Status and conservation threats to large mammals of the Laljhadi Mohana Biological Corridor, Nepal

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Abstract

Wildlife corridors connect isolated patches of habitat and support the movement of migratory species from one site to another. Human disturbances cause forest degradation and habitat fragmentation adding to the high risk of species extinction. We laid out 44 grids of 2 km × 2 km in Laljhadi Mohana Biological Corridor (LMBC). In each grid, we generated line transects ranging from 1.5 to 2 km and a systematic line transect survey was carried out with single replication to assess the distribution and relative abundance of large mammals. GPS coordinates were recorded for each direct sighting or indirect sign. Similarly, a local household survey (n=40) and key informant interviews (n=9) were conducted to explore the local perception about existing problems, major conflicting species habitat components, conservation threats and attitude towards the large mammals. A workshop was also held to discuss information about the conflicting species, possible solutions, and the ranking of threats based on a relative ranking system. A total of 51 individuals belonging to six species of large mammals were found in LMBC. Distribution was primarily confined to the south of the corridor, and the relative abundance, in descending order, is the Blue bull (29.4%), Asian elephant (25.5%), Spotted deer (21.5%), Wild boar (15.7%), Common leopard (5.9%) and Bengal tiger (2%). Major conservation threats were forest encroachment and habitat fragmentation (Very High), followed by grazing and forest product consumption (High), natural disaster (Medium) and illegal poaching, infrastructure construction, and invasive species (Low). The LMBC was found to support six large mammals, where mostly Asian elephants and Blue bull are using it for migration.

Key words: Biological corridor, large mammals, distribution, relative abundance, perception

Introduction

Nepal is rich in biodiversity but covers an area of only 0.09% in the world's total land area (ICIMOD, 2007). It has 212 species of mammals representing 11 orders i.e., Carnivora (47), Cetartiodactyla (25), Chiroptera (53), Eulipotyphla (16), Lagomorpha (10), Perissodactyla (2), Pholidota (2), Primates (5), Proboscidea (1), Rodentia (50), and Scandentia (1); and includes several threatened flagship species such as the Bengal tiger *Panthera tigris tigris* (Linnaeus), Asian elephant *Elephas maximus* (Linnaeus), Greater one-horned Rhino *Rhinoceros unicornis* (Linnaeus), and the Ganges River Dolphin *Platanista gangetica* (Roxburgh) (Amin et al., 2018). Nepal has 20 protected areas (PAs), that harbor 3.2% of the total flora and 1.1% of the total

fauna in the world (DNPWC, 2020). Protected areas serve as the principal foundation for conservation strategies in order to sustain biological diversity (Naughton-Treves et al., 2005) and to reduce anthropogenic impacts, as well as to maintain habitat along with population and ecological functions (Gaston et al., 2008).

Protected areas that are isolated, or do not have a well-connected network, are often declared as temporary, and are also where extinction incidents will be unavoidable (Hansen and Defries, 2007). PAs may not be able to provide a wide range of habitats, especially for migrating populations, and this will affect the maintenance of biological diversity (Haddad et al., 2015). Evidence exists for wildlife species that are forced to isolate in these patches of habitat and these events are rapidly increasing due to habitat loss, degradation, fragmentation, especially near areas surrounded by human settlements.

Only 13 PAs out of the 20 in Nepal have buffer zones, which are known to reduce anthropogenic disturbances within their peripheries. There is a significant rise in the number of annual human casualties attributed to wildlife encounters in human settlements (Acharya et al., 2016). Scientific observations have reported higher frequencies of wildlife attack on people who only have moderate knowledge of animal behavior, hold agricultural as their primary profession and reside in close proximity to a protected area (Silwal et al., 2017). Additionally, declared PAs were not always considered large enough to provide sufficient habitat components required by a variety of species (Ament et al., 2014). Even the small patches like grassland, waterholes are potential to provide suitable habitat to viable population either the means of translocation or natural attraction by making availability of required component by the specific species (Pokharel et al., 2019). However, the mainstreaming of wildlife and biodiversity conservation through biological corridors can sustainably address this crucial need.

A wildlife corridor is a distinct component of the landscape that provides connectivity and specifically facilitates the movement of animals from one site to another site (Ament et al., 2014). Most conservation biologists have realized the importance of giving priority and emphasis to maintaining a well-connected network of PAs that prevent ecosystems and populations from being isolated and provides movement pathways for required species survival (Belote et al., 2016).

In the case of Nepal, a biological corridor facilitates the movement and dispersal of several umbrella species, especially the Bengal tiger, One-horned rhinoceros, and Asian elephant. Otherwise, as an individual isolated unit, PAs will not be able to maintain a viable population of large mammals over the long term, as they require larger areas to acquire food, mates and retain gene flow (Bhuju et al., 2001). Therefore, restoration and rehabilitation of corridors and connectivity between two adjacent PAs are essential to maintain biological diversity.

Due to a lack of information about wildlife corridors in Nepal, less effective conservation programs are in effect, which are leading towards continuing the process of threats and extinction of endangered species. The Laljhadi Mohana Biological Corridor, abbreviated as LMBC, is one such corridor, which lacks methodical research despite it providing essential habitat and connectivity to a large number of wildlife species. The present study will explore the status and conservation threats to large mammals outside the PAs. The study goal is to help local people become aware of the value of such corridors and to attain the focus of national and international agencies on local conservation. Moreover, it provides baseline data for future action plan preparation and implementation, the basis for formulation of a strategy to conserve biodiversity through the management of biological corridors, and to be helpful in preparation of a wildlife promotion plan outside the PAs.

Material and Methods

Study area

The current study was carried out in the Laljhadi-Mohana Biological corridor (LMBC), which lies within an area of an highly ambitious landscape program Terai Arc Land (TAL) situated in the Far-western region, Kanchanpur, of Nepal (Fig. 1). It covers an area of 355 km^2 comprised of forest corridor (202 km^2) and impact zones (153 km^2). At present, 15,266 households are residing around it, dominated by the indigenous community of Tharu people who own 58 community forests, covering an area of 54.32 km^2, within this corridor. The LMBC consists of different categories of land use including forest cover, riverine forest, grassland, water sources, cultivated land, and human settlements. The forest cover includes both tropical and sub-tropical forests mainly dominated by Sal (*Shorea robusta*). The corridor is also divided by the East-West Mahendra Highway into two sections, the northern LMBC and the southern LMBC. The southern LMBC comprises a heterogeneous landscape including, grasslands, agricultural land, water resources, mixed forest and gentle terrains which are mostly preferred by the elephants (Neupane et al., 2019).

The LMBC provides a home for several iconic species listed under the endangered category (EN) of the IUCN Red List of Threatened Species. These are the Bengal tiger *Panthera tigris tigris* (Linnaeus), the Asian elephant *Elephus maximus* Linnaeus, and the Common leopard *Panthera pardus* (Schlegel). Many other commoner animals include the Wild boar *Sus scrofa* (Linnaeus), the Golden jackal *Canis aureus* (Linnaeus), the Sloth bear *Melursus ursinus* (Shaw),

and the Spotted deer *Axis axis* (Erxleben) (Jnawali et al., 2011; Shrestha et al., 2014*)*.

The LMBC geographically ranges from 80º30'E to 80º33'E to 28º38'N to 29º28'N, bordering Kailali District in the east, Dadeldhura District in the North and the country of India in the south and west (Fig. 1). The LMBC area serves as a transboundary wildlife corridor between national and international PAs by connecting Bardia National Park (BNP), Shuklaphanta National Park (ShNP) and Churiya forest within Nepal and the Dudhwa National Park, Kishanpur Wildlife Sanctuary and Katarniyaghat Wildlife Sanctuary in India (WTLCP, 2007). The study area was selected due to higher critical threats like uncontrolled forest fires, illegal poaching, and intensive livestock grazing (MFSC, 2015).

Research design

The current study was conducted following systematic square grids, which are being currently used for national Tiger and prey-based monitoring in Nepal (DNPWC, 2017). Here, similar transects were used to conduct the transect survey with the aim of exploring distribution and relative abundance of observed large mammals. The target area was divided into 49 grid cells measuring 2 km × 2 km using ArcGIS 10.5, where incomplete cells which are not covering full area of the square grids were not considered (Fig. 2). However, out of 49 grids only 5 grid cells were excluded from the full area covering grids in present study due to their inaccessibility as hilly terrain. The remaining 44 grid cells were surveyed by conducting single line transects ranging from 1.5 to 2 km/grid with solo replication process, covering a total length of 79.46 km to assess information on the distribution and habitat use of large mammals in LMBC (DNPWC, 2017).

The northern LMBC corridor includes 14 transects with a coverage of 25.2 km and the southern LMBC corridor consists of 30 transects with total coverage of 54.26 km.

Data collection

### Large mammal survey

Based on the procedure of Karanth et al. (2011), the survey was carried out in the area where there is a higher probability of detection for large mammals in each grid during the month of August and September of 2019. The survey team followed the existing paths, animal trails, roads, and tracks along the riverside for the direct and indirect signs; and each transect was assessed only once either during the morning or evening. For each direct or indirect sign like scats, pellets, dung, pugmarks, scratching and urination sites, the geo-coordinates were recorded.

For the household surveys, respondents (n= 40) were interviewed through a semi-structured questionnaire to assess their perception of the wildlife conflict status, direct observation of animals and the status of habitat components. Similarly, in the Key Informant Interviews (KIIs), select local people residing along the LMBC, were interviewed (n= 9).
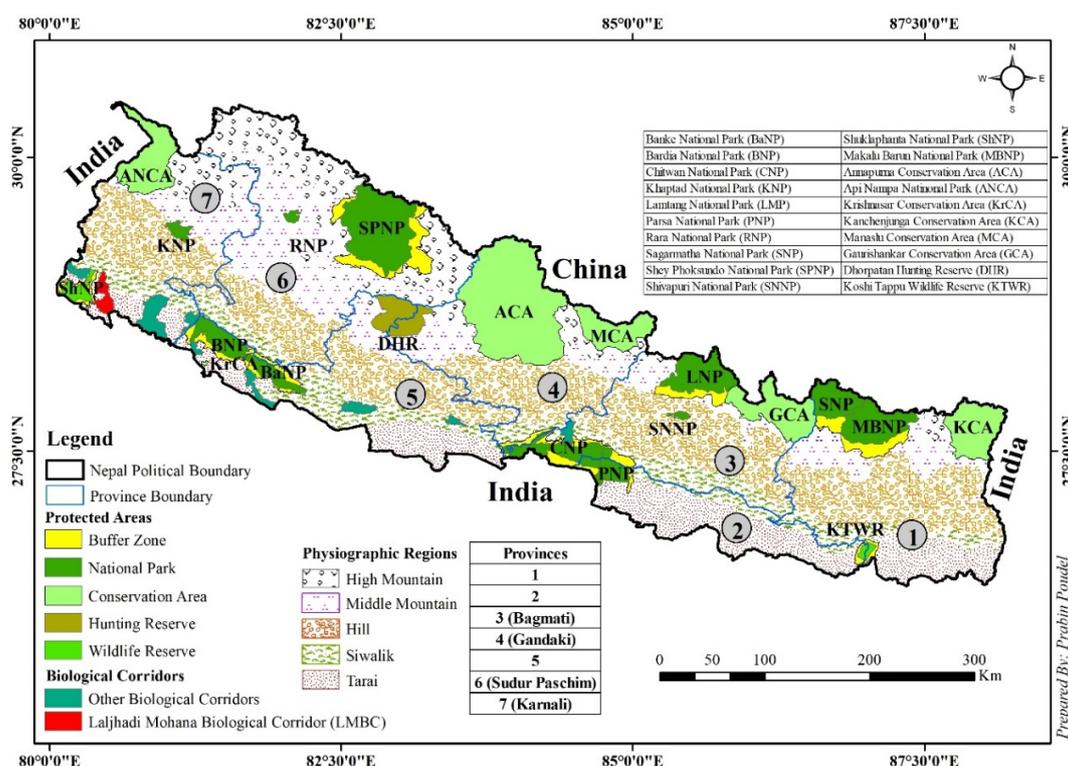
Figure 1: Study area showing all protected areas, buffer zone and biological corridors in Nepal (LMBC in red color).
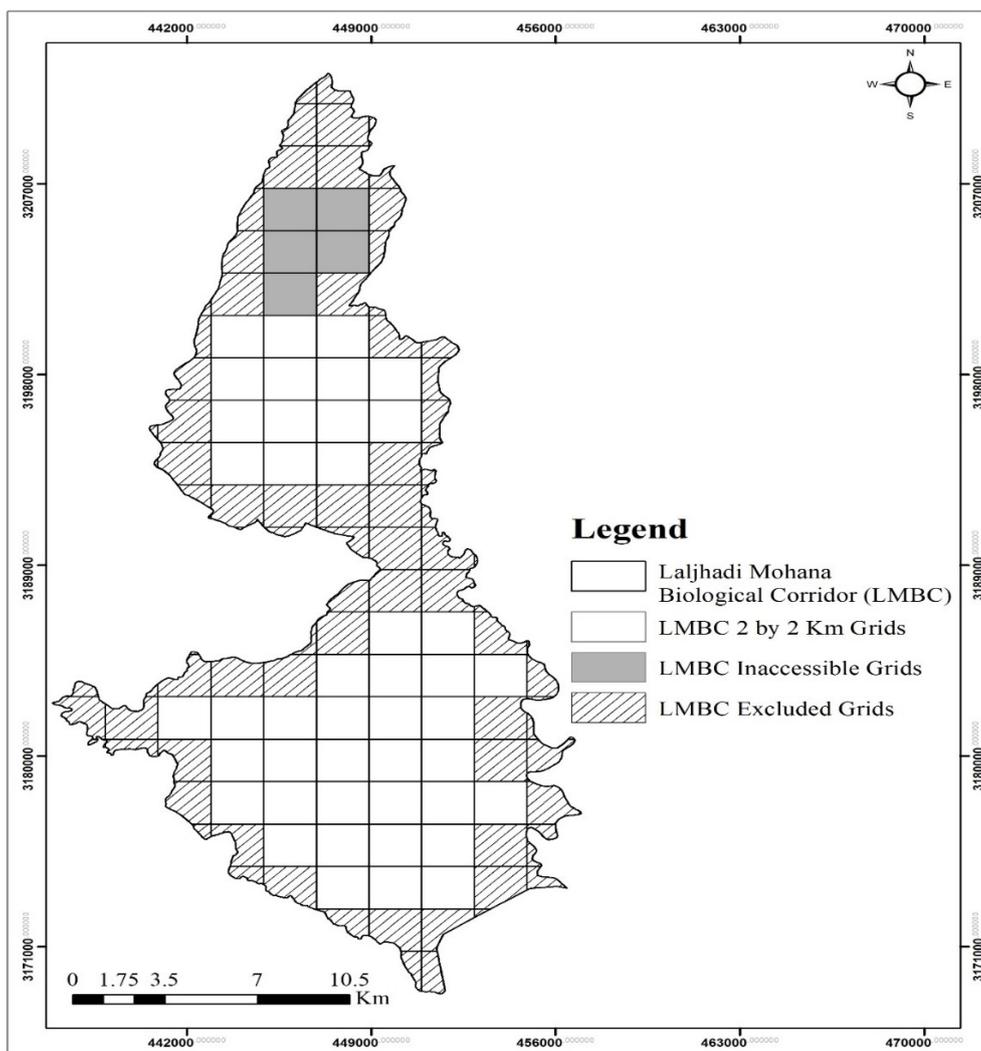
Figure 2: LMBC in Nepal, divided into 2 × 2 km grids and showing the included, excluded, and inaccessible grids.

These interviewees were chosen based on their active participation and contribution in the conservation sector following the same questionnaire mentioned above. Key informants included forest guards, political leaders, and municipal ward heads and they were chosen to explore their knowledge and viewpoints on the existing problems, conflicting species, and conservation threats along with possible remedies for these situations in the future.

A workshop was also conducted to cross-validate, discuss, and explore information about conflicting species and existing conservation threats in the LMBC, with a goal to ranking these situations for ease of further scientific analysis and representation. From this open discussion at the workshop, in-depth information about corridor-using large mammals and their status and conservation threats have been explored.

Data analysis

Data collected from fieldwork were analyzed using MS-Excel and interpreted in the form of maps, bar-

diagrams, and tables depending upon the nature of the data. Based on direct and indirect evidence retrieved during the field surveys, a distribution map of large mammals was prepared by overlaying the geo-coordinates in ArcGIS. Relative abundance of the encountered mammals was calculated by following the formula used by Botelho et al. (2012), Getachew and Mesele (2018) and Rabira et al. (2015). Household survey data of the local people's perception were analyzed and represented as frequencies and percentages.

In order to assess conservation threats, a relative threat ranking method was followed (Margoulis and Salafsky, 2001; WWF, 2007) and three scales of classification - scope, severity and urgency - were used to identify and prioritize the major existing issues based on the collected data. Three criteria were assigned to each of the identified issues and ranked with the highest rank equal to the number of total threats, as follows:

1. Scope – The proportion of the target that can reasonably be expected to be affected by the threat within 10 years,

given the continuation of current circumstances and trends.

2. Severity – Within the scope, the level of damage to the target from threats that can reasonably be expected given the continuation of current circumstances and trends.

3. Urgency – This includes the importance of taking immediate action to deal with the threat.

From these different fields, 8 types of major issues were observed and ranked as threats with the value of rank ranging from 8 to 1, where the value 8 implies very high with serious effect, and value 1 implies very low with least effect, respectively. These values are categorized under a 4-point scale for analysis and categorized as Very High (VH), High (H), Medium (M), and Low (L).

Results

Distribution and abundance of large mammals

Six species of large mammals were encountered during the transect survey within the predetermined survey grids (n=44). Direct and indirect signs of all six species of large mammals were observed in the southern part of LMBC (Appendix). Importantly, the elephant *E. maximus*, the Blue bull *Boselaphus tragocamelus* (Pallas), and the deer *A. axis* were found concentrated within the southern region while leopard *P. pardus*, boar *S. scrofa*, *B. tragocamelus*, and *A. axis* were observed in both the northern and southern regions (Fig. 3). *Boselaphus tragocamelus*, *A. axis*, and *S. scrofa* have all been directly observed in the field survey during the present study.

A total of 51 individuals of the six large mammals encountered were identified from the LMBC (Table 1). *Boselaphus tragocamelus* was recorded with the highest relative abundance (15 individuals, 29.4%), followed by *E. maximus* (13 individuals, 25.5%), *A. axis* (11 individuals, 21.5%), *S. scrofa* (8 individuals, 15.7%), *P. pardus* (3 individuals, 5.9%) and *P. t. tigris* (one individual, 2%).

Human perception

Responses to the problems faced

Local people residing along the LMBC have been impacted by the wildlife through livestock depredation or crop raiding but no cases of human casualties have been noted to date. Both residential and migratory species have been in conflict with the surrounding humans. Despite of the above-mentioned problems, about 82.50% of respondents retain a positive attitude towards their local wildlife. In comparison, only 17.50% of respondents show a negative attitude towards the conservation of such problem species. *Boselaphus tragocamelus*, *E. maximus*, *S. scrofa*, and *A. axis* are implicated in crop-raiding incidents every year and are the most problematic species faced by these local residents, who bear the significant economic loss.

Similarly, *P. t. tigris* and *P. pardus* have an impact on local livestock depredations.

Observation of large mammals

The majority of respondents (about 90%) have directly seen *B. tragocamelus* within the LMBC area and about 87% have seen *E. maximus*; while 77% and 42% have seen *P. t. Tigris* and *P. pardus*, respectively, but mostly through indirect signs like pugmarks, scat, urine, and scratches. Similarly, *S. scrofa* and *A. axis* were commonly observed by each respondent.

Furthermore, local people believe that *B. tragocamelus* is a grazing animal that moves during the summer season from one place to another and that the Asian elephants are wide-ranging animals that can cover a considerable distance within 24 hours. *Elephas maximus* is not native to this area, which implies that the LMBC is being used as a migratory route. However, some tigers are resident in this corridor, and others are locally migratory. Species like *P. pardus*, *A. axis*, and *S. scrofa* are all-year residents in the corridor.

Population trends of large mammals

In response to the population trends of large mammals question on the household survey, only 25% of respondents stated that the trend is increasing; as there has been an implication of considerable efforts made to minimize poaching and over-grazing. These respondents further pointed out that the population of *B. tragocamelus* and number of migratory *E. maximus* has been specifically increasing. In contrast to this, 10% of respondents stated that the population trend is decreasing due to habitat fragmentation, poaching, and insufficient habitat components, 20% reported it as constant, and 45% stated they have no knowledge of this matter. To date, the majority of local people stated that they have never seen any large dead mammals, specifically *E. maximus* and *B. tragocamelus*.

Condition of habitat components for endangered species (*Elephas maximus* and *Panthera tigris tigris*) in LMBC

Local perceptions of the currently available condition of habitat components for endangered large mammals (elephant and tiger) in the corridor were investigated. In the case of the Asian elephant, the availability of food was stated as satisfactory (48%), available space was sufficient (56%), vegetation cover was sufficient (50%), and water as unsuitable (92%) (Fig. 4). Similarly, for *Panthera tigris tigris* (Fig. 5), the availability of food was stated as satisfactory (46%), available space was satisfactory (42%), vegetation cover was sufficient (44%), and water as unsuitable (93%).

Migratory behavior of large mammals

All six species of the large mammals were using the LMBC for their survival. Based on the current results (Fig. 6), about 96%, 65%, and 55% of people

believed that *E. maximus*, *P. t. tigris* and *B. tragocamelus* are using LMBC for migration purposes, respectively. However, about 77%, 100%, and 98% of the local people believe that *P. pardus*, *S. scrofa*, and *A. axis* are resident in LMBC, respectively.
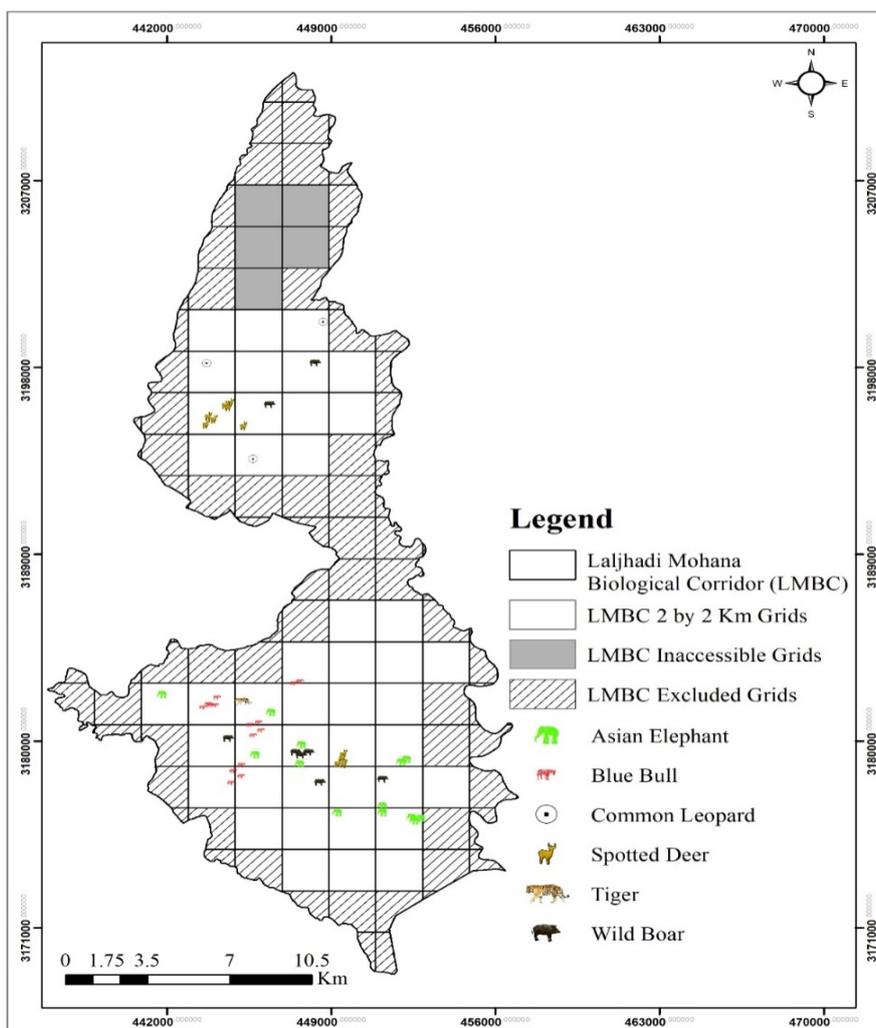

Figure 3: Map showing the distribution of large mammals found during the transect survey in LMBC, Nepal.
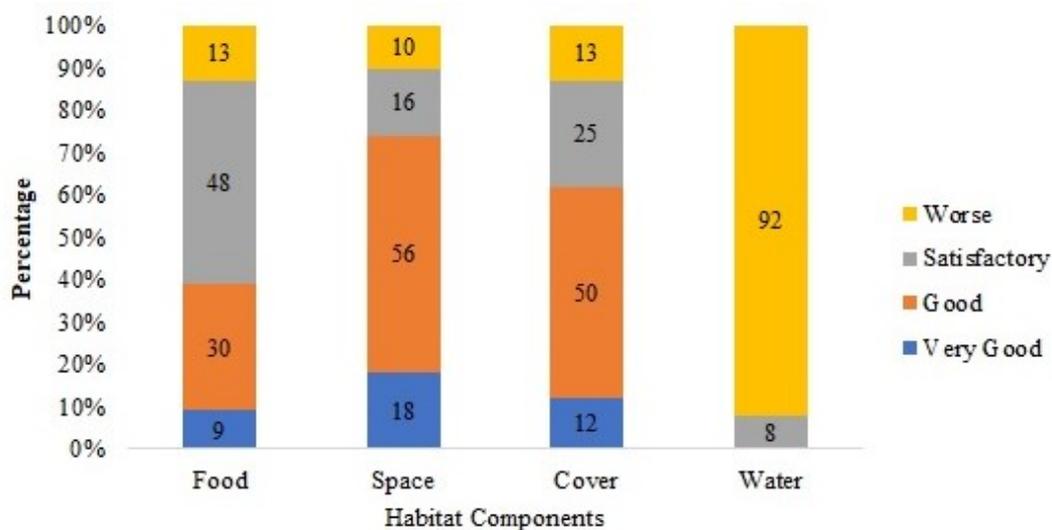

Figure 4: Local perceptions of the availability of food, space, cover, and water for *Elephas maximus* in LMBC, Nepal.
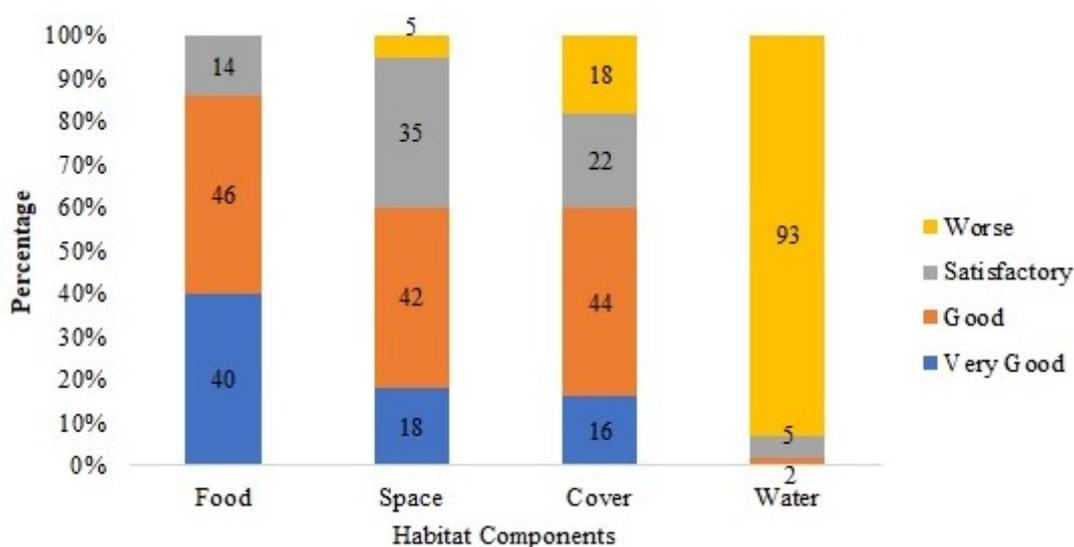
Figure 5: Local perceptions of availability of food, space, cover, and water for *Panthera tigris tigris* in LMBC, Nepal.
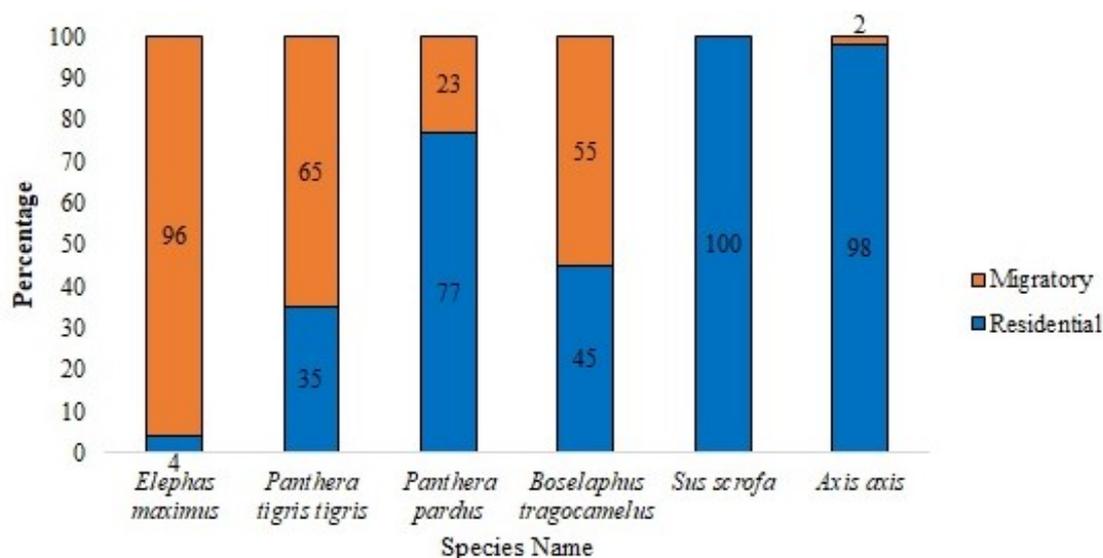

Figure 6: Local perceptions of the purpose of the large mammal species using the LMBC, Nepal.

Conservation threats

The results conclude that forest encroachment and habitat fragmentation are the most prominent issues as high ranking threats in the study area. Intensive open grazing and collection of forest products (Non-Timber Forest Products (NTFPs) and fuelwood) were high. Natural disasters and the construction of infrastructure were ranked as a medium threat to the corridor and illegal poaching and invasive species were both ranked as low. A detailed classification and ranking of all 8 main threats are shown in Table 1.

Forest resource extraction (fuelwood, timber, leaflitter) and NTFP (medicinal herbs) consumption and the open grazing of farm animals fall under the high threat category in the present study for the

LMBC. On the periphery of the LMBC, local people are dependent on the forest and on its resources to fulfill their daily subsistence. Limited resources are allocated to the local people for official consumption from the community forests, which are not sufficient for them, and people are forced to illegally enter and fulfill their remaining demands from the forests within the wildlife corridors. Agriculture is the first and livestock farming is the second occupation recorded by the majority of the local residents. The required fodder for their farm animals is met by leading the livestock to graze openly inside the forest. All these are major existing threats to the conservation of large mammals found in the LMBC.

Naturally occurring disasters are also an issue to this LMBC area and it is ranked under the medium threat category.

Table 1: Relative ranking of the threats in LMBC, Nepal.

SN	Direct Issues	Scope	Severity	Urgency	Total	Threat Classification
1	Encroachment	7	7	8	22	Very high
2	Habitat fragmentation	6	8	7	21	Very high
3	Open grazing	8	6	6	20	High
4	Illegal poaching	4	4	3	11	Low
5	Natural disaster (fire, floods)	3	5	5	13	Medium
6	Fuelwood and Non-Timber Forest Products (NTFPs) collection	5	3	4	12	High
7	Infrastructure	2	2	2	6	Low
8	Invasive species	1	1	1	3	Low
	Total	36	36	36	108	

Note: Comparisons are made within LMBC's existing threats.

Flash floods occur during the monsoon every year and damage the local agricultural lands, as well as the forest areas, by the uprooting of standing trees. In addition, the slipping and erosion of riverbanks poses the risk of changing the course of the river more towards the forest and human settlements.

Lastly, threats which ranked under the low category are illegal poaching, infrastructure, and invasive species. Poaching is a global primary problem for wildlife conservationists. Poaching of *A. axis* and *S. scrofa* were reported from the LMBC as they are resident and easily available for consumption. Poaching of *B. tragocamelus*, and consumption as a meat source, has been reported from India, however, such incidences are relatively low in comparison to *S. scrofa* and *A. axis*. No reports of the poaching of endangered species from this area have been noted to date. Human settlements in the area are located mostly in the southern part of the forest, and developed local roads, paths, and trails for access to the market run through the forest. Such mismanaged and improper local developments are also a problem in this area. Invasive plant species, such as Ganmane Jhar *Ageratum conyzoides*, Banmara *Lantena camara*, Besharam *Ipomoea carnea* and Lahare Banmara *Mikania micrantha*, are posing a threat to the local forest flora. Their continuous invasion into the forest is of concern and needs immediate attention as most of these invasive species are known to alter the native vegetation rapidly. These species are fairly commonly encountered throughout the study area during the survey. They may pose problems to the wild mammal species in the near future, especially to the herbivorous species like *A. axis* and *B. tragocamelus* which feed mostly on grasslands. Such areas have already been invaded by these above-mentioned invasive species, and are not only restricted to the forest, but also have expanded to the local agricultural lands as well.

Discussion

Terai Arc Lands have gentle terrain with high soil fertility, but face constant forest encroachment and altered land use patterns through construction of human settlements, agriculture and farming. Evidence suggests that forest areas are disproportionately sacrificed for different purposes of human modernization like ambitious national projects constructing highways, high tension lines, railway tracks, the resettlement of slums and army camps. Similarly, habitat fragmentation of forest area due to the tremendous consumption of forest products and continuous degradation in forest status has led to the isolation of forest patches. Most of the time these conversions of dense forest into sparse or scattered forests, and then into open grasslands, are examples of human-induced de-succession of the natural vegetation that threatens the existence of wildlife.

The present study revealed that the majority of charismatic species, like the Bengal tiger, Asian elephant, and Blue bull (Nilgai) are continuously using the LMBC as a migratory route and that spotted deer, wild boar and common leopards also exist as residents in LMBC. This concurs with the results of the study by Shrestha et al. (2014).

The majority of local residents have experienced wildlife conflict, in terms of crop-raiding and livestock depredation, on a continuous basis. In Nepal, considerable damage is done by the Asian elephant in terms of attack frequency and human fatalities (Acharya et al., 2016) and crop-raiding (Neupane et al., 2019), but with the higher number of observations being in the southern part. This is in line with the study conducted by Rood et al. (2010), stating that elephants prefer forest with multiple resources. Higher relative abundances of the Asian elephant in the southern part of the LMBC may be due to the greater availability of palatable fodder species and for the human settlements with crops like rice and maize, banana fields, grain storage, and locally produced home alcohol; all which elephants prefer. This is also in agreement with the fact that the elephant's preferred habitat is positively influenced by the availability of grasslands, mixed forest, and landscape heterogeneity, whereas it is restricted by the nature of the terrain (Neupane et al., 2017).

The local people have a positive perception towards the conservation of both migratory and resident wildlife, although they are continuously facing wildlife conflict. This may be because of the protected forest declaration for LMBC under the law of 2011 (Shrestha et al., 2014) which increased implementation of conservation activities in the area and has raised awareness among the local residents about the relationship and the importance of wildlife for human beings and support for their conservation. Other reasons behind their positive perception towards wildlife may be the economic benefits they receive from the government when a problem is experienced by a local household from one of the enlisted species, such as livestock loss, crop raids, and human fatalities. In addition, the locals receive advanced mitigating techniques like support for alternative crop cultivation, electric fencing, watchtowers, and ecotourism benefits.

Elephas maximus is a wide ranging migratory animal which uses LMBC as a corridor to move from Dudhwa National Park of India into Nepal and disperses towards both Bardia National Park and Shuklaphanta National Park. The similar habitat conditions between these places has already favored a gradual increase in *E. maximus* populations through seasonal movements (Velde, 2011). The southern part of the corridor is well connected to Shuklaphanta National Park in contrast to the northern part that is connected to the foothills of the Chure Ranges where the lands are fragile and contain many large exposed stones which are not preferred by the elephants. The present study found large mammals to be more confined to the southern part of LMBC in comparison to the northern part (Fig. 3), which also agrees with the study by Thapa et al. (2017). The southern part of LMBC further supports the extended habitat for endangered species like *P. t. tigris* and *E. maximus* mostly due to the availability of water resources which are lacking in the north.

However, for both mentioned species, water is available, but the amount of existing perennial water sources is increasingly not enough. The availability of water resources has been reduced, within the span of one decade from 2002 to 2012, from 14.5 km² to 10.69 km² (Thapa et al., 2017). This decrease is due to continuous forest degradation, forest encroachment, illegal resource extraction, monsoon flooding, and unmanaged settlement. For example, in 2002, there was about 58% of forest cover, which was reduced to 36% in 2012, which is an indication of the habitat degradation.

Anthropogenic disturbances are major problems for the survival of wildlife species and affect animal behavior and their abundance (Leblond et al., 2013). Overexploitation, habitat destruction, agricultural development, urbanization, deforestation, human-introduced diseases, and invasive species are widely considered to be the major factors driving excessively high local or global species extinctions; particularly for wildlife (Wan et al., 2019). The identified major threats for the large mammals in the LMBC wildlife corridor are forest encroachment and habitat fragmentation, intensive overgrazing of the local livestock in the forest area, presence of invasive species, illegal consumption of forest products, natural disasters like fires and monsoon flash floods, and illegal poaching of charismatic, rare and endangered species. Forest encroachment has reduced the availability of habitat for the existing wildlife species in the area. For instance, a study conducted by Thapa et al. (2017) concluded that within the span of one decade from 2002 to 2012, the dense forest was primarily converted to cultivated land, and later into the sparse forest, which is consistent with the results of our study. About 18% of dense forest area has been reduced within a decade, primarily for the extension of agricultural lands and properties. In addition, habitat fragmentation has often created disturbance in the movement patterns of animals which has led to isolation of the wildlife populations (McGarigal et al., 2005), and has decreased the core population while increasing the risk of extinction (Laurance et al., 2019).

Conclusion

The current study has recorded 51 individuals belonging to six species of large mammals in the LMBC through direct and indirect signs, including *B. tragocamelus*, *E. maximus*, *A. axis*, *S. scrofa*, *P. pardus* and *P. t. tigris*. As per relative abundance status, *B. tragocamelus* is the most abundant species followed by *E. maximus*. The distribution of the large mammals within the corridor is mostly confined to the southern part due to the higher availability of water sources, in comparison to the northern part which is separated by the East-West Mahendra Highway.

Local people hold positive perceptions toward the conservation of wildlife species, even though they have yearly wildlife conflict. Habitat components for both *E. maximus* and *P. t. tigris* were suitable with a lack of sufficient water being the only constraint. The local people claim that *E. maximus*, *P. t. tigris* and *B. tragocamelus* are mostly using the LMBC for movement purposes from one site to another. People also report that forest encroachment and habitat fragmentation are the major existing threats to the conservation of large mammals in the area.

The present study suggests that, even though the LMBC has been found to be optimal in habitat conditions for supporting large mammals, there are still medium and small mammal species to be discovered, which are also using this corridor for their survival. In this regard, it requires the attention of national and international communities to further conduct extensive research activities in favor of all the species using LMBC for residential or migratory purposes. It also suggests that the construction of

artificial water holes in the northern part of the LMBC would be beneficial to increase wildlife distribution.

Acknowledgements

Conflict of interest

All the authors declare that there are no conflicting issues related to this research article.

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Appendix: Pictures related to this study including, wild animals, pugmarks, pellets, dung, scat, and conservation threats in LMBC, Nepal.

Spotted deer, *Axis axis*

Blue bull (Nilgai), *Boselaphus tragocamelus*

Royal Bengal tiger, *Panthera tigris tigris*

Foot prints of large mammals observed in study area (*Boselaphus tragocamelus*, *Panthera pardus*, *Panthera tigris tigris* and *Elephas maximus*).

Dung of the Asian elephant, *Elephas maximus*

Dung of the Blue bull, *Boselaphus tragocamelus*

Scat of the Common leopard, *Panthera pardus*

Flash flood damage (Uprooted standing trees)

Forest deforestation

Forest encroachment

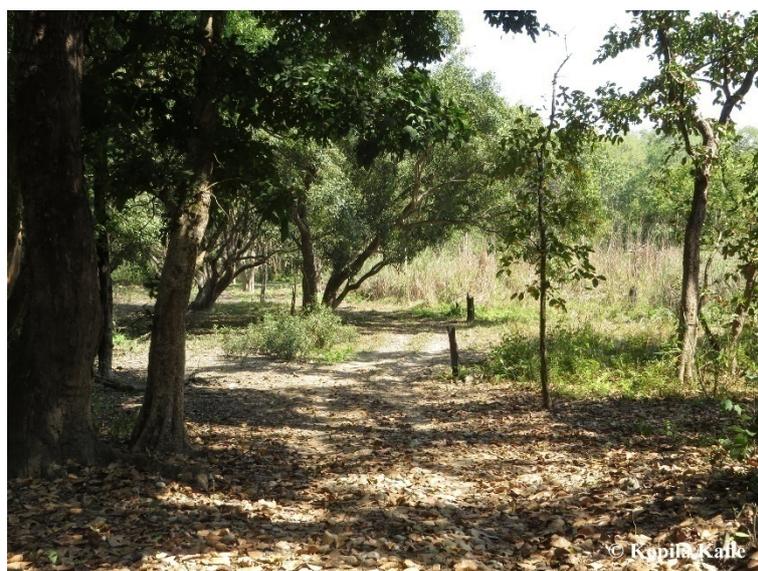Invasive species (*Ipomoea carnea*) and unmanaged grazing

Goat grazing

Open livestock grazing inside the forest

Invasive species (*Ageratum conyzoides*)

Agricultural crops raid by the Asian elephant, *Elephas maximus*

Road inside forest area

Local intentional fire inside forest