PARTICIPATORY THREAT ASSESSMENT OF TWO MAJOR WILDLIFE CORRIDORS IN THE TERAI ARC LANDSCAPE

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ABSTRACT

Threats within the Basanta and Laljhadi-Mohana wildlife corridors that connect protected areas in the Terai Arc Landscape were assessed in 2012 and 2014. The threat ranking employed a participatory and multi-stakeholder process with members of government agencies and the community. The team used two different methodologies in 2012 and 2014. In the first assessment in 2012, biodiversity targets and direct threats were identified in a conceptual model of the corridors, and absolute threat ranking was conducted using Miradi software. In 2014, direct threats in the corridors were identified and evaluated using a pairwise ranking approach. Both processes identified the type and level of direct threats in each corridor at each time period. The extent and intensity of direct threats were found to vary between wildlife corridors, between different landscapes and between the two time-periods. In the Basanta corridor, some threats identified in 2012 disappeared or were not prioritised (e.g. use of diclofenac) in 2014 while new threats emerged (e.g. infrastructure development) in the intervening years. In the Laljhadi-Mohana corridor, the level of threats varied (e.g., encroachment was a 'low' threat in 2012, whereas it was a 'high' threat in 2014). Both approaches provided simple ways of identifying and ranking direct threats in planning biodiversity conservation in a wildlife corridor or landscape.

Keywords: wildlife corridor, Terai Arc Landscape, direct threat, absolute threat ranking, pairwise ranking, Miradi

INTRODUCTION

The Terai Arc Landscape (TAL) is a vast conservation landscape of approximately 49,500 sq km, stretching from Nepal's Bagmati River in the east to India's Yamuna River in the west (MoFSC, 2004). It incorporates 13 protected areas and forest corridors stretching from Parsa Wildlife Reserve in Nepal to Rajaji National Park in India. The TAL includes the Terai-Duar savanna and grassland, a Global 200 Ecoregion, which is categorised as critical/endangered (Olson & Dinerstein, 2002). The landscape is home to some of Asia's largest mammals – Bengal tiger (Panthera tigris), Asian elephant (Elephas maximus), greater one-horned rhinoceros (Rhinoceros unicornis), gaur (Bos gaurus) and swamp deer (Cervus duvaucelii). The Terai Arc Landscape (Western Terai Complex) was identified as one of 17 priority conservation landscapes in a 2001 ecoregional assessment (WWF & ICIMOD, 2001). The Terai Arc Landscape – Nepal (TAL-Nepal) extends over an area of 23,199 sq km (Figure 1).

The Terai Arc Landscape was based on the concept of Tiger Conservation Units, a conservation tool developed by WWF, in collaboration with the Wildlife Conservation Society (WCS), and with support from Save the Tiger Fund (Terai Arc Landscape Program, A Retrospective, 2001-2008, 2008). TAL – Nepal represents two Level-1 Tiger Conservation Units (MoFSC, 2004). The TAL concept was developed around delineation of 'wildlife corridors', as defined by a tiger dispersal model using the tiger as umbrella species. Forest corridors are natural habitat areas that contain the ecological conditions necessary for potential wildlife movement. Usually, forest corridors link protected areas providing refuge for wildlife populations (MoFSC, 2006).

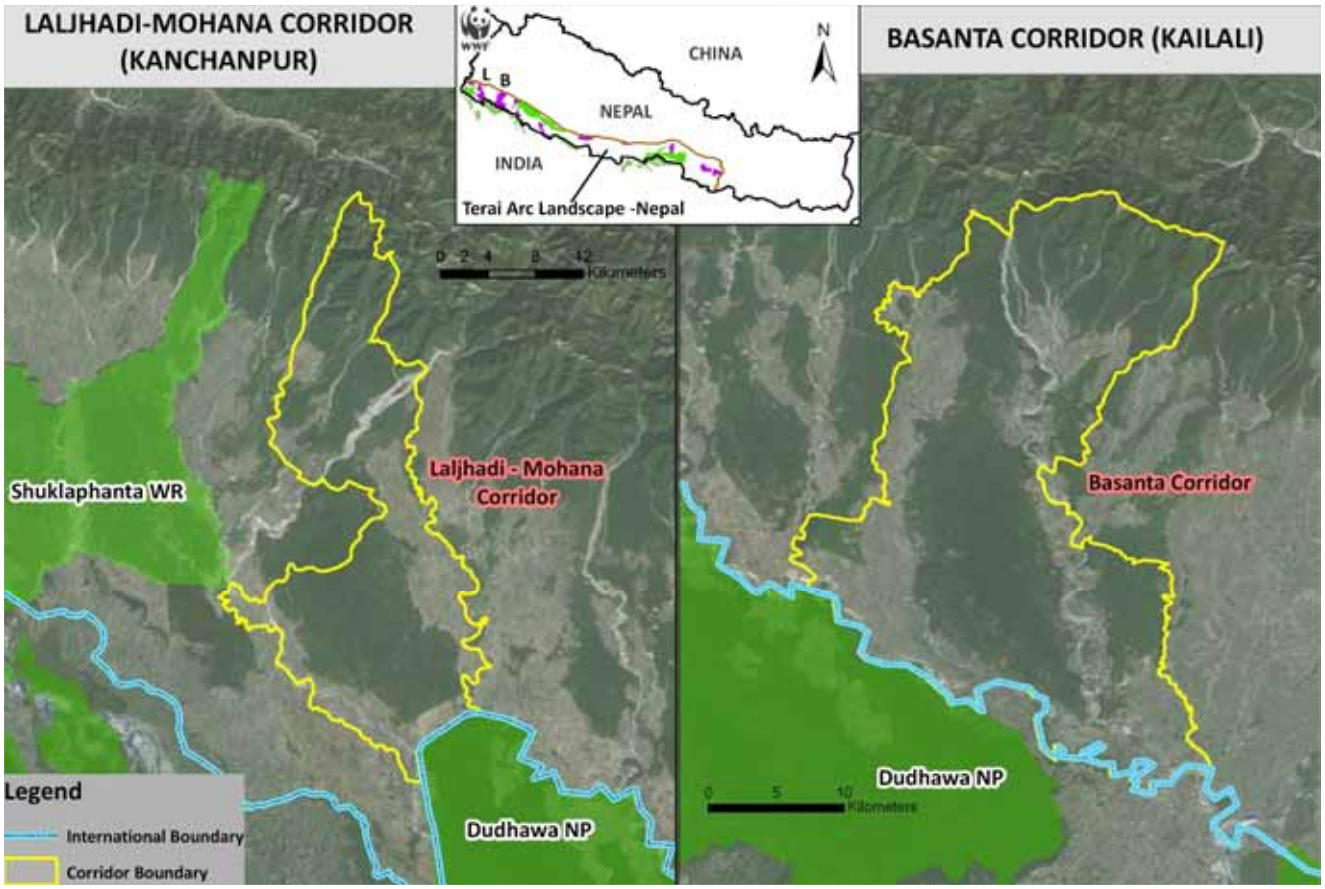

Figure 1. Protected areas and wildlife corridors in Terai Arc Landscape (TAL) – Nepal (and some protected areas in TAL India)

Three transboundary corridors were delineated in 2001: Basanta corridor, Brahamadev-Bardia-Chitwan corridor and Khata corridor. The Basanta corridor (Figure 1, labelled 'B' on the inset map of TAL) encompasses an area of 65,500 ha, connecting Suklaphanta Wildlife Reserve and Bardia National Park in Nepal with Dudhwa National Park in India through the forests of the Churia foothills (WWF Nepal, 2008). The corridor is used by tiger and rhinoceros, but encroachment in the forest area is high (TAL CBRP, 2015).

Within the Brahamadev-Bardia-Chitwan corridor a bottleneck was identified where a narrowing of the corridor had resulted from external threats (MoFSC, 2006). This bottleneck lies at the border of Kailali and Kanchanpur districts, and links Suklaphanta Wildlife Reserve with Bardia National Park through the Siwalik foothills (WWF Nepal, 2008). The degraded forest area has been gradually restored. It was identified that the southern part of the bottleneck had the potential to link to the Dudhwa National Park, India on the south. The area was then expanded as 'Laljhadi-Mohana corridor' in 2005 (Figure 1, shown as 'L' on the inset map of TAL). This corridor links Dudhwa National Park in India with the Churia forests in Nepal and lies in Kanchanpur district and east of Suklaphanta Wildlife Reserve. It covers an area of 35,400 ha. The corridor is frequently used by elephants and tigers (TAL CBRP, 2015). The government of Nepal declared parts of the Basanta corridor (40,782 ha) and the Laljhadi-Mohana corridor (24,664 ha) as protected forest areas in 2010.

ASSESSMENT OF THREATS IN THE TERAI ARC LANDSCAPE

The direct threats of biodiversity loss and environmental degradation in TAL-Nepal were identified in 2001 as forest conversion, uncontrolled grazing in forests, unsustainable timber harvesting, unsustainable fuelwood extraction, forest fires, Churia watershed degradation, and wildlife poaching and human wildlife conflict (MoFSC, 2004). The type and level of direct threat varied from one corridor to another and one protected area to another in TAL-Nepal. As part of more detailed conservation planning for projects in the Basanta and Laljhadi-Mohana corridors, WWF conducted threat assessments at a more local level in 2012 and 2014. Methods of threat analysis include (a) absolute rating systems like that used in the Open

Standards methodology and Miradi software (see https://www.miradi.org/), and (b) approaches that use pairwise comparisons of threats (Russell, 1997).
This paper reports on the results from applying both these approaches as part of a conservation project in the Terai Arc in Nepal. A WWF conservation team used absolute threat ranking in the analysis in 2012 (required as part of its USAID-supported programme) and used a pairwise ranking method, which included consultation with the surrounding communities in 2014.

METHODS AND METHODOLOGY

The conservation team used the absolute threat ranking methodology in 2012 with technical support from WWF Nepal who were facilitating the process. Absolute ranking of threats is done separately for each individual conservation target such as a species or particular ecosystem, and the rankings are rolled up to determine each threat's overall effect on the site. Thus, for each target, the team needs to look at all the threats that affect it and rank the degree to which each threat affects the target. The team used three criteria to evaluate each direct threat: scope, severity and irreversibility with each assessed on a four-point scale (very high, high, medium and low) as used in the Miradi software (WWF, 2012; see Supplementary Online Material 1 for details). The steps followed in threat ranking are outlined in Supplementary Online Material 2.

In the discussion of the Basanta corridor, key stakeholders such as members of the community forest coordination committee, community forest user groups, district forest office and the field staff of WWF Nepal participated in the team. The team held discussions and, after achieving a consensus, presented their results. Similarly, the team of stakeholders for Laljhadi-Mohana corridor included members of Suklaphanta Wildlife Reserve, the community forest coordination committee, community forest user groups, district forest office, local non-governmental organisations and field staff of WWF Nepal. There were 20 members in each team, made up of the organisations or institutions involved in biodiversity conservation in the corridors.

In 2014, the teams again conducted threat ranking of the same two wildlife corridors. Instead of using the

Indigenous Tharu community in Basanta corridor © WWF Nepal

absolute threat rating approach used previously in 2012, on advice and with the support of technical support staff, the teams used a pairwise ranking approach. In pairwise ranking, each item on a list is compared in a systematic way with every other item (Russell, 1997). In a table, each threat/problem is compared in turn with each of the other threats/ problems. The most important threat amongst the two is placed in the cell in the table. This is repeated until all threats are compared with the first threat. The same process is repeated for the second threat. The process is repeated for all threats until all possible comparisons are made and the matrix is completed (see Supplementary Online Material 2).

In the discussion of the Basanta corridor, the participants comprised members of the community forest coordination committee, community forest user groups, sector forest office, and field staff of WWF Nepal. In the discussion of Laljhadi-Mohana corridor, the participants comprised members of Laljhadi-Mohana protected forest, sector forest office, community forest coordination committee, community forest user groups, and field staff of WWF Nepal. There were 30 participants in each team made up of the organisations and institutions involved in biodiversity conservation in the corridors.

In 2012, the exercises were carried out in the district headquarters of Kailali district of the Terai Arc Landscape. Kailali district incorporates Basanta corridor, whereas its adjoining district in the west, Kanchanpur district incorporates Laljhadi-Mohana corridor. In 2014, the exercises were carried out in their respective corridors, one in Basanta corridor and the other in Laljhadi-Mohana corridor. So, the number of participants was higher in 2014 as there was greater representation from the community forest coordination committee and community forest user groups of the respective corridors. The officer of the sector forest office joined the meeting in 2014. Almost 40 per cent of the participants meeting in 2014 had previously participated in 2012.

RESULTS

Basanta Corridor

In 2012, 12 biodiversity targets and 10 direct threats for Basanta corridor were identified using absolute threat ranking (Supplementary Online Material 3 -– Basanta conceptual model and threat ranking). Flood and erosion/ sedimentation, poisoning (fishing) and excessive grazing were ranked as 'high' threats, whereas the remaining threats were ranked 'medium'. The overall project threat rating was 'high' (Table 1).

In 2014, the team conducted the threat ranking of Basanta corridor using pairwise ranking methodology (Supplementary Online Material 4 – Pairwise threat ranking, Basanta, 2014). The team identified nine threats. Two direct threats, encroachment and large infrastructure development were ranked 'very high'. Overgrazing and Chure degradation were ranked 'high'. Forest fire, river-bank cutting and wetland/habitat loss were ranked 'medium'. Poaching and illegal timber smuggling were ranked 'low' (Table 2).

Laljhadi-Mohana corridor

Similarly, in 2012, the team identified 15 biodiversity targets and nine direct threats for Laljhadi-Mohana corridor using absolute threat ranking (Supplementary Online Material 5 – Laljhadi-Mohana conceptual model and threat ranking).

Illegal grazing, poaching and uncontrolled forest fire were ranked as 'very high' threats, whereas lack of food and shelter, use of poison in river, river bank erosion and siltation and illegal extraction of fuelwood were ranked as 'high' threats. Timber smuggling was ranked 'medium' and encroachment was ranked as 'low' threat (Table 3). The overall project threat rating was 'very high'.

In 2014, the team conducted the threat ranking of Laljhadi-Mohana corridor using pairwise ranking methodology (Supplementary Online Material 6 – Pairwise threat ranking, Laljhadi-Mohana, 2014). The team identified 10 threats.

Illegal fuelwood collection was ranked as a 'very high' threat. Encroachment, river-bank cutting and flooding and open grazing were ranked as 'high' threats (Table 4). Poaching, forest fire, habitat loss and boulder/sand

Laljhadi Mohana corridor © WWF Nepal

Table 1: Summary of threat rankings of Basanta corridor in 2012 using absolute threat ranking

Very High	High	Medium	Low
	Flood, erosion and sedimentation	Use of diclofenac	
	Poisoning (fishing)	Illegal logging	
	Excessive grazing	Uncontrolled forest fire	
		Poaching	
		Excessive firewood extraction	
		Encroachment	
		Invasive species	
Overall Project Rating			**High**

Table 2: Summary of threat rankings of Basanta corridor in 2014 using pairwise comparison

Very High	High	Medium	Low
Encroachment	Overgrazing	Forest fire	Poaching
Infrastructure development	Chure degradation	Riverbank cutting	Illegal timber smuggling
		Wetland/habitat loss	

Table 3: Summary of threat rankings of Laljhadi-Mohana corridor in 2012 using absolute threat ranking

Very High	High	Medium	Low
Illegal grazing	Lack of food and shelter	Timber smuggling	Encroachment
Poaching	Use of poison in river		
Uncontrolled forest fire	Riverbank erosion and siltation		
	Illegal extraction of fuelwood		
Overall Project Rating			**Very high**

Table 4: Summary of threat rankings of Basant corridor in 2012

Very High	High	Medium	Low
Illegal fuelwood collection	Encroachment	Poaching	Poisoning
	Riverbank cutting and flooding	Forest fire	Human-wildlife conflict
	Open grazing	Habitat loss	
		Boulder/sand extraction	

extraction were ranked as 'medium' threats. Poisoning and human-wildlife conflict were ranked as 'low' threats.

Comparison of results

Comparing the results between the two methodologies over the two periods of time 2012 and 2014, indicates that new threats have emerged or become prioritised and some existing threats have receded or were not prioritised. Possible explanations are apparent for at least some, but not all, of these changes.

In the Basanta corridor, four threats from 2012 were not similarly identified or prioritised in 2014 (invasive species, poisoning (fishing), use of diclofenac, and excessive firewood extraction) while a number of new threats were identified at the later time (infrastructure development, Chure degradation, river-bank cutting and wetland/habitat loss). The governments of India, Nepal and Pakistan banned veterinary use of the painkiller diclofenac in 2006 because of its lethal effects on vultures that feed on the carcasses of cattle and buffaloes that have been treated with the drug shortly

before they died (Bird Conservation Nepal, 2014). Seven districts, including Kailali district which includes the Basanta corridor, were declared diclofenac-free in 2010/2011 (Bird Conservation Nepal, 2015) and may be the reason why use of diclofenac was seen as a threat in 2012 but not in 2014. Also, in the Kailali district, around half of households use fuelwood for cooking (Alternative Energy Promotion Centre, 2014) although fuelwood is being progressively replaced by technologies such as domestic solar, biogas and improved cook stoves (ICS). WWF Nepal, the Biogas Sector Partnership – Nepal, Alternative Energy Promotion Centre and other organisations are providing support to biogas and ICS in the district. WWF Nepal chiefly focuses on the corridor areas within the districts, and its programme supported the installation of 606 biogas plants and 345 ICS in the corridors in 2014 alone (TAL CBRP, 2014), which could explain why excessive firewood extraction was not seen as a threat in 2014.

The government of Nepal allocated a budget for national pride projects in 2013 (Ekantipur, 2013) including the postal highway project which passes through Basanta corridor. The government of Nepal also funded the Rani-Jamara-Kulriya irrigation project which passes through the Basanta corridor. These projects could have led to the identification of infrastructure development as a new priority threat. Chure degradation and river-bank cutting identified in 2014 closely relate to 'flood, erosion and sedimentation' which was identified in 2012. The Basanta corridor is connected to the Chure hills in the north which are geologically young, structurally weak and lie in a zone of high volume precipitation (MoFSC, 2008). In the monsoon season, the heavy rain in areas of forest degradation causes erosion and landslides and the increased run-off leads to flood and river-bank cutting in the lowland. The Kailali district is rated as 'moderate' in terms of flood vulnerability index (Ministry of Environment, 2010). So, 'flood, erosion and sedimentation' and/or 'river-bank cutting' were manifested as a threat in the Basanta corridor in Kailali district.

All but one (timber smuggling) of the threats identified in the Laljhadi-Mohana corridor in 2012 were also recorded in 2014, while three new threats were recorded at the later time (habitat loss, boulder/sand extraction and human-wildlife conflict). In 2014, a herd of elephants killed a farmer and destroyed several huts (TAL CBRP, 2015) and thus, exacerbated human-wildlife conflict while development pressures and weak governance lead to exacerbation of habitat destruction and exacerbation of resource extraction activities.

Members of community forest user groups in Laljhadi-Mohana corridor © WWF Nepal

Table 5: Strengths and weaknesses of the two methodologies

	Absolute threat ranking	Pair-wise ranking
Strengths	Threat is measured target-by-target basis.	Threat is measured considering the overall site or area.
	It is efficient and more scientific as it incorporates set criteria or parameters and their categories for rating – very high, high, medium and low. It thus allows sound comparison of the results over time.	It is a simple method that does not require a highly trained facilitator, nor the usage of software.
	The assessment of threats lends itself to the design of a target-driven activity or programme-based responses based upon the target-by-target analysis of the threat ranking.	It is less costly in terms of the requirement for a trained facilitator and is easier to understand for community members. It takes less time to conduct the exercise in the group.
	The method calculates an overall threat rating for the area or project.	
Weaknesses	It requires a trained facilitator who can guide the group through absolute threat ranking (best done using Miradi). So, it can be relatively costly and such a trained facilitator may not be available at the community level.	It requires another set of group work to identify a target-driven activity or programme.
	It is harder to understand by community members in the beginning of the group exercise as it is more technical in its procedure and it also takes longer for the whole exercise.	It does not show the overall threat rating for the area or project.

Relative strengths and weaknesses of the threat assessment approaches

Based on a discussion of the core team involved in managing both assessments, we assessed the strengths and weaknesses of the absolute threat ranking and pairwise threat ranking based upon our experience of the two exercises in 2012 and 2014 (Table 5). In the absolute threat ranking, the threat was analysed target-by-target based on scope, severity and irreversibility. The threat rating was then rolled up in the summary threat rating that shows the impact of the direct threat to the overall site. Pairwise ranking did not include the target-by-target analysis of threats and hence provided less detailed information. While the absolute ranking approach provided much more detailed results, conducting this assessment required the assistance of a trained facilitator who was able to use the Miradi software, and was hence more costly. We also observed that it was less easily understood by community participants than the pairwise ranking although it was easily understood by scientists and other technically trained participants.

DISCUSSION

The process and results presented here are examples of two different threat assessment methodologies applied at the project/programme scale and used to help guide the design and implementation of two conservation corridors. The threat assessment of the two corridors helped to design and prioritise activities in the planning process of the organisations involved in biodiversity conservation in the wildlife corridors at the two points in time. The organisations allocated more resources to addressing 'excessive grazing', 'flood, erosion and sedimentation' and 'poisoning' in Basanta corridor in 2012 whereas more resources were allocated to addressing 'encroachment', 'infrastructure development', 'overgrazing' and 'Chure degradation' in

Basanta corridor in 2014. WWF Nepal strengthened its efforts in sustainable grazing management (stall feeding practices, education of herders, etc.) in the Basanta corridor in 2014. Recently, WWF Nepal drafted a 'guideline for eco-friendly linear infrastructures' that can help address issues such as that seen within the Basanta corridor. Similarly, WWF Nepal strengthened its efforts in livestock management in Laljhadi-Mohana corridor to help control 'illegal grazing'. Some of the sites were declared as 'zero grazing sites' in 2014 in Laljhadi-Mohana corridor. WWF Nepal supported a bamboo plantation along the river bank in 2015 in Laljhadi-Mohana corridor to help address erosion issues. The threat analysis results have been used as an adaptive management tool in these projects and programmes.

This paper conveys the findings of two methodologies, aimed at identifying the type and level of direct threats in the two wildlife corridors. A group of practitioners and stakeholders could choose either of these two methodologies based upon the available resources and context. Based on our experiences, we recommend using absolute threat ranking and Miradi software in threat analysis as it is more technical and detailed in its content and procedure. Pairwise ranking can provide a rapid assessment when resources are limited and community members do not understand the technical terms and terminologies of the Open Standards.

SUPPLEMENTARY ONLINE MATERIAL

Supplementary Online Material 1. Threat Rating Criteria

Supplementary Online Material 2. Absolute threat ranking and Pairwise threat ranking processes

Supplementary Online Material 3 Basanta conceptual model and threat ranking, 2012

Supplementary Online Material 4 Pairwise threat ranking, Basanta, 2014

Supplementary Online Material 5 Laljhadi-Mohana conceptual model and threat ranking, 2012

Supplementary Online Material 6 Pairwise threat ranking, Laljhadi -Mohana, 2014

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RESUMEN

Las amenazas dentro de los corredores de vida silvestre de Basanta y Laljhadi-Mohana que conectan las áreas protegidas en el Arco de Terai fueron evaluadas en 2012 y 2014. Para la clasificación de las amenazas se empleó un proceso participativo y de múltiples partes interesadas con miembros de las agencias gubernamentales y la comunidad. El equipo utilizó dos metodologías diferentes en 2012 y 2014. En la primera evaluación en 2012, los objetivos de biodiversidad y las amenazas directas fueron identificados en un modelo conceptual de los corredores, y la clasificación de amenaza absoluta se realizó utilizando el software Miradi. En 2014, las amenazas directas en los corredores fueron identificadas y evaluadas mediante un enfoque de clasificación por pares. Ambos procesos identificaron el tipo y el nivel de amenazas directas en cada corredor y en cada período de tiempo. El alcance y la intensidad de las amenazas directas varían entre los corredores de vida silvestre, entre los diferentes paisajes y entre los dos períodos de tiempo. En el corredor de Basanta, algunas amenazas identificadas en 2012 desaparecieron –o no se les asignó prioridad (por ejemplo, el uso de diclofenaco) en 2014, en tanto que nuevas amenazas (por ejemplo, desarrollo de infraestructura) surgieron en el ínterin. En el corredor de Laljhadi-Mohana, el nivel de amenazas varió (por ejemplo, la invasión representó un nivel "bajo" de amenaza en 2012, mientras que en 2014 constituyó un nivel “alto” de amenaza). Ambos enfoques proporcionaron formas sencillas para identificar y clasificar las amenazas directas en la planificación de la conservación de la biodiversidad en un corredor o paisaje de vida silvestre.

RÉSUMÉ

Les menaces dans les corridors fauniques de Basanta et de Laljhadi-Mohana, qui relient les aires protégées dans le paysage du Terai Arc, ont été évaluées en 2012 et 2014. Le classement des menaces a été établi grâce à un processus participatif et multipartite comprenant des membres des agences gouvernementales et de la communauté. L'équipe a employé deux méthodologies différentes en 2012 et 2014. Lors de la première évaluation en 2012, des cibles de biodiversité et des menaces directes ont été identifiées dans un modèle conceptuel des corridors, et un classement absolu des menaces a été réalisé à l'aide du logiciel Miradi. En 2014, les menaces directes dans les corridors ont été identifiées et évaluées en utilisant une approche de classement par paires. Les deux processus ont identifié le type et le niveau des menaces directes dans chaque corridor à chaque période. L'étendue et l'intensité des menaces directes varient entre les corridors fauniques, entre les différents paysages et entre les deux périodes. Dans le corridor de Basanta, certaines menaces identifiées en 2012 ont disparu ou n'ont pas été classées par ordre de priorité en 2014 (par exemple l'utilisation du diclofénac) alors que de nouvelles menaces ont émergé (par exemple le développement des infrastructures) dans les années intermédiaires. Dans le corridor Laljhadi-Mohana, le niveau de menaces variait (par exemple, l'empiètement était une menace «faible» en 2012, alors qu'il s'agissait d'une menace «élevée» en 2014). Les deux approches ont fourni des moyens simples d'identifier et de classer les menaces directes dans la planification de la conservation de la biodiversité dans un corridor ou un paysage faunique.