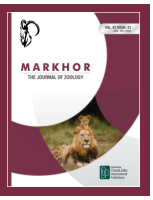
DOI: https://doi.org/10.54393/mjz.v4i01.60

MARKHOR
THE JOURNAL OF ZOOLOGY
https://www.markhorjournal.com/index.php/mjz
Volume 4, Issue 1 (Jan-June 2023)



Original Article

Population and Distribution of Himalayan Tahr *(Hemitragus jemlahicus)* in Lamtang National Park of the Nepal Himalaya

Pravat Dhakal[1], Ranjit Kumar Sharma[1], Birat Raj Rajak[1], Naresh Pandey[1,2] and Laxman Khanal[1*]

[1]Central Department of Zoology, Institute of Science and Technology, Tribhuvan University, Kathmandu 44618, Nepal
[2]Conservation Himalaya, Chandragiri-14, Kathmandu 44619, Nepal

ARTICLE INFO

Key Words:
Habitat, Himalayan Tahr, Lamtang Valley, Prey Base, Predators

How to cite:
Dhakal, P., Sharma, R. K., Rajak, B. R., Pandey, N., & Khanal, L. (2023). Population and Distribution of Himalayan Tahr (*Hemitragus jemlahicus*) in Lamtang National Park of the Nepal Himalaya: *Hemitragus jemlahicus* in Lamtang National Park of the Nepal Himalaya. MARKHOR (The Journal of Zoology), 4(01), 02-10.
https://doi.org/10.54393/mjz.v4i01.60

***Corresponding Author:**
Laxman Khanal
Central Department of Zoology, Institute of Science and Technology, Tribhuvan University, Kathmandu 44618, Nepal
lkhanal@cdztu.edu.np

Received Date: 31st March, 2023
Acceptance Date: 15th May, 2023
Published Date: 30th June, 2023

ABSTRACT

The Himalayan ecosystems, which are among the least studied mountain ecosystems, face threats and habitat degradation due to unplanned development, natural calamities, and overgrazing. Ungulates like Himalayan tahrs (*Hemitragus jemlahicus*), play a crucial role in mountain ecology as it forms the major prey base of the top predators of mountain ecosystems. **Objective:** To explore the population status, distribution, and habitat uses of Himalayan tahrs in Lamtang National Park (LNP), Central Nepal by line transect method during May 2022. **Methods:** Total 20 transects each of about 500 m length were established randomly along the Lamtang River at different elevations from 3100m to 4300m and Himalayan tahrs were observed. **Results:** A total of 154 Himalayan tahrs were recorded from 9 herds that accounted for an average herd size of 17.1 ± 5.77 individuals. The elevational distribution of the herds ranged between 3107 m and 4200 m asl. Their preferred habitat was rocky cliffs, with grasslands, shrublands, and rhododendron-fir-mixed forests being utilized to a lesser extent. The tahrs predominantly inhabited rugged terrain on south-facing slopes, prioritizing it over other available habitats. **Conclusions:** The demographic indices of the Himalayan tahrs in the LNP show a remarkable decline when compared with the previous studies in the same area in 1976 and 2006. Therefore, conservation and management initiatives of the Himalayan tahrs are urgently needed in the LNP.

INTRODUCTION

The Himalayan ecosystems are one of the threatened but least studied mountain ecosystems [1]. The ill-planned developmental works and overgrazing by livestock are among the major causes of mountain habitat degradation [2]. Mountain habitat degradation affects on the ecology of the wildlife population inhabiting there and the study of distribution of a species is important to assess the relationship between the population with its habitat [3]. Animal populations change characteristically over time, so the study of the potential habitat, status, distribution, and habitat preference of an animal is important [4]. The data on the wildlife of such degraded habitats aid in the systematic and evidence-based conservation efforts of the species [5]. Among the mountain wildlife, ungulates play a great role in ecological processes of mountains but are under the effects of alarming conservation threats [6]. They are the key indicators of the quality of habitats in mountain ranges [1]. Nepal is home to 28 species of ungulates which are among the most threatened groups of mammals in Nepal [7]. The downfall of ungulate populations directly harms carnivore populations which adversely affects the ecosystem structure. Therefore, ungulate populations should be regularly monitored for better wildlife management practices [8]. The large herbivores like Himalayan tahrs (*Hemitragus jemlahicus*) form the major diets of the top carnivores of the mountain

DOI: https://doi.org/10.54393/mjz.v4i01.60

ecosystems such as snow leopards (*Panthera uncia*) and also help for economic development through ecotourism. Therefore, regular monitoring of their distribution and population and conservation status is a requisite for ecosystem management [9, 10]. Himalayan tahr (Order: Artiodactyla, Family: Bovidae) is a form of a wild goat having small head, narrow erect ears, long robust limbs and backward curved horns whose body is covered with thick, reddish-brown wool coat with dark mid-dorsal streak [11]. At present, three species of tahrs i.e. Arabian tahr (*Arabitragus jayakari*), Nilgiri tahr (*Nilgiritragus hylocrius*) and Himalayan tahr (*Hemitragus jemlahicus*) are recorded in the world [12]. The distribution range of the Himalayan tahr is extended along the southern part of the Himalayas from India, Nepal, and Bhutan whereas some introduced populations were reported from England, New Zealand, New Mexico, California, Ontario of Canada and South Africa [13, 14]. In Nepal, the Himalayan tahrs have been reported in Sagarmatha National Park (NP), Rara NP, Lamtang NP, Shey-Phoksundo NP, Makalu-Barun NP, Khaptad NP, Dhorpatan Hunting Reserve, Manasalu Conservation Area (CA), Annapurna CA and Kanchanjunga CA [14–21]. The Himalayan tahr is listed as Near Threatened in the IUCN Red List of Threatened Species [22]. Himalayan tahr occupies mountainous habitat with topographical features characterized by rocky terrain and vertical cliffs between elevations from 1,500 m and 5,300 m [11, 23, 24]. The abundance of Himalayan tahrs is negatively associated with roads and settlements [25]. The presence of livestock also pushes the tahrs towards marginal grassland or broken terrain [16]. The Himalayan tahrs are facing conservation threats such as degradation and loss of habitat, hunting and competition with livestock due to overgrazing, etc. [26, 27]. The conservation success of threatened mountain carnivores like snow leopards is directly related to the management of populations of its major wild prey like Himalayan tahrs, so its conservation is a key element of management in Himalayan region [28]. The effective method of determining population status of different species and managing them requires ecological research [29]. The effects of inborn and external factors that determine the population and composition of large mammals can be assessed by the regular mapping of their population dynamics. Besides anthropogenic activities, natural disasters can also change the habitat and population of wild animals to a great extent. Lamtang National Park, a mountainous protected area in the central Himalaya was heavily affected by the huge earthquake of April 2015. The Lamtang Valley was washed away by a catastrophic avalanche and landslide. The effects of such calamity on the wildlife of this area haven't been documented yet. Himalayan tahrs were studied in Lamtang NP in 1978 [24] and 2006 [17]. No other scientific documentation of this ecologically important mountain ungulates has been done in the Lamtang National Park, Nepal. Therefore, study on population status and distribution of Himalayan tahrs is essential for its conservation. This study aimed to assess the population status and distribution of Himalayan tahrs along the Lamtang River of Lamtang National Park and to examine the effects of habitat characteristics on their abundance.

METHODS

This study was conducted along the Lamtang River in Lamtang National Park (LNP) in central Nepal (Figure 1). The LNP is the first mountainous national park in Nepal with geographical location of approximately 85°15' to 85°55'E and 27°40' to 28°25' N and an area of 1710 km^2 and an additional buffer zone of 420 km^2. The LNP is the first Himalayan national park established in 1970-71 to conserve the unique flora and fauna of this region. The northern border of the LNP is the Tibet of China and southern border is mid hills of Central Nepal [30].

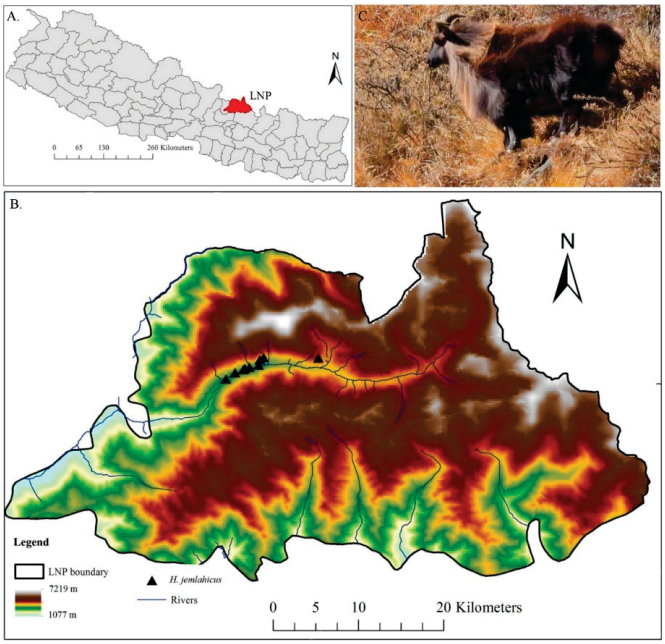


Figure 1: Map of the study area. A- Map of Nepal showing Lamtang National Park; B- Map of PNL showing Himalayan tahrs observed points and, C- An adult male Himalayan tahr in the LNP

The LNP is spread over three administrative districts including Rasuwa- 57%, Sindhupalchowk- 36% and Nuwakot- 7%. The park is the converging point of Indo-Malayan and Palearctic realms. The altitude of LNP ranges from 792 m at Bhote Koshi to 7245 m at the peak of Lamtang Lirung peak. The LNP includes Gosaikunda, one of the Ramsr sites from Nepal and more than fifteen associated lakes. Lamtang Valley and adjoining areas of Lamtang National Park were focused for the current study. The

DOI: https://doi.org/10.54393/mjz.v4i01.60

elevation of the intensive survey areas ranged from 3000 m to 4200 m. Ghodatabela, Thangsyap, Lamtang Village, Sindum, Mundum and Kyanjing were the main sites for this study which lies in Gosainkunda Rural Municipality of Rasuwa District [30]. The lower region of Bhote Koshi consists of *Shorea robusta* forest which is associated with *Bombax ceiba*, *Semecarpus anacardium*, *Adina cordifolia*, *Terminalia tomentosa*, *Bauhina vahlii*, and *Butea monosperma.* Lower sub-alpine zone is composed of *Tsuga dumosa, Abies spectabilis*, *Rhododendron barbatum* mixed with *Acer campbelli*. In dry areas, *Juniperus recurva* is dominant. *R. lepidotum*, *R. campanulatum*, *Larix himalaica* and *Caragana sukiensis* are also found in this region. The south-facing slope of this region has dense shrub cover of *Caragana nepalensis* which is associated with *Berberis concinna*, *Rosa macrophylla* and *Rhododendron lepidotum*. The alpine region consists of scrub species such as *Rhododendron* spp., *Lonicera* spp., *Cotoneaster* spp. and *Juniperus* spp. that corresponds to the dry alpine scrub; moist scrub and grassland. LNP is inhabited by 46 species of mammals, 345 species of birds, 11 species of herpeto-fauna, 30 species of fish, 10 species of spiders, and 70 species of butterflies [30]. Rhesus macaque (*Macaca mulatta*), Assamese macaques (*M. assamensis*), Himalayan langur (*Semnopithecus schistaceus*) are some common primates found in this region. Fox (*Vulpes vulpes*), Red panda (*Ailurus fulgens*), Himalayan black bear (*Selenarctos thibetanus*), Leopard cat (*Felis bengalensis*), Common leopard (*Panthera pardus*), Clouded leopard (*Neofelis nebulosa*) and snow leopards (*P. uncia*) are the carnivores. Wild boar (*Sus scrofa*), Himalayan musk deer (*Moschus chrysogaster*), Barking deer (*Muntiacus vaginalis*), Ghoral (*Naemorhedus goral*), Himalayan tahr (*Hemitragus jemlahicus*) are the common ungulates [17, 30]. The preliminary field survey was carried out between 8–13 June 2019. Preliminary information on potential site of Himalayan tahr distribution was gathered through informal interaction and discussion with knowledgeable and concerned people, national park staff, herders and villagers. The pattern of distribution was investigated based on direct observation and presence or absence of pellets. During the preliminary survey, distribution of Himalayan tahrs was observed from Ghodatabela to Kyanjing Village, so, transects for the final population survey were designed for that area only. The estimation of the abundance of wild animal populations has been widely performed by line transect sampling [31, 32]. A set of lines or equally spaced lines were placed randomly in the survey areas for line transect sampling [31]. An observation was conducted along each line and the number of sighted animals was recorded with measurement of their distance from the trail. If animals were seen at random distance from the trail then perpendicular distance was calculated by using simple trigonometry after measuring the adjacent sides. For the groups of animals or pellet groups the centre of the group was identified and the shortest distance to the trail was measured. Following assumptions were made during this study regarding the population and distribution records of Himalayan tahrs: i) the herd of Himalayan tahr whose centers are on line or very near to the line is encountered with certainty; ii) the independent movement of Himalayan tahr is slow relative to observer's speed; iii) the distances from the line to the center of each detected herd is measured accurately; iv) there is an adequate sample of randomly-distributed lines which are positioned randomly in the survey zone.Field surveys were conducted from 11th May to 19th May 2022. For the study of the distribution and habitat preference of Himalayan tahr, 20 Km of the walking trail of Lamtang River of Lamtang National Park was chosen. 20 transects each of about 500 m length were established along the Lamtang River at different elevations from 3100 m to 4300 m for covering the maximum area of the National Park. The transects were laid randomly where distance between the transects varied from 200 m to 600 m and possible width was scanned which ranged from 100 m to 1000 m according to structure of the landscape. The species were observed from Ghodatabela to Kyanjing Village. Ghodatabela, Thangsyap, Gumpa, Lamtang village, Mundum, Singdum and Kengjing were the settlements along the trail. The survey started early in the morning from 6:30 AM and continued to 10:00 AM and repeated at noon from 2:30 PM to 5:00 PM in evening. The direct observation method was employed for species using 10×40 binoculars and photographs were taken using camera (Nikon D7100). The observed grazing or resting site was visited as far as possible and elevation, locations were recorded using a handheld GPS unit (Garmin eTrex 10). Along with occurrence points, habitat structure and vegetation compositions were recorded. The distance from trail, settlement and water source was measured by using measuring tape and using simple trigonometry. The slope, aspect and terrain type were also noted and the general disturbance factors like people, livestock, and predators in the habitat were recorded.nOnce the animals were sighted, the counting of individuals in a herd was performed from ridge line vantage points similar to the method suggested by Jackson and Hunter [33]. The vantage points help in wide scanning of study area for proper identification [34]. Records of group size, sex, age, and other features were noted along with date and time. The male, female and juvenile were categorized on basis of bigger body with manes, bigger body without manes and smaller body, respectively. Individuals were categorized into different herds when the distance between two groups

DOI: https://doi.org/10.54393/mjz.v4i01.60

was more than 500 m. The habitat parameters were studied in Himalayan tahr observed site. Habitat suitability was studied on basis of availability of Himalayan tahr in different habitats. The variables were categorized into distinct groups with sub-groups for determination of habitat preference of Himalayan tahr. Total available habitats were categorized into four groups- Rhododendron forest, shrubland, grassland and rocky cliff. Data analysis, visualization as tables, figures, graphs, charts and mathematical calculations were performed through Microsoft Excel. Presence-absence of Himalayan tahr was verified in each transect and locations recorded were used during preparation of distribution map. ArcGIS-10.3 software was used to produce a Himalayan tahr distribution map based on the current distribution area. Population data were analyzed under different parameters.

$$\text{Average herd size} = \frac{\text{Total number of individuals observed}}{\text{Total number of herds observed}}$$

$$\text{Sex ratio} = \frac{\text{Total number of Male Tahr}}{\text{Total number of Female Tahr}}$$

$$\text{Young to adult female ratio} = \frac{\text{Total number of young}}{\text{Total number of females}}$$

The overall density of Himalayan tahrs was calculated by,

$$\text{Population density} = \frac{\text{Total number of individuals observed}}{\text{Total area surveyed}}$$

The habitats were categorized into four categories (Rhododendron forest, shrubland, grassland and rocky cliff) and difference in the number of individuals of Himalayan tahrs in those four categories was tested for significance by χ^2-test. Similarly, the observed slopes were categorized into four categories (flat<20°, moderate= 20°-40°, steep= 40°-60° and very steep >60°) and aspects were categorized into three categories (south, south-east and south-west). The difference in number of Himalayan tahrs in those categories was also tested for statistical significance by χ^2-test.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

Where, O = observed frequency and E = expected frequency

RESULTS

A total of 154 individuals from nine herds of Himalayan tahrs were recorded along the Lamtang River of Lamtang National Park (Table 1). During the study, it was found that the average herd size of 17.1±5.77.

Figure 2: Himalayan tahrs observed along Lamtang River in Lamtang National Park (Photo: Birat Raj Rajak)

Himalayan tahr herds were mostly observed from rocky cliff (45%) habitats followed by shrubland (22%), grassland (22%), and Rhododendron forest (11%). The distribution range of entire population of Himalayan tahrs was between 3107 m to 4200 m with a mean elevation of 3346 m.

Table 1: Population size and Composition of Himalayan tahr in LNP

S.N.	Latitude	Longitude	Elevation	Location	AM	AF + SAM	Juv.	Total
1	28° 11.858'	85° 27.365'	3107	Ghodatabela-1	2	6	1	9
2	28° 12.259'	85° 27.931'	3126	Ghodatabela-2	4	8	1	13
3	28° 12.451'	85° 28.458'	3131	Ghodatabela-3	4	-	-	4
4	28° 12.512'	85° 28.567'	3202	Thangsyap-1	5	-	-	5
5	28° 12.594'	85° 28.848'	3271	Thangsyap-2	8	24	7	39
6	28° 12.744'	85° 29.437'	3295	Thangsyap-3	3	13	2	18
7	28° 13.091'	85° 29.502'	3376	Gompa-1	6	8	5	19
8	28° 13.230'	85° 29.753'	3401	Gompa-2	5	17	4	26
9	28° 13.184'	85° 33.210'	4200	Kyanjing	7	11	3	21
Total					44	87	23	154

Two types of herds of Himalayan tahrs were observed throughout the study. Out of nine herds observed, seven (78%) were mixed herds and two (22%) were male-only herds. Out of 154 Himalayan tahrs observed, 107 were classified into their respective sex and age, remaining 47 could not be classified due to a long-distance view and morphological similarities of subadult females and subadult males. The adult sex ratio was observed to be 1:1.88 and adult female-to-juvenile ratio was found to be 1:0.19. Effects of habitat characteristics such as habitat types, slope, elevation and aspect on the abundance of Himalayan tahrs were analyzed. About 39% (n=60) of Himalayan tahrs were observed from rocky cliff habitats followed by grassland and shrubland (Figure 3). There was a statistically significant difference in the abundance of Himalayan tahrs in different habitat categories (χ^2 = 37.013, $p < 0.001$).

DOI: https://doi.org/10.54393/mjz.v4i01.60

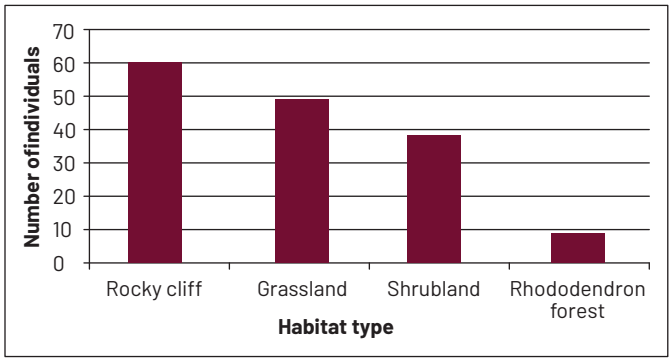


Figure 3: Abundance of Himalayan tahrs in different habitat types available in the LNP

Majority of the individuals of Himalayan tahrs were observed from the very steep slopes (85.79%). There was a significant difference in number of individuals observed among the four types of slopes in the study area (χ^2= 157.636, df= 3, p < 0.001)(Figure 4).

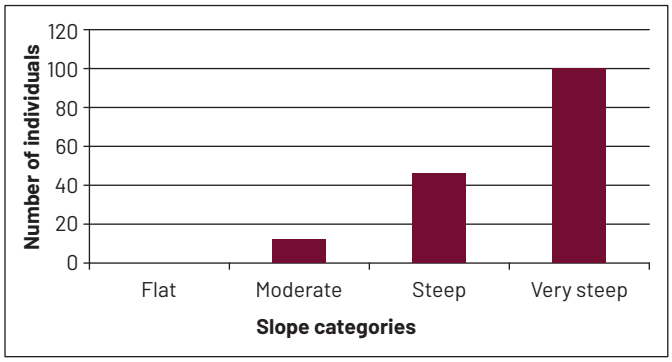


Figure 4: Variation in number of Himalayan tahrs observed from different slope categories of the LNP

The distribution range of entire population of Himalayan tahr was between 3107 m to 4200 m where the highest number of individuals was observed between the elevational range of 3200–3400 m asl (Figure 5).

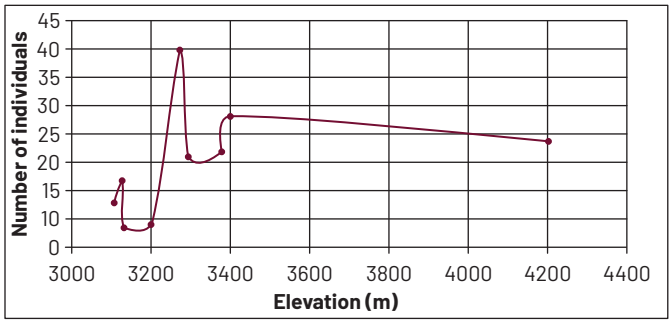


Figure 5: Variation in number of Himalayan tahrs according to elevation in the LNP

The observation of 52% (n = 80) of Himalayan tahrs was on the south-facing slope followed by South-east and South-west facing slopes. The difference was statistically significant (χ^2= 53.50, p< 0.001)(Figur 6).

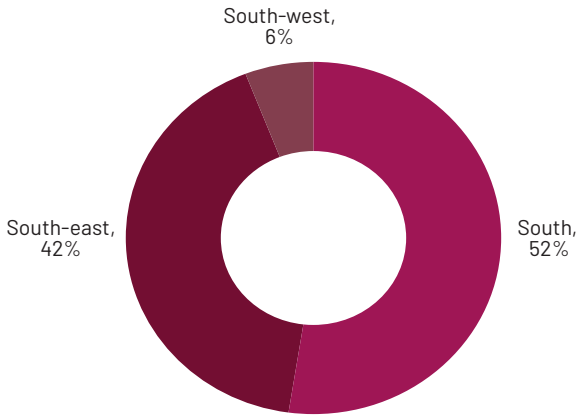


Figure 6: Percentage of Himalayan tahr population in different slope-aspect of the LNP

DISCUSSION

This study explored the population status, distribution and habitat features of threatened species- Himalayan tahrs in Lamtang National Park (LNP), Central Nepal. A total of 154 individuals of Himalayan tahrs belonging to nine herds were observed which accounted for an average herd size of 17.1 individuals. Tiwari [17] recorded a total of 218 Himalayan tahrs in LNP with an average herd size of 27.25 individuals. The largest maternal herd was recorded with 77 individuals in LNP where average group size was 15 which shows the decline in population and herd size of Himalayan tahrs in the same area when compared with the demographic data of 1976 [35]. The maternal herd ranged in size between 1-57 while male herd's size ranged from 1-13 [36]. The average group size of Himalayan thar varied from 3 to 16 individuals in different habitats of Dhorpatan Hunting Reserve [37]. The study of Himalayan tahrs in Kang Chu Valley of east Nepal revealed the average group size of 7 in winter where the largest maternal herd was observed with only 23 individuals [38] which is much lower than our findings. The record of herd size of our study varied from 4 to 39 which is similar to most of the studies. Two male herds with 4 and 5 individuals were recorded among nine herds showing male bands as reported in previous study [38]. Himalayan tahrs were reported from the Lamtang Valley during the study in 2006 but no observation was recorded in our study. Previous geological and environmental research has extensively demonstrated the severe decline of animal populations and the degradation of their habitats due to an earthquake of 2015 in Lamtang National Park [39, 40]. The Lamtang Valley was heavily destructed due to a massive landslide after the earthquake of April 2015 in Nepal. However, before concluding the complete loss of Himalayan tahrs from the valley after an earthquake, a detailed study is essential. The occurrence of 11% adult males, 49% adult females and sub adults, 18% yearlings and 22% young were reported in eastern Nepal when 50

DOI: https://doi.org/10.54393/mjz.v4i01.60

Himalayan tahrs were counted [38]. Similarly, the observation of 17% adult males, 47% adult female-sub adults, 17% yearlings and 14% young were recorded in LNP [35]. This study revealed 31% adult males, 57% adult females and subadults and 11% young which showed more adult males in comparison to previous study with almost similar results for other two groups. The sighting of 25% male herds, 37.5% adult female-young herd and 37.5% adult male-adult female herd were concluded in LNP in 2006 [17] but current study showed only two types of herds as adult male- adult female herd was not observed during this study. Only two types of herds were observed in LNP during our study where of which seven were mixed herds and two were male herds. Previous study conducted in Dhorpatan Hunting Reserve documented a total of 285 Himalayan tahrs, with a sex ratio of 3 males to 5 females [18]. In the LNP during a survey in 2006, average adult sex ratio was 1 male per 8 adult females and young to adult female ratio was 1 young per 5 females. This study in the same habitat showed an adult sex ratio of 1:1.88 which was found to be similar to previous studies and a juvenile-adult female ratio of 1:5.1 which was also similar as other results. The observation of Himalayan tahrs was 46.55% in grassland and 44.82% in vegetated rocky areas [17]. Himalayan tahrs were dominated by rocky cliffs (45%), followed by shrubland (22%), grassland (22%) and rhododendron forest (11%). Himalayan tahr is more or less continuously distributed in all types of vegetation like forestland close to open grassy vegetation, shrubland of different types, and steep grassland [3] which was quite different from our study. In Kedarnath Wildlife Sanctuary, Uttarakhand, Himalayan tahrs used the subalpine scattered tree and scrub, alpine scrub and alpine meadow habitats [41]. Himalayan tahrs occupy mountainous habitats with topographical features characterized by rocky terrain, vertical cliffs and rocks covered by tree lines between 1,500m and 5,300m [42]. But in some research, it was never found above the tree line, i.e. above 3050 to 3660m [42]. The habitat of this species is the subalpine zone from 3900m-5200m within the Trisuli Watershed in central Nepal [43]. In Kang Chu valley of Nepal also Himalayan tahrs were reported to use a variety of vegetation types in the altitude range 2500–4400 m [38]. The distribution range of the entire population of the species was recorded from 3700–4900m with a mean elevation of 4300 m [17]. Similarly, Himalayan Tahr was recorded between an elevation of 3000 m to 5000 m in Sagarmatha National Park and Annapurna Conservation Area, Nepal [18]. The distribution was found between 3000 m to 3400 m in a sanctuary of India [41]. The distribution range of Himalayan tahr in Lamtang LNP was between 3107 m to 4200 m during this study which was similar to most of the studies. Slopes can indeed provide animals with a safe place from predators and human disturbance due to several factors like topographical advantages, reduced human activity and vegetation cover [44]. Himalayan tahrs were found at a slope having range of 10–30° to 50–70°, aspect of south-east, south-west and south in Sagarmatha National Park [18]. The preference of higher and middle slopes was observed in LNP [17]. Slope angle was categorized into "flat" <20°, "moderate" 20°–40°, "steep" 40°–60° and "very steep" >60° where the most chosen slope was steep slope and flat slope was never used by Himalayan tahrs in LNP during this study. The broken terrain was preferred more followed by very broken and smooth terrain. The observation of 56% of herds of Himalayan tahrs was on south facing slope followed by a south-east-facing slope and south-west-facing slope. In Nanda Devi Biosphere Reserve, it was reported that the Himalayan tahrs were fairly distributed between the elevations of 2500 m and 4500 m, on the eastern 60%, southeastern 30%, southwestern <10% and western slopes mainly on steeper slopes 50°–60° [45]. The evidence of predation or record of any fatal accident of Himalayan tahr was not encountered in the LNP during the present study. The deaths of tahr occurred through accidental falls in New Zealand [46], and falling of Himalayan tahrs have been reported during crossing of the iced surfaces [11,38]. The diseases and parasites of tahr is not studied yet in LNP but some studies are available which have studied its parasites [26]. The Survey about perception towards tahr in LNP showed that 80% of people have good thought regarding tahr, 5% have no concern but 15% was threat due to grazing of crops by tahr but poaching was very less [18]. The occasional poaching of Himalayan tahr was found to be known through informal interviews especially by the workers from other districts only as Lamtang has majority of Buddhists. The loss of Habitat and poaching of animals pose an intense challenge for conservation of wildlife in Nepal's mountains [47]. The harvesting of grass for livestock was reported as the major threat of Himalayan tahr in Sagarmatha National Park [48]. A similar pressure was observed in LNP with considerable habitat destruction [17] which was observed to be similar during current study so number of livestock should be limited inside park. The conservation of wildlife is directly affected by local people's perception towards them which was found positive in LNP. The high traffic of tourists was also observed in LNP so it should be managed. Following the 2015 earthquake, Lamtang Valley experienced landslides, resulting in the absence of Himalayan tahr sightings in the areas where they had been previously observed according to earlier studies [17, 27]. Therefore, a detailed assessment of such catastrophes in the population status of wild animals is inevitable for their conservation.

DOI: https://doi.org/10.54393/mjz.v4i01.60

CONCLUSIONS

This study concluded that Himalayan tahr is distributed in higher elevational of Lamtang National Park from 3107 m to 4200 m. They prefer rocky cliffs followed by grassland, shrubland and Rhododendron-fir-mixed forest. They use broken terrain in south facing slopes. The demographic indices of the Himalayan tahrs show a remarkable decline when compared with the previous studies in 1976 and 2006. Therefore, conservation and management initiatives of the Himalayan tahrs are urgently needed in the Lamtang National Park of the Nepal Himalayas.

Authors Contribution

Conceptualization: LK
Methodology: PD, NP
Formal analysis: RKS, BRR
Writing-review and editing: LK, PD, RKS, BRR

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Zafar MZ, Khan B, Ahmed E, Khan G, Ajmal A, Ali R, *et al*. Abundance distribution and conservation of key ungulate species in Hindu Kush Karakoram and Western Himalayan (HKH) mountain ranges of Pakistan. International Journal of Agriculture and Biology. 2014 Dec; 16(6): 1050–8.

[2] Kittur S, Sathyakumar S, Rawat GS. Assessment of spatial and habitat use overlap between Himalayan tahr and livestock in Kedarnath Wildlife Sanctuary, India. European Journal of Wildlife Research. 2010 Apr; 56: 195–204. doi: 10.1007/s10344-009-0302-3.

[3] Thakuri S. Habitat suitability analysis of key mammals: combining CCA with GIS application. Journal of Nepal Science Olympiad. 2016 Feb; 1(1): 61–7.

[4] Bhattacharya T, Bashir T, Poudyal K, Sathyakumar S, Bisht S, Saha G. Distribution, relative abundance and habitat use by mountain ungulates in Prek Chu catchment, Khangchendzonga Biosphere Reserve, Sikkim, India. Galemys. 2010; 22:149–70.

[5] Jetz W, McPherson JM, Guralnick RP. Integrating biodiversity distribution knowledge: toward a global map of life. Trends in Ecology & Evolution. 2012 Mar; 27(3): 151-9. doi: 10.1016/j.tree.2011.09.007.

[6] Soulé ME, Estes JA, Berger J, Del Rio CM. Ecological effectiveness: conservation goals for interactive species. Conservation Biology. 2003 Oct; 17(5): 1238-50. doi: 10.1046/j.1523-1739.2003.01599.x.

[7] Amin R, Baral HS, Lamichhane BR, Poudyal LP, Lee S, Jnawali SR, *et al*. The status of Nepal's mammals. Journal of Threatened Taxa. 2018 Mar;10(3): 11361-78. doi: 10.11609/jott.3712.10.3.11361-11378.

[8] Estes JA, Terborgh J, Brashares JS, Power ME, Berger J, Bond WJ, *et al*. Trophic downgrading of planet Earth. science. 2011 Jul; 333(6040): 301-6. doi: 10.1126/science.1205106.

[9] Van der Waal C and Dekker B. Game ranching in the northern province of South Africa. South African Journal of Wildlife Research-24-month Delayed Open Access. 2000 Jan; 30(4): 151-6.

[10] Ogutu ZA. The impact of ecotourism on livelihood and natural resource management in Eselenkei, Amboseli ecosystem, Kenya. Land Degradation & Development. 2002 May; 13(3): 251-6. doi: 10.1002/ldr.502.

[11] Anderson JA and Henderson JB. Himalayan thar in New Zealand: aspects of life history and assessment of management problems. New Zealand Deerstalkers Association. 1961; 2: 37.

[12] Lovari S, Ale SB, Boesi R. Notes on the large mammal community of Sagarmatha National Park (Nepal). In Proceedings of International Karakorum Conference. Islamabad, Pakistan. 2005: 225-230.

[13] Forsyth DM. Ecology and management of Himalayan thar and sympatric chamois in the Southern Alps, New Zealand (Doctoral dissertation, Lincoln University). 1997. Available at: https://researcharchive.lincoln.ac.nz/handle/10182/1774.

[14] Buffa G, Ferrari C, Lovari S. The upper subalpine vegetation of Sagarmatha National Park (Khumbu Himal area, Nepal) and its relationship with Himalayan tahr, musk deer and domestic yak. In: R. Baudo, G. Tartari, M. Munawar (Eds.), Top of the World environmental research: Mount Everest-Himalayan ecosystem: Backhuys Publishers, Leiden. 1998: 167–75.

[15] Green MJ. Tahr in a Nepal national park. Oryx. 1979 Nov; 15(2): 140-4. doi: 10.1017/S0030605300024224

[16] Shrestha B. Status, distribution and potential habitat of Himalayan tahr (*Hemitragus jemlahicus*) and conflict areas with livestock in Sagarmatha National Park, Nepal. Nepal Journal of Science and Technology. 2006; 7: 27-34. doi: 10.3126/njst.v7i0.568.

[17] Tiwari DP. Status, Habitat Uttlization and Conservation of Himalayan Tahr *Hemitragus jemlahicus* (H. SMITH, 1826) In Langtang National

DOI: https://doi.org/10.54393/mjz.v4i01.60

Park, Central Nepal (Doctoral dissertation, Department of Zoology). 2006. Available at: https://elibrary.tucl.edu.np/handle/123456789/9120.

[18] Karki JB and Thapa BB. Status of blue sheep and Himalayan tahr in Dhorpatan Hunting Reserve, Nepal. Banko Janakari. 2011 Oct; 21(1): 25-30. doi: 10.3126/banko.v21i1.9060.

[19] Katuwal HB, Khanal B, Basnet K, Rai B, Devkota S, Rai SK, *et al*. The mammalian fauna from the Central Himalaya, Nepal. Asian Journal of Conservation Biology. 2013 Jul; 2(1): 21-9.

[20] Thapa C and Maharjan M. Parasitic burden in high altitude wild ruminants: Himalayan Tahr (*Hemitragus jemlahicus* Smith, 1826) and Barking Deer (Muntiacus vaginalis Boddaert, 1785) of Rara National Park, Nepal. Nepal Journal of Environmental Science. 2015 Dec; 3: 1-6. doi: 10.3126/njes.v3i0.22727.

[21] Devkota BP, Silwal T, Shrestha BP, Sapkota AP, Lakhey SP, Yadav VK. Abundance of snow leopard (*Panthera uncia*) and its wild prey in Chhekampar VDC, Manaslu Conservation Area, Nepal. Banko Janakari. 2017 Nov; 27(1): 11-20. doi: 10.3126/banko.v27i1.18545.

[22] Singh VK, Joshi BD, Dalui S, Ghosh A, Jabin G, Sharief A, *et al*. Genetic diversity and population structure of Himalayan tahr (*Hemitragus jemlahicus*) from Western Himalaya. Mammalia. 2023 May; 87(3): 238-44. doi: 10.1515/mammalia-2022-0037.

[23] Caughley G. Eruption of ungulate populations, with emphasis on Himalayan thar in New Zealand. Ecology. 1970 Jan; 51(1): 53-72. doi: 10.2307/1933599.

[24] Green MJ. The ecology and feeding behaviour of the himalayan the (*Hemitragus jemlahicus*) in the Langtang valley, Nepal (Doctoral dissertation, Durham University). 1978. Available at: http://etheses.dur.ac.uk/8982/1/8982_5913.PDF?UkUDh:CyT.

[25] Esfandabad BS, Karami M, Hemami MR, Riazi B, Sadough MB. Habitat associations of wild goat in central Iran: implications for conservation. European Journal of Wildlife Research. 2010 Dec; 56: 883-94. doi: 10.1007/s10344-010-0386-9.

[26] Schaller GB. Mountain monarchs. Wild sheep and goats of the Himalaya. University of Chicago Press. 1977: 425.

[27] Green MJ. Ecological separation in Himalayan ungulates. Journal of Zoology. 1987 Mar; 1(4): 693-719. doi: 10.1111/j.1096-3642.1987.tb00751.x.

[28] Fox JL, Nurbu C, Chundawat RS. The mountain ungulates of Ladakh, India. Biological Conservation. 1991 Jan; 58(2): 167-90. doi: 10.1016/0006-3207(91)90118-S.

[29] De Garine I and de Garine-Wichatitsky M. Providing impala meat (*Aepyceros melampus*) to local populations in Nyaminyami (Omay, Zimbabwe): Nutritional and sociocultural aspects of man-wildlife interactions. Bois Et Forets Des Tropiques. 1999; 262: 61-76.

[30] DNPWC. Department of National Parks and wildlife Conservation Government of Nepal. Kathmandu, Nepal. 2023. [Last Cited: 26 Jun 2023]. Available at: https://dnpwc.gov.np/en/.

[31] Buckland ST, Anderson DR, Burnham KP, Laake JL, Borchers DL, Thomas L. Introduction to distance sampling: estimating abundance of biological populations. OUP Oxford. 2004 Aug. Available at: 10.1002/0470011815.b2a16019.

[32] Buckland ST, Rexstad EA, Marques TA, Oedecoven CS. Distance Sampling: Methods and Applications. Springer Cham. Available at: 10.1007/978-3-319-19219-2.

[33] Jackson RM and Hunter DO. Snow leopard survey and conservation handbook. International Snow Leopard Trust. 1996 Nov. Available at: https://snowleopardconservancy.org/pdf/SL_Survey_Cons_Handbook_Part_1.pdf.

[34] Ashraf N, Anwar M, Hussain I, Mirza SN. Population parameters of Grey goral (*Naemorhedus goral goral*) at two different sites in Machiara National Park, Azad Jammu and Kashmir, Pakistan. JAPS: Journal of Animal & Plant Sciences. 2015 Feb; 25(1): 88-94.

[35] Lovari S. Observations on the Himalayan Tahr (*Hemitragus jemlahicus*) and other ungulates of the Sagarmatha National Park, Khumbu Himal, Nepal. Oecologia Montana. 1992 Jun; 1(1): 51-2.

[36] Gurung JB. Population, habitat selection and conservation of Himalayan tahr in the Annapurna Sanctuary, Nepal (Doctoral dissertation, M. Sc. thesis. Agricultural University of Norway). 1995. Available at: https://elibrary.tucl.edu.np/bitstream/123456789/9120/1/Full%20Thesis%283%29.pdf.

[37] Austegard GO and Haugland H. Trophy hunting in Nepal: a case study on Blue Sheep in Dhorpatan Shikar Reserve. M. Sc. Degree., Agriculture University of Norway. 1993.

[38] Schaller G. Observations on Himalayan tahr (*Hemitragus jemlahicus*). The Journal of the Bombay Natural History Society. 1973; 70: 1–24.

[39] Holtmeier FK and Broll G. Subalpine forest and treeline ecotone under the influence of disturbances: a review. Journal of Environmental Protection. 2018 Jun; 9(07): 815. doi:10.4236/jep.2018.97051.

[40] Tuladhar S, Pasakhala B, Maharjan A, Mishra A.

DOI: https://doi.org/10.54393/mjz.v4i01.60

Unravelling the linkages of cryosphere and mountain livelihood systems: A case study of Langtang, Nepal. Advances in Climate Change Research. 2021 Feb; 12(1): 119-31. doi:10.1016/j.accre.2020.12.004

[41] Sathyakumar S, Rawat G, Johnsingh A. Himalayan tahr. Mammals of South Asia. Oxford University Press, England. 2009: 385-408.

[42] Spinage CA. African ungulate life tables. Ecology. 1972 Jul; 53(4): 645-52. doi: 10.2307/1934778.

[43] Prater SH and Barruel P. The book of Indian mammals. Bombay Natural History Society. 3rd Edition. the Bombay Natural History Society.1971: 348.

[44] Fotang C, Bröring U, Roos C, Enoguanbhor EC, Dutton P, Tédonzong LR. Birkhofer K. Environmental and anthropogenic effects on the nesting patterns of Nigeria–Cameroon chimpanzees in North-West Cameroon. American Journal of Primatology. 2021 Sep; 83(9): e23312. doi:10.1002/ajp.23312.

[45] Kandpal V and Sathyakumar SA. Distribution and relative abundance of mountain ungulates in Pindari valley, Nanda Devi Biosphere Reserve, Uttarakhand, India. Galemys. 2010; 22(1): 277-94.

[46] Douglas M. The warning whistle of thar: Tussock Grasslands and Mountain Lands Institute Review (New Zealand). Forest and Bird. 1977; 15: 2–6.

[47] Paudel PK. Understanding wildlife distribution in the human-dominated landscape of Nepal: implications for conservation. PhD Thesis; University of South Bohemia in České Budějovice. 2012. Available at: https://dspace.jcu.cz/handle/123456789/23657.

[48] Shrestha B, Kindlmann P, Jnawali SR. Interactions between the Himalayan tahr, livestock and snow leopards in the Sagarmatha National Park. Himalayan Biodiversity in the Changing World. Springer, Dordrecht. 2012 Jan: 115-43. doi: 10.1007/978-94-007-1802-9_5.