology **55,** 760-771. http://dx.doi.org/10.2307/1934412

Thomas L, Buckland ST, Rexstad EA, Laake JL, Strindberg S, Hedley SL, Bishop JR, Marques TA, Burnham KP. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology **47,** 5-14. http://dx.doi.org/10.1111/j.1365-2664.2009.01737.x

Zimina RP Gerasimov IP. 1973. The periglacial expansion of marmots (Marmota) in middle Europe during late Pleistocene. Journal of Mammalogy **54,** 327-340. http://dx.doi.org/10.2307/1379120