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Caption: Malabar Slender Loris *Loris lydekkerianus malabaricus* © Dileep Anthikkad.

INTRODUCTION

Otters are elusive mammals of the family Mustelidae (Acharya & Rajbhandari 2011) in the order Carnivora. They are top predators of wetland ecosystems (Yonzon 1998; Acharya et al. 2010) and require fresh water for feeding adjacent to undisturbed forest and scrub for dwelling. Otters spend 3–5 hours a day fishing and hunting for crab, frogs, and insects (Kafle et al. 2008). Of 13 species of otters found in the world, three occur in Nepal: 1) The Eurasian Otter *Lutra lutra*, 2) The Smooth-coated Otter *Lutrogale perscapillata*, and 3) The Asian Small-clawed Otter *Aonyx cinereus*, (Acharya & Rajbhandari 2011; Basnet et al. 2020). The Eurasian Otter is distributed along mountain streams, rivers, and lakes (Acharya 2006), and according to Shrestha (2003) the Smooth-coated Otter has been recorded from major river basins of Nepal: Koshi, Narayani, Karnali, and Mahakali. Asian Small-clawed Otters were reported in Nepal, China, and India (Hodgson 1839) and later (Biodiversity Profile Project 1995) in Kailali and Kanchanpur districts of Nepal. Although these species are not included in the protected list under the national parks and Wildlife Conservation Act 1973; the act restricts killing, hunting and capturing them, and imposes rules and regulations to curb illegal trade of this species (Acharya & Rajbhandari 2011). The Amendment (2002) of the Aquatic Life Protection Act 1961 has given legal protection to the Eurasian Otter and Smooth-coated Otter. The Smooth-coated Otters are listed as Vulnerable in the IUCN Red List of Threatened Species, and in Appendix II of CITES. As with the other species, the distribution of the Smooth-coated Otter in Nepal is still poorly known, although it has been reported from major river basins: Koshi, Narayani, and Mahakali (Thapa 2002; Acharya et al. 2010). It was also reported from Annapurna conservation area, Makalu Barun National Park, Bardia National Park, Chitwan National Park, Koshi Tappu Wildlife Reserve, Shuklaphanta National Park, and districts of Kailali & Kanchanpur (BPP 1995; Acharya & Rajbhandari 2011). The Smooth-coated Otters have been reported from Geruwa, Khaura, Batahani, Patkanunua, Banjara Ghat, Gaida Machan area, Lamak tal, and Bagaura phant (Thapa 2002; Acharya & Rajbhandari 2011). Smooth-coated Otters are more common along the length of the Narayani river, where it relies heavily on fish (Houghton 1987). They live in holts which may be burrows under tree roots, or within rock piles, and many more are found in Nepal near the banks of lakes which are covered with ferns (Acharya & Gurung 1991; Acharya & Rajbhandari 2011).

Loss of wetland habitats due to construction of large-scale hydroelectric projects, encroachment of wetlands for settlements and agriculture, diminishing prey biomass, poaching and contamination of water ways by pesticides are continuously deteriorating freshwater ecosystems and nearby forest (Joshi 2009), which imposes major threats to Smooth-coated Otters and other freshwater animals. Overfishing, poisoning, industrial and water pollution, and sand and boulder extraction are also contributing to declining otter populations (Acharya & Rajbhandari 2014). Otters have been depicted as symbols of undamaged nature, of clean water and pure vegetation (Acharya et al. 2010). Habitat fragmentation/destruction, fire, intentional killing and lack of awareness, degradation of wetlands, has had a significant impact on otter populations, and over hunting, especially for the illegal fur trade, threatens their survival in many parts of Nepal. In recent decades, its populations have probably declined as a consequence of hunting and the overall loss of natural habitats (Acharya & Gurung 1994; Acharya 2006).

Research on otters is inadequate in Nepal and the distribution of Otter species is still poorly known. Despite its importance as an indicator of the health of aquatic habitats (Foster-Turley et al. 1990; Yonzon 1998), until recently its conservation has not been considered in Nepal. There is a little on distribution and status of otters (Acharya 1998), but their populations do appear to have declined as a consequence of overall loss of natural habitat and deliberate killing (Acharya & Rajbhandari 2014). Therefore more information is needed to develop conservation measures to the protection of these species. This paper will contribute in formulating appropriate policies for their conservation so that sound conservation measures by protected areas could be implemented. Inside Shuklaphanta National Park, there are many small wetlands but previous research inside Shuklaphanta National Park focused only two wetlands Chaudhar river and Kalikhich lake. That is why this research has been conducted to assess the distribution of otters inside the park wetlands. In order to identify the threats and people's perception towards the otter conservation this research was focused. The main objective of this study was to determine the distribution pattern and threats to otter inside park area as well as to understand people's perception towards its conservation.

MATERIALS AND METHODS

Study area

The study was conducted in Shuklaphanta National Park (Figure 1) a protected area in the Terai of the Far-Western Province, covering an area of 305 km² at an altitude of 174 to 1,386 m. It was gazetted in 1976 as Royal Shuklaphanta Wildlife Reserve. A small part of the reserve extends north of the east-west highway creates a corridor for seasonal migration of wildlife into the Siwalik hills. The Syali river forms the eastern boundary southward to the international border with India, which demarcates the reserve's southern and western boundary. The protected area is part of the Terai-Duar savanna and grasslands ecoregion and is one of the best-conserved examples of floodplain grassland. It is included in the Terai Arc Landscape. Shuklaphanta National Park supports a wide range of biodiversity which is naturally and globally important. The aquatic and terrestrial habitats of SNP contain more than 665 plant species belonging to 438 genera and 118 families, which is the highest diversity reported for any protected area in Terai (DNPWC 2005). Similarly, a total of 46 species of mammals, five species of amphibians, 12 species of reptiles and 28 species of fish, 450 species

of birds have been recorded so far (DNPWC 2005).

The study area has tropical monsoon climate with four different seasons; winter, spring, summer and monsoon with hot temperature range of 6.8 °C to 40 °C. An average annual precipitation was estimated to 1832 mm for the period 1992–2001 at Mahendranagar, 94% of which falls between May and September. The maximum of 639.17 mm precipitation was recorded in August and minimum of 3.98 mm was recorded in November. The monsoon typically begins from July and continues until late September to early October. The common soil types found in the park are sandy loam, silty loam, and clay loam (DNPWC 2003).

Data collection

This study was based on field and social surveys to collect information for distribution patterns and assess threats to Smooth-coated Otter. Direct surveys included field observations, while social surveys incorporated key informant surveys and questionnaires with local people, fishermen, nature guides working in the park, park administrators, non-governmental organization (NGO) and governmental organization officials. Reconnaissance field visits were conducted before starting field data collection. This was done through consultation with

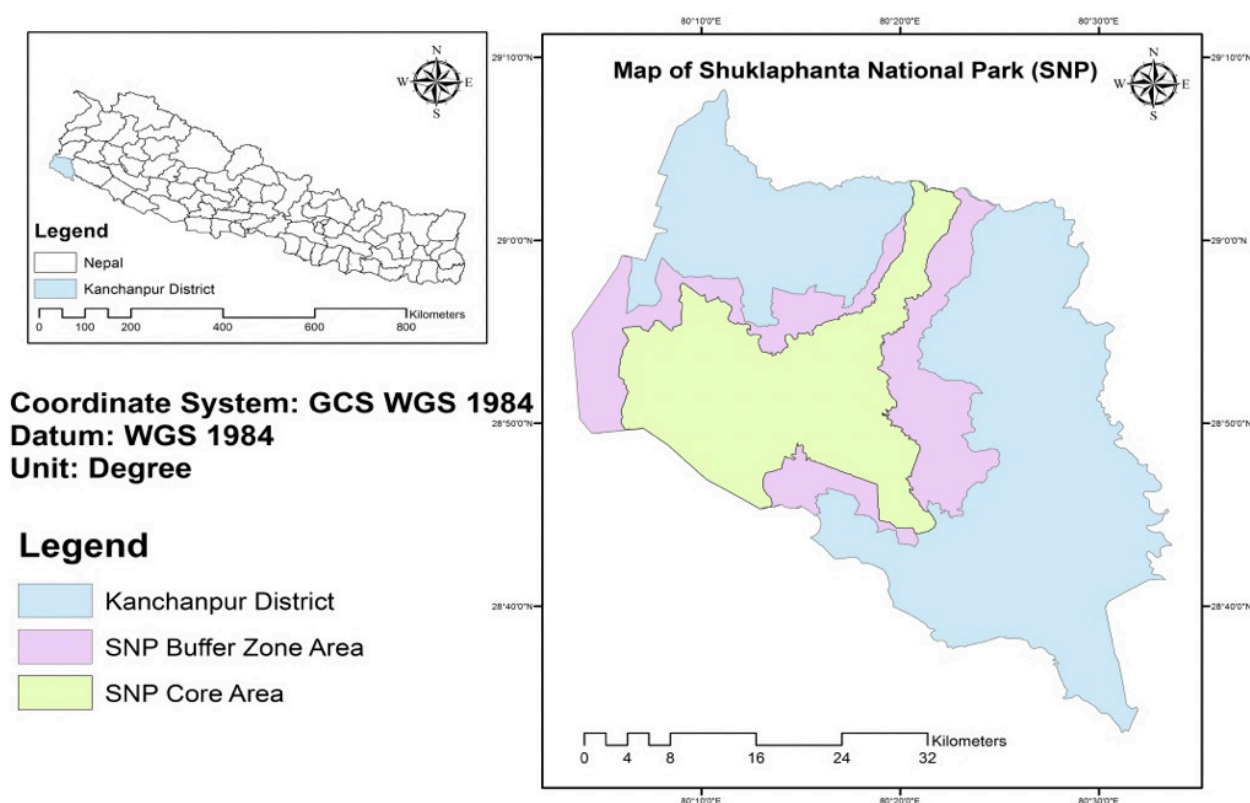


Figure 1. Map of the study area.

park senior officials and park rangers, nature guides and fishermen from the local community. This has helped to known about the existing wetlands, distance between the wetlands, previous research selected site and condition of wetlands, and enhance the data collection process. Observations were carried out in the fields. Location, situation and actions of Smooth-coated Otters were observed. GPS points of each sign sited area were taken for distribution mapping. Different from our study site, Kafle (2011) used social surveys and observation of scat in streams of the Pyaudikhola Watershed and Kapring Khola Watershed of Marsyangdi River in the same district. He reported Otter presence based on local people's perception and characteristics of the scat he collected: dark grey, with fragments of fish, frog and crab remnants, fragile, and smelling of fish. During field observations; photos of live Smooth-coated Otter and their signs (e.g., latrine sites, tracks, scats and dens) was also taken into consideration for this study to determine the presence of the Smooth-coated Otters. After field observation, information obtained was analyzed through MS excel, Arc GIS, to find out the desired outputs as objectives.

Field survey

Wetlands inside the Shuklaphanta National Park were visited for Otter survey. Survey was done in order to directly observe the presence of live Smooth-coated Otter, locating and recording reliable sign such as tracks, spraints, dens and scats on altogether 20 transects of 1.5 km each along the wetlands bank of SNP. The transects were chosen purposively based on our key informant and preliminary surveys. The field survey was conducted in November-December, 2019 when river was low and sand banks were remained exposed.

The Smooth-coated Otters typically leave spraints on visible habitat features (stones, rocks and base of trees). The conspicuous nature of Smooth-coated Otter's spraint markings enables researchers to easily verify the presence of Otters in an area (Reuther et al. 1999, 2001). The tracks of the Smooth-coated Otter were identified by a round impression of five toes and faint webbing marks (Jamwal et al. 2016).

Key informant survey

To collect the information, firstly we conducted key informant interview (KII) to gain the overall idea about the status, distribution and threats to Smooth-coated Otters. For KII, one having detailed and concrete information were chosen like park staffs, nature guides, fisherman, local peoples and owners of the hotels living

in the vicinity of the park were taken as key informants as they have more information in Smooth-coated Otters. Altogether 15–20 people were chosen as key informants and separate questionnaire survey was conducted to gather information on status, distribution and threats to otters.

Checklist was prepared for interviewing the key informants to determine the major threats to Smooth-coated Otters and their perception towards conservation of otter. Major threats to Smooth-coated Otter including climatic threats were also assessed through the people who are chosen as key informant. They were asked about the effect of climate. SNP staffs and fisherman from the local community were mainly focused as most of the time they visit to the wetlands and known about the Otter's habitat, occupancy, population and migration route.

Questionnaire survey

Semi-structured questionnaire form was prepared for interviewing local inhabitant particularly among fisher communities, buffer zone households and Rana-Tharu homestay council members to identify the distribution, threats, condition of Otter and their perception towards otter conservation in the study area. The local respondents were surveyed using semi-structure questionnaire to a sample of 70 purposively selected households living in the vicinity of the SNP and purposive sampling was done for this study. The perception of the local peoples towards Smooth-coated Otter was measured in three points Likert scale.

Secondary data

Secondary data relevant to the study was collected from various published and unpublished documents. Information was also collected from various news and journal articles. Academic and research institutions like IOF (Institute of Forestry), NTNC (National Trust for Nature Conservation) were also enquired as needed. Similarly, the camera trap data were also used which were conducted before by the researcher, national park for different wildlife counts.

Data analysis

Data collected from field survey was thoroughly analyzed, both qualitatively and quantitatively, using appropriate statistical tools or programs and interpreted in the form of, figures, charts or table depending upon the nature of the data. Collected data was entered in MS-Excel 2010, *p* value was collected with the help of excel and otter distribution map was prepared with the help of



Arc Map 10.3 version. The output from the MS-Excel and Arc GIS 10.3 was used to analyze data and results were shown through simple table and graphs. Descriptive statistics like mean, percentage, and frequency was used to interpret the result. All these statistical analysis was done by using the SPSS and R software.

RESULT AND DISCUSSIONS

DISTRIBUTION OF OTTERS

Wetlands of Shuklaphanta National Park

Main wetlands of Shuklaphanta National Park include Bahuni river, Rani lake, Salgaudi lake, Kalikhich lake, Chaudhar river, and Haatikunda lake (Figure 2). Most of the wetlands inside the park were partially covered with water during the field days.

Distribution of Otters in Shuklaphanta National Park

Smooth-coated Otters were mostly sighted in Chaudhar river, Kalikhich lake, Radhapur river, Bagh pokhari lake, Rani lake, Shikari lake, Bahuni river, respectively (Figure 2). They were mostly seen along the river bank and lake surroundings (Image 1). The distribution map was made based on the direct observation of Smooth-coated Otter and sign presence.

Types of sign

During the field visit in different wetlands inside the national park, most of the observations were scats (42.63%) followed by tracks (36.14%) and live sightings (21.23%) (Figure 3). Most of the scats were observed during the field survey as it was performed in summer season and most of the wetlands have less water content due to which the scat was not washed away easily and were visible during the field observation.

During the field study, the signs (footprints and scat) of the Smooth-coated Otters were observed in both fresh and in old condition (Figure 4). The study conducted by Hussian & Chaudhary (1997) explained that by February to March the swamps begin to dry and the fish biomass appears to be depleted, consequently Otters move to perennial river. Similar result was observed during the study.

THREATS TO OTTERS

Threats identified through household survey of questionnaires

Different types of threats to Smooth-coated Otters identified through the social survey are as mentioned in Figure 4.

Excessive extraction of construction materials

From the data obtained through questionnaire survey with the buffer zone community people, (42%) of respondents said that major threat to Smooth-coated Otter was excessive extraction of construction material from the rivers as most of local infrastructure development works relied on locally available construction materials (Figure 4). Without any initial environment examination (IEE)/ environment impact assessment (EIA) excessive extraction of stones, gravels and sand was in progress that ultimately disturbed the habitat of Smooth-coated Otter.

Excessive fishing

Nowadays population is increasing day by day and joint family of Tharu community is changing into single family because of this also the percentage of family for fishing is increasing. About 17% people during social survey identified fishing as one of threat to Smooth-coated Otter population. The main food of Smooth-coated Otter is fish, if fish number decreases ultimately Smooth-coated Otter population decreases. Thus, high fishing areas shows inverse relationship with the presence of Smooth-coated Otter.

Water pollution

The drainage pipe, wastes from the settlements, the drained soil from the road construction were making the water sources polluted. During the questionnaire survey, 9% of respondents reported water pollution may be one of the threats to Smooth-coated Otter. About 22% of the total respondents said that they are unknown about the reasons for the threats to Smooth-coated Otter (Figure 4).

Threats identified by the key informant survey

Fire

Uncontrolled fire during the summer season affects the habitat of Smooth-coated Otter. Most of the key informant (46.66%) identified fire as most vulnerable threat to the Smooth-coated Otter population (Figure 5). The buffer people for the succession of primary grasses people initiate the fire. Rise in temperature and burnt debris inside the rivers and lakes and ponds causes' habitat destruction of Smooth-coated Otters.

Water pollution

Out of the total respondents 19.76% key informants identified water pollution as one of most threat to the Smooth-coated Otter population.

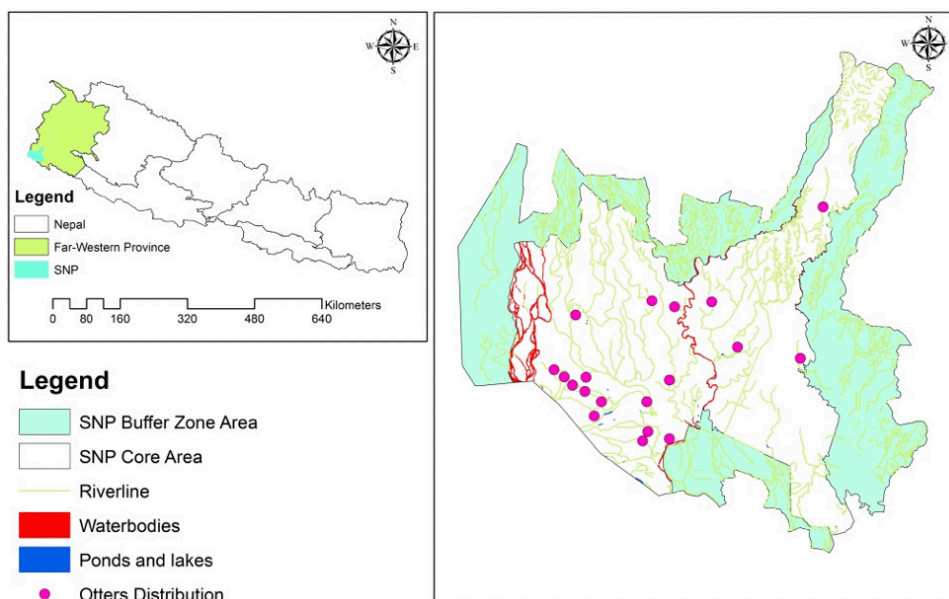


Figure 2. Distribution of Smooth-coated Otter in wetlands of Shuklaphanta National Park.

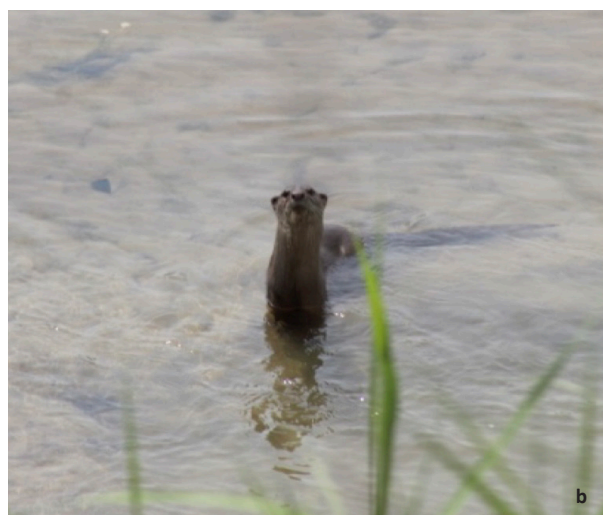
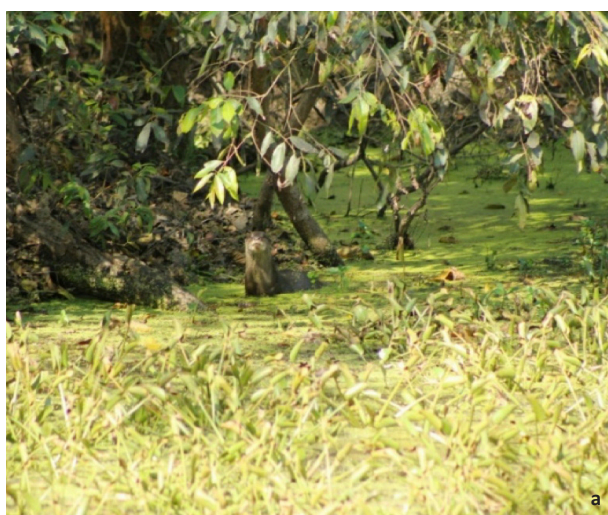


Image 1. Presence of Smooth-coated Otters in SNP: a—Radhapur River | b—Chaudhar River. © Yam Raut.



Image 2. Foot print of Smooth-coated Otter: a—fresh signs | b—old signs | c—scat of otters. © Yam Raut.

Poisoning

Sometimes the buffer people use drugs for fishing. Out of the total respondent 13.38% key informants identified poisoning as one of most threat to the Smooth-coated Otter population. As both Smooth-coated Otter and fish share the same habitat poisoning for one species also harms the other species.

Other factors (climate change, invasive species, habitat alternation)

Key informant (20.20%) identified climate change; spread of invasive species such as *Lantana camara* inside the park area was changing the habitat. Similarly, riverine forest is changing towards the Sal *Shorea robusta* forests inside the park; area of grassland is declining yearly due to the intrusion of woody trees in grassland area.

Population trend

Out of the total respondents, 17% of the respondents said that the Smooth-coated Otter population has been increasing while 45% of the respondents said that the Smooth-coated Otter population is decreasing (Figure 6). Most of the Tharu community people said that the population is decreasing; 'we used to saw the Smooth-coated Otters in buffer wetlands frequently but this trend had decreased these days'. Our questionnaire survey of households revealed that local respondents older than 60 years who had sighted Smooth-coated Otters long ago have seen little presence of otters in the study area in the last decade. Similar results was found in the study conducted by Basnet et al. (2020), an otter survey along the Budigandaki River and adjoining streams that lie in Bhimsen Rural Municipality and Sahid Laxan Rural Municipality of Gorkha District.

Perception towards Otter conservation

Since in Tharu community, both male and female were found engaged in fishing activities and most of fisher communities are illiterate, therefore the gender and education categories were selected. In case of gender, majority of male and female (42.5%) agreed on the statement, 31.6% were stable and 26.25% disagreed on the statement (Table 1). Difference among the responses was significant ($p < 0.1$). Similarly, in the case of education category, 49.05% of the total respondents were agreed, 27.1% were stable and 23.85% disagreed on the statement. The difference among the responses varied significantly ($p < 0.1$). Majority of people had knowledge about Smooth-coated Otter and most of them gave positive response on conservation of Smooth-coated Otter. Only few people including the fisher

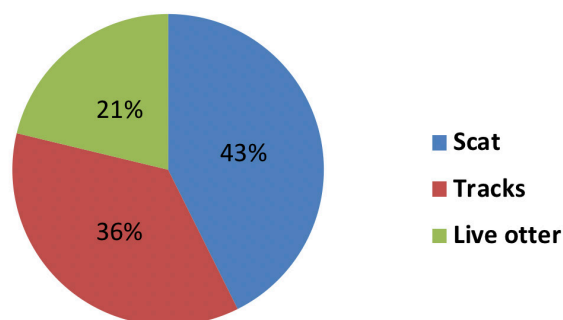


Figure 3. Direct sightings and indirect signs of Smooth-coated Otter in the study area.

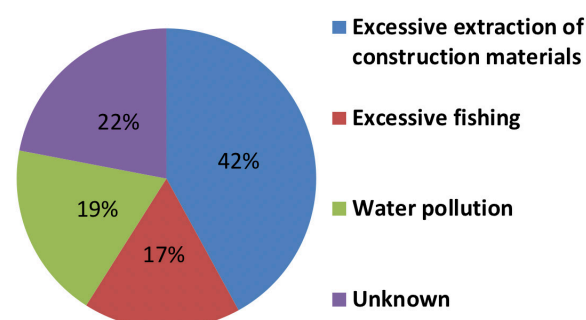


Figure 4. Different threats to the Smooth-coated Otter in the study area.

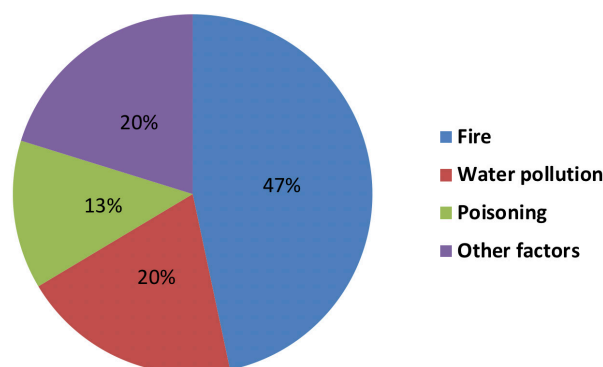


Figure 5. Threats to Smooth-coated Otter through key informant survey.

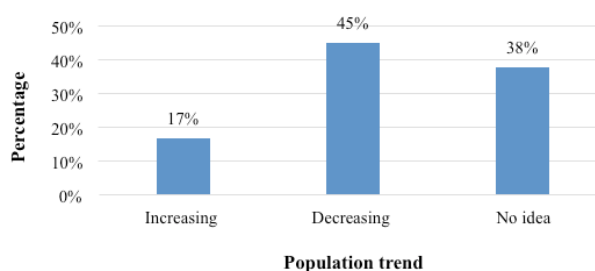


Figure 6. Status of the Smooth-coated Otter population.

Table 1. As Smooth-coated Otters are the indicator of fresh water, they should be conserved.

Categories		Response in % within categories			Mean response	d.f	Chi-square value	p value
		Agree	Stable	Disagree				
Gender	Male	56.1	23.2	20.7	1.5891	2	5.435	0.0594
	Female	28.2	40	31.8	2.0565			
Average		42.15	31.6	26.25	1.8228			
Education	Illiterate	23.1	43	33.9	2.1167	2	19.4841	0.000
	Literate	75	11.2	13.8	1.1342			
Average		49.05	27.1	23.85	1.62546			

Note: At 10% significance

communities were negative towards otter conservation as Smooth-coated Otter eat up all the fishes which they wanted to capture. This result was similar with the findings mentioned by Thapa (2019).

Distinctive roles by buffer zone user committee/parks for Otter conservation

Respondents were asked about the methods implemented by the park and buffer zone user committee (BZMC) for the Smooth-coated Otter's conservation; 92% of respondents agreed that park was protecting the Smooth-coated Otter's through enforcing strong laws and only 8% of the respondents agreed that park and BZMC is protecting Smooth-coated Otter's population through awareness program. In order to conserve the Smooth-coated Otter's population awareness program should be conducted frequently.

CONCLUSION

This study found that Smooth-coated Otter's field signs were mostly concentrated in the moist soil near the wetland area. Otter's distribution was mostly recorded in Radhapur river, Kalikhich lake, Chaudhar river, Hattinala near hattisar area of Pipraiya, Bahuni river, Sikari lake and Salgaudi lake of Shuklaphanta National Park. But Smooth-coated Otter's populations in buffer wetlands were decreased due to the excessive extraction of the construction materials (stones, gravels, sand etc.), poisoning, and water pollution. There was no anthropogenic disturbance inside the park as it was strictly protected with army officials but domesticated livestock inside the park area was creating a problem for habitat destruction, uncontrolled fire, and habitat alternation were some of the threats identified inside the park area. People were positive although the Smooth-

coated Otter eat the fish and affects Tharu communities who mostly depend on fishing for their livelihoods.

RECOMMENDATION

Σ Park officials should focus on yearly census of otters during camera trapping surveys of other mega wildlife such as tiger.

Σ Research and findings related to otters are to be taken into considerations while developing park strategies and management plans for otter conservation.

Σ Excessive fishing, excessive extraction of construction materials in buffer areas river, infrastructure development works should be minimized.

Σ Conservation education and awareness programs relating to otters, their ecological behaviors need to be conducted in the local level.

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