Chapter

Wildlife Population Monitoring Study among Endangered Animals at Protected Areas in Nepal

Amir Sadaula, Yagya Raj Pandeya, Yogendra Shah, Dhan Kumar Pant and Rabin Kadariya

Abstract

Nepal is a small country located in South Asia which is geographically highly diverse and fairly rich in its variety of endangered wild animals. Conservation and monitoring of endangered wildlife is great challenging task in developing country like Nepal. Different body parts of wild animals are used as raw material for making pharmaceutical products, cosmetic, and other purpose; hence their value increased in the international market, as a result poaching and trading activities of endangered wild animals has been increased rapidly at protected areas in Nepal. This review will provide detailed information about different population monitoring techniques being applied for different endangered wild animals in protected areas of Nepal. Techniques like camera trapping, radio collar, noninvasive methods, mobile application, GPS, GIS, direct head count, etc. are commonly used for monitoring wildlife in Nepal. Since conservation of endangered wildlife species has become very much crucial, more advance technologies and social network analysis will be also used to determine the monitoring of wild animals at protected areas in Nepal.

Keywords: South Asia, conservation, protected areas

1. Introduction

Nepal is a small landlocked country located in Southeast Asia surrounded by India (South, East, and West) and China (North), which is geographically highly diverse and fairly rich in its variety of endangered flagship species, that is, wild animal and plants. The conservation of endangered wild animal species is a major challenge to government conservation of endangered wild animal species is a major threat as well as a challenge to government in developing countries particularly Nepal to protect the loss and degradation of natural habitats, poaching, and illegal trade activities of their crucial body parts for making pharmaceutical products, cosmetic, and other purpose [1]. Therefore, monitoring tools can be helpful to minimize the risk of possible human-animal conflict and also above described conditions especially to extinction of endangered wild animals in Nepal [2, 3].

However, the Government of Nepal has already successfully used the modern technologies such as radio collars and camera trap to monitor and conserve some endangered species like tigers and vulture at protected areas [4–7]. In the other hand, monitoring technologies have also several limitations, for example, camera trapping and radio collar require a long period of time as well as high costs [8]. Noninvasive genetic analysis from scat, urine, and hair samples have become widely used in wildlife research study, where molecular markers helps to identify the species, sex, and individuals [9, 10]. noninvasive genetic analysis from scat, urine, and hair samples have become widely used in wildlife research study, and additionally molecular markers can also help to identify the species, sex, and individuals [9, 10]. Noninvasive genetic analysis technique is more safe and avoids the potential harmful effects from direct contacts with endangered wild animal species while performing research at protected areas [11]. In Nepal, more than dozens of previous studies on endangered wild animal species have been successfully recognized by applying the noninvasive genetic analysis insight into population structure, mitochondrial (mt) DNA of cytochrome b and D-loop control region sequencing, effective population size, phylogenetic inference, and other modeling [9, 10, 12, 13] approach as described in **Table 1** [14–21].

Nepal has a total area of 147,181 square kilometers of which protected area mainly includes forest land area of different altitudes in terai, hills, and mountains. This possesses a multitude of landscape and maintains vast biodiversity in the Palearctic and Indo-Malayan ecozones. In Nepal, altitude ranges from 67 m in the southeastern Terai to 8848 m at the highest peak in the world "the Mount Everest." It has 11 bioclimatic zones which are ranging from lower tropical below 500 m to nival above 5000 m in the high Himalayas containing 9 terrestrial eco regions with 36 vegetation types. Nepal attains 10th rank in terms of richest flowering plant diversity in Asia having 1120 species of nonflowering plants and 5160 species of flowering plants. According to recording made by zoologists, Nepal has 181 mammal species, 844 bird species, 100 reptile species, 43 amphibian species, 185 fresh water fish species, and 635 butterfly species. For protection of biodiversity, the Government of Nepal has established 20 protected areas since 1973 AD consisting 10 national parks, 3 wildlife reserves, 6 conservation areas, and 1 hunting reserve. Suklaphata and Parsa wildlife reserves were upgraded to national parks in 2017 AD. Nine different Ramsar sites have been declared between 1988 and 2008.

Wild animal population is monitored for different reasons like to know the status of species whether it is in endangered or threatened state, biological interest or research purposes, game management, population being monitored to assess recovery or progress of any threatened species, biological diversity study, to know the effects of human management actions, land use patterns, etc. [7, 22, 23].

Very much careful consideration has to be done in collecting information about wild animals for monitoring wildlife population. Direct observation of animal and behavior observation is important for wildlife population monitoring. Tracks and dung of animal, thermal cameras or attaching monitoring devices like collars, leg bands, and data loggers are also used for population monitoring [7].

The purpose of this review study is to highlight the different population monitoring techniques being applied in Nepal for different endangered wild animals and their application in the field condition. Based on these applied techniques, counting of animals and their status and further research and conservation strategy are made.

Endangered species		Genetic techniques				Conservation location	Monitoring method	Reference
Common name	**Scientific name**	**Sample**	**Sample size**	**Genetically profile remarks**	**Genetic analysis**			
Snow leopard	*Pantheria unica*	Scats	71 putative scats	(i) 19 (27%) scats: genetically identified; 10 (53%) successfully genotype at 6 microsatellite loci. (ii) Total 9 individual snow leopards; 4 individual identified at SPNP (1 male and 3 females) and 5 (2 male and 3 females) at KCA.	PCR; mitochondrial cytochrome b gene/ carnivore specific/ species /sex/individual identification	(SPNP) (KCA)	Noninvasive genetic analysis	[14]
Bengal tiger	*Panthera tigris tigris*	Feceal sample/ tigerparts/ skin vespieces/ blood smear	(*n* = 770)120 (15 putative cases)	(i) All forensic samples (*n* = 15) were of tiger: 10 male and 5 females. (ii) Geo-source location for 9 of the 14 samples with 6 ± 8 nuclear DNA microsatellite loci (iii) 6 samples were assigned to BNP and 1 was an exact match to a female tiger previously profiled according to their fecal DNA reference database. (iii) 2 tiger samples were assigned to SWR (iv) 1 from CNP	PCR; mt DNA cytochrome-b (CYT-B)/ species/sex/individual identification	CNP BNP SWR PWR	Noninvasive genetic analysis/ genetic structure analysis/ Geo-source assignment of unknown tigers/Molecular forensic techniques	[15]
Himalayan black bear	*Ursus thibetanus laniger*	Fresh bear feces/hair sample	n = 126 fecal samples n = 21 hair samples	8 microsatellite loci by using 147 samples: 60 individual identified.	PCR: mt control region (CR) D-loop/ cytochrome-b/whole mitogenome sequencing	ACA	Non-invasive genetic diversity/microsatellite genotyping/mitochondrial DNA sequencing/phylogenetic inference	[16]

Endangered species		Genetic techniques				Conservation location	Monitoring method	Reference
Common name	**Scientific name**	**Sample**	**Sample size**	**Genetically profile remarks**	**Genetic analysis**			
Hanuman langur	*Semnopithecus entellus*	Fecal sample	67 non-invasive fecal sample	(i) DNA sequences; successfully; 67 non-invasively collected fecal samples belonging to 18 wild Hanuman langur troops covering the entire distribution range of the species in Nepal. (ii) identified 37 haplotypes from the concatenated CR + CYTB (2230 bp) sequences	PCR: mt DNA control region (R = 1090 bp), cytochrome B (CYTB=1140 bp) sequences	KRS GRS KMRS	Non-invasive genetic diversity/population genetic structure/ molecular analysis/ paleodistribution modeling	[17]
Assam macaques	*Macaca assamensis*	Fecal sample	227 fecal samples collected from 39 wild troops	The mt DNA fragment complete control region (1121 bp): recovered from 208 fecal samples defining into 54 haplotye.	PCR: mt DNAcomplete control region (1121 bp)		Non-invasive genetic analysis/population genetic structure/paleodistribution constrcution	[18]
Tiger	*Panthera tigris tigris*	Fecal sample (Scat)	770 scat samples	(i).770 scat samples; 412 (57%) (ii) Out of 10 microsatellite loci; 8 markers identify 78 individual tigers (iii) Sex was genetically identified 353 scat samples; 255 samples (male) and 98 female	PCR:mt DNA cytochrome B fragment (162 bp)/species/ sex/individual identification	SuNP BNP BaNP CNP PNP	Non-invasive genetic analysis/genetic structure/ population structure/ genetic variation/ contemporay gene flow/ potential population	[19]
Snow leopard Himalayan Wolf	*Panthera unica* *Canis lupus chanco*	Scat samples	N = 573 leopard scat samples N = 236 wolf scat samples	N = 182 Wolf = 57	PCR:mt DNA cytochrome B/ species/sex/ individual identification	ACA MCA	Non-invasive genetic analysis	[20]

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Endangered species		Genetic techniques				Conservation location	Monitoring method	Reference
Common name	Scientific name	Sample	Sample size	Genetically profile remarks	Genetic analysis			
Himalayan Wolf	*Canis lupus chanco*	Fecal samples	N = 6 fecal samples	Out 6 fecal samples; 5 samples were successfully ampfified	PCR: mt DNA control region CR locus (220 bp)	ACA	Non-invaasive genetic analysis/molecular analysis/phyolgenetic analysis	[21]

SPNP, Shey Phoksundo National Park; KCA, Kangchanjunga Conservation Area; BNP, Bardia National Park; CNP, Chitwan National Park; PWR, Parsa WildlifeReserve; SWR, Suklaphanta Wildlife Reserve; ACA, Annapurna Conservation Area; KRS, Koshi River System; GRS, Gandaki River System; KMRS, Karnali-Mahakali River System; SuNP, Suklaphanta National Park; PNP, Paras National Park; MCA, Manasula Conservation Area.

Table 1.
Non-invasive genetic analysis studies were identified among the endangered wild animals species at protected areas in Nepal from 2011-2018.

2. Monitoring systems

Although conservation practice has come since long time in Nepal, only few biodiversity monitoring systems exist. Among existed system, the address is only for some mammal species of Terai region and one species of mountain (snow leopard). In monitoring process, repeated measurements are taken, and comparison is made to understand the cause of change.

Therefore, biodiversity monitoring includes carrying out repeated survey works to find out the size and extent of population of certain species. It also includes quality of habitat of certain species analysis results to find out trend and rate of change of species being monitored. By using standard methods and different field protocols, data is collected, and it is analyzed to determine the rate of progress. In the field data collection procedure ecologists and managers will be assisted by data analysis and GIS techniques.

GIS allows team to identify areas where they live. By overlying within a GIS environment, areas which match all criteria can be identified within minutes. This saves much fieldwork time, especially on hills and mountains where most wildlife habitat areas need to be accessed only on foot. Another important contribution made by GIS is in locating sample plots, which is crucial for validating datasets and results obtained from them. By the use of GIS, sample plot location can be identified either randomly or systematically. Thus identified sample plots can be overlaid within the three-dimensional GIS model, which will be helpful in providing exact impression of real field location. Location of these plots can be extracted from the GIS and will be identified in the field using GPS.

GIS uses uniform addressing format in the form of latitude, longitude, and altitude which is another advantage. Geostatistical techniques offer interpolation tools that take into consideration continuously changing spatial variables, which cannot be performed with general statistics. Such interpolation tools are useful for generating stoking density, especially of floral biodiversity [23–25].

2.1 Tiger monitoring (*Panthera tigris*) in Nepal

Abundance (N) and density (D) are important population parameters estimated for tiger monitoring programs. Photographic capture-recapture through camera trap is a most reliable technique for estimating tiger population as it being elusive species and the use of the unique identification patterns on each individual. Capture-recapture models provide a statistically robust framework to estimate species abundance, particularly when a population is said to be closed to births, deaths, immigration, or emigration during the survey period [26]. For camera trapping protected area or forest is divided into grids of 2 km × 2 km area, and a pair of cameras is placed in each grid cells. Field sampling design is determined by the size of the survey area and availability of logistics like camera number and personnel. Camera trapping was conducted in shifting blocks as described by Royle et al. [25] in each protected area and surrounding forests, which are divided into several blocks. Stations for camera trap are determined through prior sign survey of area like pugmarks, scrapes, and scat. In each station, two cameras are placed facing each other at a height of 45 cm above ground and were mounted on trees or posts on either side of a forest trail or road, with a distance of 6–8 m between the two cameras. In every grid cameras are placed for the standard sampling period of 15 nights. Each camera and memory card is given a unique identification number for data recording and maintenance purposes. Camera traps were checked every second day to ensure they were operating effectively.

Tiger habitat occupancy surveys are conducted across all potential tiger habitats. A grid cell each (15 km × 15 km) was laid across the survey area. Each grid cell is further divided into sub-cells. To include an element of randomness in the spatial distribution of survey routes, one sub-cell per grid cell coded as tiger habitat was randomly selected prior to the survey [27]. The number of spatial replicates per grid cell (i.e. km walked) was proportional to the percentage of tiger habitat [27]. For grid cells with 100% tiger habitat, we sampled 40 km in the cell touching random grid in every sampling route. Each contiguous 1 km segment was considered as a "spatial replicate" [28–30]. The field team walked along trails, roads, ridgelines, and river and stream beds in selected sub-cells, searching for tiger signs (scats, scrapes, pugmarks, kills, and urination sites), prey signs (dung, footprints, calls, and sightings), and human disturbance (wood cutting, lopping, grazing, poaching, etc.) following high probability tiger sign areas [28]. Observations were recorded for every 100 m section of the transect walk (**Figure 1**).

2.2 Rhino (*Rhinoceros unicornis*) monitoring in Nepal

The greater one-horned rhino was once believed widespread throughout the northern floodplains and nearby foothills of the Indian subcontinent between Indo-Myanmar border in the east and Sindh River basin, Pakistan, in the west; now greater one-horned rhinoceros are currently restricted in few protected areas in northeastern India and lowland terai of Nepal. Different techniques used for rhino monitoring in Nepal are mentioned below.

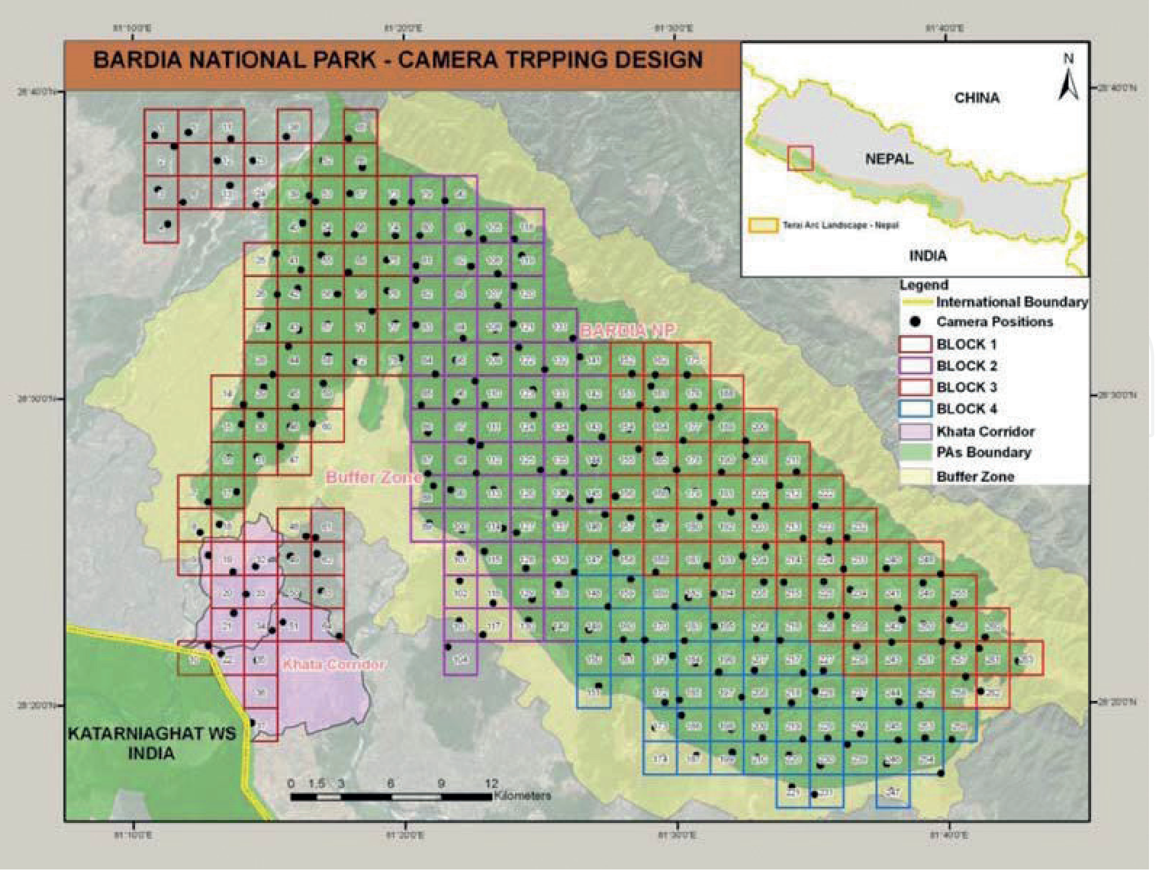

Figure 1.
Camera trapping grid (Bardiya National Park).

2.2.1 Rhino census

According to different physical demarcation like rivers and other field knowledge, potential rhino habitats (both inside and outside the protected areas) are divided into blocks. Reconnaissance surveys are also conducted in the more difficult areas to refine the blocks and plan for the sweeping operation. Where necessary, tall grasses are cut and burnt to improve visibility to observe animals. Elephant is an essential component for this census. Elephants are lined up over 5 km long with visible gap between the elephants and moved parallel along transects marked on the map to sweep individual blocks. Experienced staffs with camera, radio communication, GPS receivers, and maps are assigned to manage sections of the sweep to coordinate the operation. Radio communication is essential to maintain distance of approximately 50 m in dense forest and 100–200 m in open grassland so that rhino will not be missed. Maps of area to be covered on each census day are provided to each observer for navigation purposes. The maps in conjunction with the GPS receivers are extremely useful to ensure groups of elephants did not break from the census line particularly in thick forests (**Figure 2**).

A rhino data recording booklet is designed to standardize the accurate recording of rhino identification features and demographic data. The booklet convenient to fit in a shirt pocket is put together to form a convenient way of recording all of the details about each greater one-horned rhino. The observers are trained to look for and draw/note any features such as horn shape, ear tears, skin folds, deformities, epidermal knobs, body scars, or tail shape that would make a rhino distinguishable. They are trained to correctly fill in the following information:

- Date and time
- GPS location
- Standardized age class (adult, subadult, or calf)
- Sex (male, female, or unidentified sex)
- Habitat type (tall grassland, short grassland, Sal forest, riverine forest, wetland, other)
- Distinct rhino identification features (ears and horn, body and tail features)
- Body condition (good, average, poor)
- Group composition
- Activity

2.2.2 ID-based rhino monitoring

ID-based rhino monitoring is carried out in low population density area where population can differentiate easily and manually track and monitor individual animals and their movements. Intensive ID-based rhino monitoring is a simple monitoring system where each individual rhino is assigned a particular ID or name based on its distinct physical appearance and body features. All potential rhino habitats are divided into several blocks for ID-based rhino monitoring. The basic equipment required for rhino monitoring comprises cameras, binoculars, GPS, maps, and data forms. Based on the

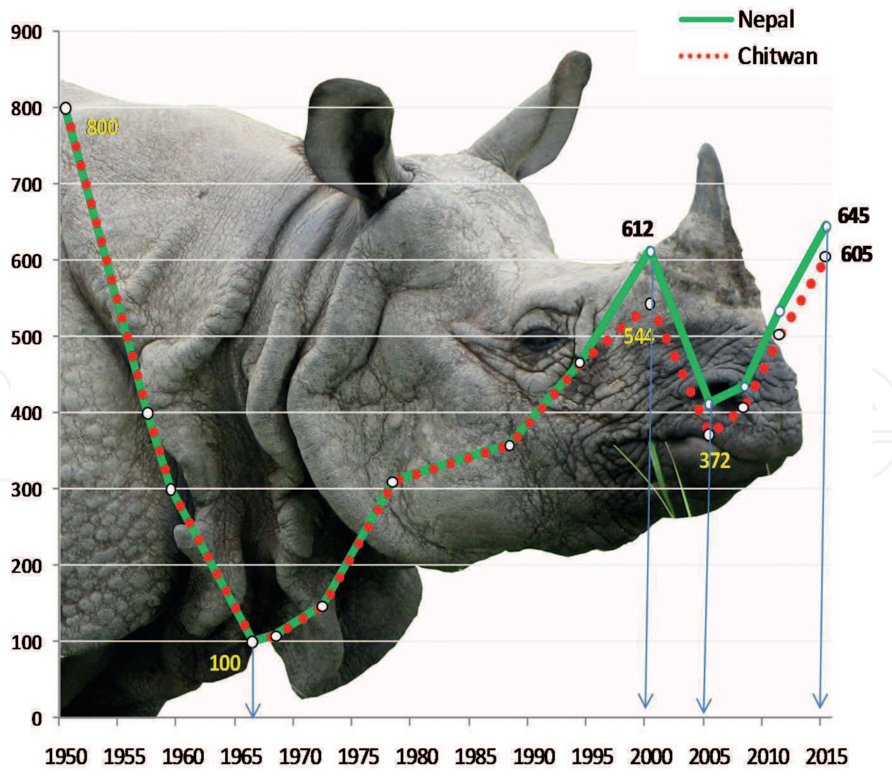

Figure 2.
Trend of Rhino Population in Nepal and Chitwan National Park.

field information of an individual rhino, a master ID file is prepared which is an invaluable tool for monitoring the rhino population. Rhino identification master files are used to control quality of rhino sighting data recorded in field sighting forms and trace the record of each rhino. The files also help to capture and transfer the knowledge/skills of the highly experienced key observers for future generation. The photographic sequences kept in the files enable to assess the changes in the animals over time and allow development of guidelines on horn and body size appearance with rhino age [31]. This also helps to monitor the animals for anti-poaching control. It is therefore essential that the information in the files is accurate and kept up-to-date by the data controllers with change in information like calving number, inter-calving intervals, and number of calves.

Once rhinos are individually identifiable, their details are maintained in population databases which assist greatly in ensuring that information can be derived to meet the needs both at park and national (metapopulation management) levels [31].

2.2.3 Monitoring rhinos through radio tracking

VHF, GPS, and satellite radio transmitter neck collars are modern radio-tracking technology which facilitates the monitoring of rhino. However, these are considerably more expensive. The transmitters can also include mortality sensors that change the frequency of the signal after a predetermined period of immobility.

The radio-tracking technology can be cost effective in certain situations such as:

- To monitor severe poaching activity.
- To monitor post-release adaptation of translocated rhinos to assess the adaptation in new habitat.
- Where there is insufficient monitoring capacity to ensure regular sightings through recognition of identity features

2.2.4 Mark-recapture population estimation

Mark-recapture methods provide population estimates. Mark-recapture population estimation software can be used for this purpose provided:

- Rhino sighting throughout subpopulation over a period of time.
- Equal attention been paid to monitoring both identifiable and "clean" rhinos.
- There are enough sightings of adults and independent subadult rhinos.

This technique of estimation is useful in populations where not all animals are individually identifiable and information are collected by nonspecialized teams of anti-poaching patrols and other staff on an ongoing ad hoc basis. Additional knowledge about the population will be derived (mortality, introductions, and removals in a population and where known calves have become independent of their mothers), are obtained through estimation process, and violates classical mark-recapture estimation. In these situations, periodic discrete surveys of a rhino subpopulation can be used to generate population estimates, using basic methods of mark-recapture population monitoring. Such estimates may have a lower degree of accuracy and precision than those that would be derived through the more continuous monitoring but will nonetheless be useful.

2.3 Red panda (*Ailurus fulgens*) monitoring in Nepal

First national red panda population count was made in 2016 by Red Panda Network in collaboration with the Government of Nepal. During this count program, habitat survey was also conducted. This study was conducted in 35 different districts of Nepal, and presence of red panda population was obtained in 23 districts of the country including 7 protected areas. This study provided information on deforestation level, habitat quality of red panda, and effect of climate change in their range.

A mobile application is being used to monitor movement of red panda, in eastern hill districts, including Panchthar, Ilam, and Taplejung. Wildlife activists who have received the phones have been entrusted with recording situation, speed, appearance, direction, and signs of the red panda and uploading them into the network through the Internet. GPS, camera, and mobile apps are used to monitor the red panda in Nepal [32–35].

2.4 Elephant (*Elephas maximus*) monitoring in Nepal

Photographic capture-recapture (CR) methods are sometimes adopted to estimate elephant population densities. However, this approach faces many functional challenges posed by difficulties in temporal sampling and unreliable identification of individuals on variable traits. Data of elephants were collected by photograph from roads and along water hole.

If an elephant is seen, it is recorded as fresh encounter, and its detailed description is made. Every elephant's morphological characteristics are classified as variable traits (holes and tears), fixed traits (tusk characteristics and ear fold shape), and tail traits (tail length, tail brush shape). Height of animal and age are recorded. Each animal is marked with different identity code [36].

2.5 Snow leopard (*Panthera uncia*) monitoring in Nepal

Camera trapping is also applied for the monitoring of snow leopard. Beside this satellite radio collaring in Kanchenjunga Conservation Area of eastern Nepal has been started since 2013 in collaboration with WWF Nepal. Both Conservation Committee and citizen scientists are trained in GPS handling and camera trapping and monitoring of snow leopards and their prey. The use of advanced technology in wildlife research such as noninvasive genetic analysis, camera trap surveys, and GPS-satellite telemetry presents better opportunity to conduct ecology and behavioral studies of snow leopards and their prey and habitats [24].

2.6 Gharial (*Gavialis gangeticus*) monitoring in Nepal

Gharial population monitoring is carried by sweep operation in the river system with potential habitat of gharial. River system is divided into several blocks. Each block is observed by a team of observers on boat. They will move along the river system and record all presence of gharial along with the activity of them. Monitoring is carried out continuously for 3 days. Average number is calculated with a record of 3 days.

A study on population status and distribution of Gharial in Nepal was commissioned by the Department of National Parks and Wildlife Conservation and WWF Nepal in 2008 aiming to update the existing status and distribution pattern of gharial and also to assess the threats in gharial conservation in Nepal. Data were collected from direct count by the use of opportunistic search method and questionnaire survey from Karnali and Babai Rivers of western Nepal, Narayani and Rapti Rivers of central Nepal, and Koshi River of eastern Nepal [37].

2.7 Swamp deer (*Cervus duvauceli*) monitoring in Nepal

Swamp deer count is carried out at the reserve by Suklaphanta Wildlife Reserve in partnership with Terai Arc Landscape Program and Suklaphanta Conservation Program, NTNC. The reserve is home to the world's largest herd of swamp deer. The count was based on direct head count of animals. Swamp deer is a protected species of Nepal and listed in Appendix I of CITES.

2.8 Gaur (*Bos gaurus*) monitoring in Nepal

For the census, protected area and surrounding forest are divided into several blocks. Sex, age, location, group size, habitat, and time are recorded. An elephant is deployed along with the observers; they will ride in the back of the elephant and count the individual head. Global positioning system (GPS), digital camera, binocular, maps, and communication sets were used for the census purpose. In Nepal, the Gaur is listed as protected animal under National Parks and Wildlife Conservation Act 2029, as vulnerable in IUCN Red Data Book, and is listed in Appendix I of CITES.

2.9 Musk deer (*Moschus chrysogaster*) monitoring and conservation status in Nepal

Musk deer is one of the genera called primitive deer that produced musk and high value of raw materials for making cosmetic as well as pharmaceutical products which is why musk can sell up to US $45,000 per kilogram (2.2 pounds) on the international market. However, musk is produced in the gland of males; later it can be extracted from live animals; for that purpose humans kill the musk deer to remove the entire sac having yields only about 25 g (1/40 of a kilogram) composed of the brown waxy substance [38, 39]. Due to increased price of musk deer on the international market, activities of poaching and trade of musk deer have been reported to rapidly increase in the Himalayan region of Nepal [40]. The study from neighboring country also revealed that poaching and trade of the species of musk is also a threat to conservation in Uttarakhand state of India [41]. The population of musk deer rapidly decrease due to many reasons such as poaching for musk pod, habitat overlapping, excess harvesting of forest resources like grass, shrubs, and timber for the human benefits, causing a serious problem for the survival of musk deer in the Himalayan region of Nepal [42, 43]. Grazing of livestock within protected areas might also be a possible risk and grazing of livestock within protected areas might also be a possible risk and threat to musk deer for no availability of enough diet to survive and high chance of disease transmission from livestock to musk deer and vice versa [40].

However, there was only limited information on musk deer and lack of detailed study on the distribution as well as threat in few protected areas in Nepal. Noninvasive genetic analysis was carried out to know information on the population status, distribution, habitat, seasonal diet, altitude range, survival life span, genetic diversity, and phylogenetic analysis of musk deer in Nepal.

3. Conclusion

Although Nepal is a small country, it has a vast biodiversity found from very low land to the highest mountain in the world. Conservation has come a long way in Nepal; few biodiversity monitoring systems exist and do address for some large species like tiger, greater one-horned rhino, elephant, crocodile, swamp deer, musk deer, snow leopard, red panda, gaur, etc. This review provides information on different population monitoring techniques that have been used in Nepal for endangered wildlife species. In Nepal, wildlife population is basically monitored to assess progress or recovery of endangered or threatened species and research purposes and to know the effect of human management actions. Different methods such as directly observing animals and their behavior in situ, looking for signs like tracks and dung of animals, radar, thermal cameras, capture/mark/release of animals, or attaching or implanting monitoring devices (e.g., collars, leg bands, back packs, or data loggers) and noninvasive methods using fecal, hair, etc. are used for population monitoring. In Nepal population monitoring is being done for few wildlife species only although it has many species. So, population monitoring of other species is also important for making proper conservation plan. In developed countries more advance monitoring technologies are being developed and adapted too. So it needs to collaborate with different biodiversity conservation organizations to work together and share technology and make monitoring more comprehensive. This present review study will provide strong recommendations to community persons, leaders, conservation NGO/INGO, and government bodies to prepare the future action plan strategies about the conservation and monitoring of flagship endangered wild animal species at protected areas in Nepal. It is important to know further detailed information on population status, distribution, habitat, seasonal diet, altitude range, survival life span, genetic diversity, and phylogenetic inferences of each particularly endangered wild animal found at protected areas in Nepal.

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Conflict of interest

None.

Author details

Amir Sadaula[1†], Yagya Raj Pandeya[2†], Yogendra Shah[3,4*†], Dhan Kumar Pant[4] and Rabin Kadariya[5]

1 National Trust for Nature Conservation, Biodiversity Conservation Center, Chitwan, Nepal

2 Nepal Agricultural Research Council (NARC), National Cattle Research Program, Chitwan, Nepal

3 Everest International Clinic and Research Center, Kathmandu, Nepal

4 National Zoonoses and Food Hygiene Research Centre, Kathmandu, Nepal

5 Laboratory of Wildlife Biology and Medicine, Graduate School of Veterinary Medicine, Hokkaido University, Japan

*Address all correspondence to: yogendra90@hotmail.com

†Equally contribution authors.

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