Community Knowledge, Perception and Conservation Challenges of Smooth-coated Otter (*Lutrogale perspicillata*) in Shuklaphanta National Park, Nepal

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ABSTRACT

Smooth-coated otters face increasing challenges from anthropogenic pressure, but research studies in human-dominated environments are sparse. This study aims to analyze residents' knowledge, attitudes, and practices about smooth-coated otters to guide sustainable conservation efforts and management decisions for implementing management interventions as well as policy intervention to safeguard the otter populations in the wetlands of Shuklaphanta National Park's buffer zone. Sixty-six locals from three user committees of Shuklaphanta National Park's buffer zone participated in semi-structured interviews to gain information on their livelihoods, resource consumption, awareness of otters, and conservation attitudes. Agriculture (78.7%) was the primary source of income, and a lack of information hampered conservation efforts. Fishing and livestock grazing are common activities along the river, but these practices, combined with pollution and riverbank construction, have resulted in habitat degradation and declining fish populations. Socioeconomic challenges, such as poor education levels, intensify these issues. Despite these challenges, 95% of respondents expressed strong support for otter conservation, highlighting awareness campaigns and habitat protection as their primary concerns. However, the community's inadequate understanding of otters' ecological importance and involvement in maintaining healthy river ecosystems demonstrates the need for targeted education. Human activities that affect river ecology emphasize the importance of long-term management strategies to conserve otter habitats and local resources. The major community support for otter protection provides a solid platform for conservation efforts.

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1. INTRODUCTION

Smooth-coated Otter, semi-aquatic mammals of the Mustelidae family, play an important role in maintaining a healthy ecosystem [1,2]. Thriving across diverse wetland habitats-rivers, ponds, marshes, and lakes—these adaptable animals contribute significantly to aquatic ecosystem stability as apex predators [3,4]. Their presence indicates a healthy, balanced ecosystem free of significant pollution [5,6]. Foraging primarily in freshwater and marine environments, otters consume a diverse diet of fish, frogs, crabs, and insects [7,8,9,10]. However, growing human encroachment has forced them to adopt nocturnal behaviors, shifting from their natural diurnal patterns to avoid human conflict [11,12]. This behavioral change reflects the pressures that human presence and activity exert on their population. Despite their resilience, otters are becoming more vulnerable to environmental changes, particularly those caused by human activity [2,8,13,14]. However, rapid infrastructure development, particularly dams and hydroelectric projects, has significantly altered their habitats. Pollution from industrial waste, including heavy metals and toxic chemicals, further threatens their survival [2,15]. Conflicts between otters and fishermen pose challenges to conservation, as otters are seen as competitors for fish, often leading to harm [16,17] (Trivedi & Variya, 2023; Shrestha et al., 2023). Overfishing and toxic fishing methods worsen food scarcity, intensifying these conflicts [1,15,16]. The smooth-coated otter is classified as Vulnerable on the IUCN Red List [18,19] and is listed under Appendix I of CITES [20]. The smooth-coated otter, once widespread in Nepal's Terai wetlands [5,6,22], is now confined to fragmented habitats within protected areas like Koshi Tappu, Chitwan, Bardia, and Shuklaphanta. Its population has declined due to habitat loss, human disturbance, and limited protection, highlighting the urgent need for conservation efforts [5,23,24].

Local communities' knowledge of otters' behavior, habitat requirements, and ecological roles can offer valuable insights for conservation, while their perceptions—whether positive or negative—can directly influence conservation success [6,15, 17,23,25,26]. Socio-economic factors largely shape local perceptions, which can range from viewing otters as valuable for ecotourism to regarding them as pests, complicating conservation efforts [15,23,27]. Despite legal protections under Nepal's Aquatic Life Protection Act (2002), minimal enforcement and illegal hunting for otter fur and body parts continue to threaten their populations [1,21].

This study builds upon [23], which offered essential insights into otter conservation in Shuklaphanta National Park. Expanding on their work, this research incorporates a more

comprehensive survey of public opinion to enhance understanding of local perceptions and uncover detailed conservation challenges, ultimately guiding more precise and effective conservation efforts Shuklaphanta National Park is located amidst human settlements and agricultural areas, where human-wildlife conflict is a significant issue [28]. Although the park's rich wetland habitats are essential for otter survival, these areas are increasingly impacted by natural and human-induced threats [2,15,23]. Research in Nepal has provided valuable insights into otter conservation, but further exploration of local attitudes and socio-economic factors influencing habitat destruction and human-otter conflicts could deepen our understanding of these challenges [23,29,30]. This study explores local knowledge, attitudes and threats to otters in Shuklaphanta and Nepal, analyzing local perceptions and socio-economic factors. It offers critical insights for policymakers, conservationists, and communities, aiding smooth-coated otter conservation amid environmental change.

2. METHODOLOGY

2.1 Study Site:Shuklaphanta National Park

Shuklaphanta National Park (hereafter - ShNP) in far western Nepal spans 305 km², encompassing grasslands, forests, wetlands, and riverbeds at elevations of 174–1,386 m (Fig 1). Renowned for its biodiversity, it supports species of conservation concern, including smooth-coated otters in areas like the Mahakali and Chaudhar rivers and wetlands such as Kalikich Tal and Rani Tal [2,15,23]. The 243 km² buffer zone of ShNP includes five urban municipalities—Bedkot, Belauri, Bhimdatta, **Dodhara Chandani** , and Shuklaphanta—and two rural municipalities, Beldandi and Laljhadi [28]. This study focuses on Bhimdatta, Bedkot, and Beldandi municipalities (Figure 1). The subtropical monsoonal climate features three seasons—cool-dry (September–February), hot-dry (February–June), and monsoon (June–September)—with an average annual rainfall of 1,579 mm [31]. ShNP is home to 665 plant species, 88 fish, 15 amphibians, 56 reptiles, 460 birds, and 57 mammals, including the greater one-horned rhino, fishing cat, and Asian elephant [2,31,32,33,34].

2.2 Data Collection: Questionnaire Surveys

The survey was conducted from February to May 2022, using a mixed-methods approach that combined both qualitative and quantitative research techniques. Data were collected through a questionnaire survey. A purposive sampling method was followed since our main purpose was to elicit as much information as possible from informants [35]. A review of relevant literature, including published articles and scientific reports was done. The survey included 66 respondents, comprising residents, fishermen, and other stakeholders of the Shuklaphanta, Bedkot, and Kalikich users committee The questionnaire covered socio-economic and demographic details, river usage and fishing practices, otter sightings and ethnobiological knowledge, perceptions of otters, and potential threats based on observations. Participants were shown a picture of the Smooth-coated otter to ensure accurate identification and informed consent was obtained before the survey [17,23,36].

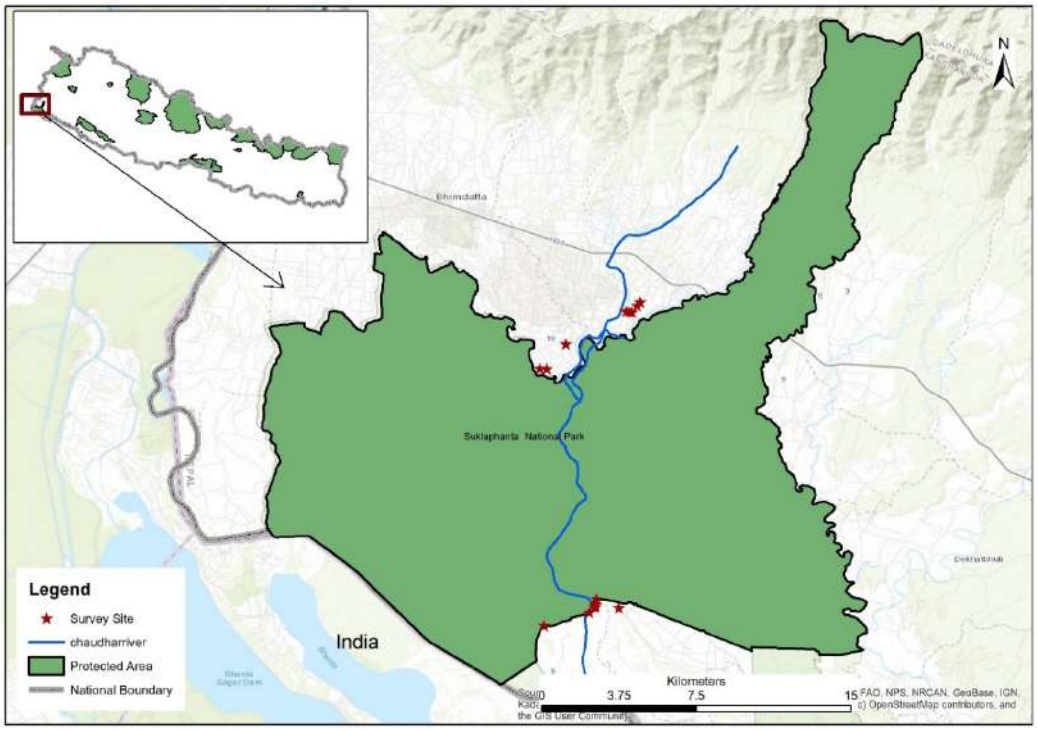

Fig. 1: Survey locations for interviews in the Buffer Zone of ShNP.

2.3 Key Informant Interview (KII) Surveys

Key Informant Interviews (KIIs) were conducted with 20 individuals deeply familiar with ShNP, including park officials, nature guides, mahouts, and National Trust for Nature Conservation (NTNC) staff offered detailed insights into wildlife behavior, conservation challenges, and management

effectiveness. Respondents highlighted issues like overfishing, human disturbance, and habitat degradation while also noting ecological changes such as shifts in biodiversity and vegetation. These insights are crucial for informed conservation planning.

Data Analysis

Data were analyzed descriptively. Additionally, logistic regression analysis to examine the relationship between age, education, and knowledge about otters was done in R version 4.4.1. (R Core Team, 2023).The predictor variables included Age (categorized as 15-24, 25-54, 55-64, and 65+ years) and Education (treated as an ordinal variable ranging from illiterate to bachelor's degree or above).For data visualization, the ggplot2 package (Wickham, 2016) and functions available in base R were used.

3. RESULTS

3.1 Demographic and Socio-economic Profile of Respondents

The ShNP Buffer Zone is predominantly a farming community, with 78.78% of respondents engaged in agriculture (Table 1). The population is of prime working age (68.18%), and educational attainment remains low, with just a small proportion completing secondary school or above. This profile depicts an urbanized area with a strong agricultural reliance and access to advanced education and diversified job options.

Table 1: Socio-demographic characteristics of the people in the ShNP Buffer Zone area.

Socio-demographic status	Category	Total	Percentage
Gender	Male	35	53.03
	Female	31	46.94
Age	Early working age (16 - 24)	7	10.60
	Prime working age (25 - 54)	45	68.18
	Mature working age (55 - 64)	3	4.54
	Elderly age group (≥ 65)	11	16.66
Occupation	Farmers	52	78.78
	Business	3	4.54
	Job	1	1.51
	Others (laborers)	7	10.60
	Students	3	4.54
Education	Illiterate (no formal education)	5	7.58
	Literate	31	46.97
	Primary level (≤ 8 class)	16	24.24
	Secondary level (9 - 12 class)	11	16.67
	Bachelor and above	3	4.54

Livelihood Dependence and Resource Use on the River Ecosystem in ShNP Buffer Zone

The river ecosystem supports the livelihoods of communities in the ShNP Buffer Zone, providing essential natural resources for livelihood. All respondents (n=66) reported that their family members visit the river for various purposes (Fig2).

Fish Species Abundance and Taste Preferences

Fish species distribution and preferences indicate that certain species, like Rohu, are widely available and highly valued for taste, reflecting their cultural and dietary significance. Other species, while noted for abundance, are less favored for consumption, suggesting selective preferences shaped by culinary or cultural factors within the community (Table 2).

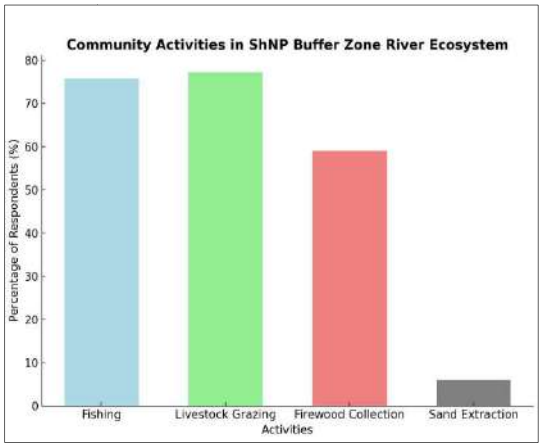

Fig. 2: Resource use in the ShNP Buffer Zone River Ecosystem

Table 2: Fish abundance and taste preferences among people in the ShNP Buffer Zone area (n= 66).

Common/Local Name	Scientific name	Abundant (%; N)	Not Abundant (%; N)	Taste Preference (%; N)	Inference
Rohu	*Labeo rohita*	66.67 (44)	33.33 (22)	48.48 (32)	Highly abundant and highly preferred
Spotted Snakehead/Geluwa	*Channa punctata*	50.00 (33)	50.00 (33)	7.56 (5)	Moderately abundant but less preferred for taste.
Spiny Eel/Bam	*Mastacembelus armatus*	33.33 (22)	66.67 (44)	-	Moderately abundant, not recognized for taste preference
Spotfin Swamp Barb/ Chocolate/Sidhra	*Puntius sophore*	30.56 (20)	69.44 (46)	-	Moderately abundant, limited culinary use
Giant freshwater prawn/Jhinge Maccha	*Macrobrachium rosenbergii*	-	100.00 (66)	10.60 (7)	Not abundant but has moderate appeal
Stinging Catfish/ Shingi	*Heteropneustes fossilis*	-	100.00 (66)	9.09 (6)	Not abundant but some appeal

The community employs a variety of fishing methods, with traditional techniques being widely practiced (Table 3). The major fishing methods include Hulka, Hand Catching, Pakhiya, Poison, Ghagi, Dhariya, Chiudi, Tapi, Khong, and Patta (Fig 3).

Table 3: Fishing methods used by respondents in the Shuklaphanta Buffer Zone area (n=66).

Fishing Methods (Local name)	Response (%)
Hulka	45.45
Hand Catching	25.76
Pakhiya	25.76
Poison	7.58
Ghagi	6.06
Dhariya	4.55
Chiudi	3.03
Tapi	3.03
Khong	1.52
Patta	1.52

Fig. 3: (a) Fishing net Hulka, (b) Fishing net Tapi, (c) Fishing net Dhariya, (d) Fishing activity in the study area, (e) Animal grazing on the riverbank (f), Researcher (Ms. Kusum Uprety) with local respondents.

Community Knowledge and Perceptions of Otters

Respondents widely recognized Smooth-coated Otters, with 66.67% reporting sightings and 71.21% identifying fish as their primary diet (Table 4). Logistic regression analysis revealed that age significantly influenced otter food knowledge ($p = 0.022$). Participants in the 15-24 age group were notably less likely to possess otter food knowledge compared to the reference group (Estimate = -2.1439, $p = 0.0194$). Education, however, did not have a significant impact on otter knowledge ($p = 0.3513$).

Table 4: Respondents' perspective on smooth-coated otter ecology, cultural significance, and use (n=66).

Characteristics Question	Responses	Number	%
	Yes	40	60.60
Awareness of the otter habitats	No	13	19.69
	No Idea	13	19.71
	Decreased	31	46.96
	No response	14	21.21
Perceived status of otter population (last 10 years)	Stable	2	3.03
	No Idea	15	22.72
	Increased	4	6.06
	No	48	72.72
Identification of otter scats	Yes	6	9.09
	No response	12	18.18
	No	39	59.09
Cultural or traditional myths associated with otters	No Idea	19	28.78
	No response	8	12.12
	No	41	62.12
Medicinal value of otter body parts	No Idea	15	22.72
	No response	10	15.15
Knowledge of otter diet	Fish	47	71.21
	Insect	1	1.51
	No Idea	18	27.27

Knowledge of Otter conservation status and approaches

About 96% of respondents expressed positive views on otters and supported their conservation, with 92 % of respondents prioritizing conservation efforts. Dynamite fishing was reported as minimal indicating limited use of this destructive practice (Table 5).

Table 5: Respondents' Perceptions of Otters (n=66): Their Role in Ecosystem Services and Conservation Significance.

Characteristic Questions	Opinion	Number	(%)
Do you appreciate the presence of otters?	Yes	63	95.46
	Neutral	3	4.55
Should efforts be made to conserve otters?	Yes	61	92.43
	Not sure	5	7.57
	No	0	0
Is dynamite fishing present in the area?	Yes	1	1.5
	No	45	68.18
	Not sure	12	18.18
	No response	8	12.12

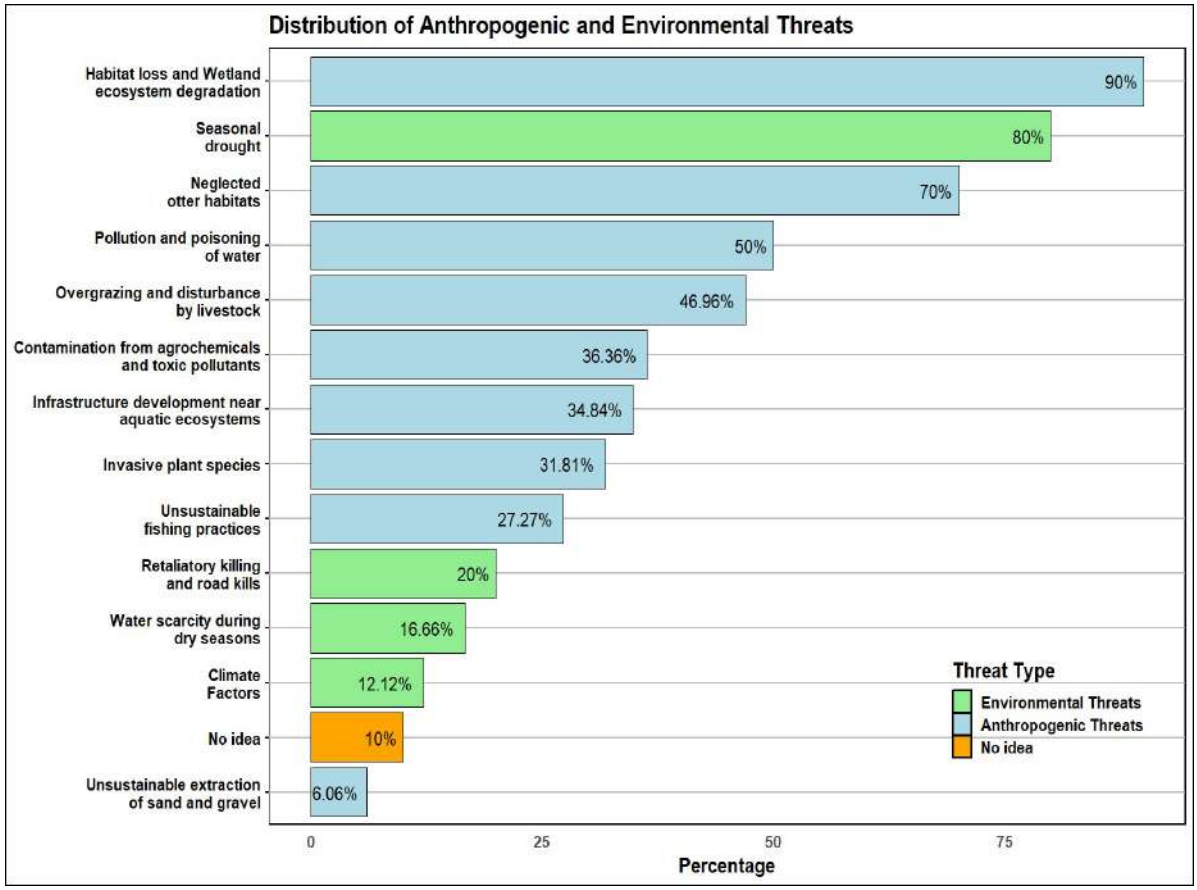

Fig. 4. Perceived Conservation Threats to Smooth-coated Otters in ShNP Buffer Zone

Conservation challenges for Smooth-coated otter

The community members highlighted several challenges impacting otter conservation in ShNP. The most serious threats to otter conservation were recognized as anthropogenic. The biggest percentages were habitat loss and wetland ecosystem degradation, followed by neglected otter habitats and water pollution and poisoning (Fig 4). Overgrazing and disturbance by livestock, contamination from agrochemicals and toxic pollutants, infrastructure development near aquatic habitats, invasive plant species, and unsustainable fishing methods contributed to human-induced stresses. Retaliatory killing and road kills (20%), as well as sand and gravel extraction (6.06%), were also challenging the otter conservation.

Environmental risks included seasonal drought, water scarcity during dry seasons, and climate change. A modest number of responders indicated doubt regarding specific conservation concerns. These findings highlight the crucial need for specific mitigation methods that address both human and environmental stresses on otter habitats.

3.3 DISCUSSION

The socio-demographic profile of respondents reveals communities heavily reliant on agriculture, with limited access to diverse job opportunities and advanced education, which may shape their environmental priorities. Low levels of formal education suggest low awareness of ecological issues, with the survey revealing gaps in knowledge about otters and their habitats, likely due to minimal educational background and interaction with river ecosystems. This knowledge gap could hinder effective conservation efforts, underscoring the need for targeted educational and awareness programs to enhance understanding of otter ecology and habitat requirements [7,30]. Despite these gaps, the community exhibits a strong positive attitude toward otter conservation, providing a solid foundation for conservation initiatives [23,37]. Addressing knowledge deficits and increasing awareness of otters' ecological roles will be essential for building on this goodwill and ensuring the long-term success of conservation efforts [23,37].

The river ecosystem plays a vital role in sustaining the livelihoods of the ShNP Buffer Zone community, with fishing and livestock grazing being the primary activities. This strong dependence on the river's resources for subsistence may impact both the environment and local wildlife, including otters, as increased human activity can lead to habitat degradation and resource competition [30]. Despite the community's heavy reliance on these resources, the survey revealed significant knowledge gaps regarding otters and their ecological roles [23,38]. This limited understanding likely stems from low educational attainment and minimal exposure to environmental education, which could hinder effective conservation efforts [1,7,30].

While the community exhibits a positive attitude toward otters, our findings indicate a knowledge gap about otters among younger, more educated people, implying that ecological knowledge is not being efficiently passed down through generations [17]. Adults, particularly farmers who work closely with the environment, have better knowledge despite their lower education levels. This mismatch indicates a loss of species awareness as younger generations transition away from land-based livelihoods. To remedy this, incorporating ecological education into formal curriculum and encouraging intergenerational information exchange could assist in maintaining important conservation knowledge.

Implementing educational programs to bridge these gaps could enhance the community's understanding of how their reliance on river resources intersects with otter conservation [7,17,30]. By fostering a deeper appreciation for otters' roles within the ecosystem, these initiatives could strengthen the community's support for conservation actions and encourage sustainable practices [17,30]. Leveraging the community's positive sentiment and promoting a better understanding of ecological balance will be crucial in building a foundation for sustainable resource use and successful otter conservation efforts [17, 39]. The survey also identifies several environmental challenges that threaten otters. Livestock grazing and road construction along riverbanks are significant threats, as these activities can degrade otter habitats and disrupt their access to essential resources [15,23]. Pollution from human activities further exacerbates these problems, indicating the need for improved land-use management and stricter regulations to protect river ecosystems [15].

The ShNP Buffer Zone community relies on traditional fishing methods like *Hulka* and hand-catching, which, while culturally significant, contribute to overfishing and declining fish populations, impacting both livelihoods and otter food sources [15,40]. Regional challenges, including agricultural runoff and toxic fishing practices, further threaten aquatic ecosystems [41,42]. Low otter sightings in some areas highlight their vulnerability. Sustainable fishing, pollution control, and targeted conservation strategies are essential to protect both the river ecosystem and dependent species [43].

The results indicate that otters are a well-known fish-eating species in the ShNP Buffer Zone, with the majority of respondents reporting that they have either seen or heard about them however, poor knowledge of otter habitats and minimal cultural linkages with otters indicate a gap in our understanding of their ecological roles [15,44]. While most respondents understand that otters eat fish as their principal food source, many are unaware of other elements of otter behavior and importance. This underscores the importance of focused awareness programs to increase community knowledge and build a stronger relationship with otters as members of the local environment.

The community's strong positive attitude toward otter protection provides a solid foundation for conservation efforts [15,23,45]. Almost all respondents showed admiration for otters, and the majority support conservation efforts, suggesting a willingness to participate in conservation operations [15]. The few reported instances of dynamite fishing, though limited, represent a highly destructive practice that adds further pressure on the environment. It is indiscriminate, harming not only fish populations but also the wider aquatic ecosystem while intensifying other threats such as pollution and habitat degradation. These positive views present an opportunity to conduct awareness campaigns that capitalize on the community's goodwill, further educate them about conservation concerns, and empower them to actively participate in safeguarding otters and their habitat [45,46].

Community members identified a variety of human-caused hazards to otter habitats, with livestock grazing and road building along riverbanks standing out as major concerns. Other issues, such as pollution from washing and bathing and habitat change, show the strain that human activities put on otter habitats. Suggested conservation methods, such as increasing habitat quality, raising awareness, and banning harmful practices, demonstrate a strong community commitment to conservation efforts. For conservation strategies, respondents emphasized the importance of raising awareness about otter conservation and suggested habitat improvement as a key approach. Other recommendations include protecting the fish population that otters depend on, enforcing hunting bans, and addressing pollution issues. These recommendations are consistent with the need for a comprehensive conservation strategy that includes education habitat restoration, and sustainable resource management to effectively safeguard otters.

Overall, the survey highlights the importance of several approaches for otter conservation. These approaches should include efforts to restore and protect habitats, enhance community awareness and involvement in conservation

activities, and enforce regulations to address environmental threats.By addressing these, it will be possible to improve the otter's habitats, safeguard fish populations, and support the long-term sustainability of local ecosystems.

4. CONCLUSION

This study highlights the complex relationship between traditional fishing practices, environmental disruptions, and human-wildlife conflicts in the region. While local communities have extensive fishing knowledge, their practices face threats from habitat degradation and illegal activities, impacting fish populations and dependent livelihoods. Addressing these issues requires integrated management strategies. The research also found low awareness of otter conservation, with key threats including overfishing, pollution, encroachment, invasive species, and illegal sand mining. Additionally, a common challenge in otter conservation is the misidentification of otters, which are often mistaken for mongooses by local communities. This confusion, coupled with negative perceptions from fish farmers, further complicates conservation efforts to support otter conservation, the study recommends habitat restoration, better riverine management, and targeted outreach to foster community involvement. These efforts are essential for balancing wildlife protection with sustainable livelihoods.

AUTHOR CONTRIBUTIONS

Balram Awasthi: Conceptualization, Methodology, Resource, Fieldwork, Data curation, Analysis, Writing – original draft, Writing– review & editing. Kusum Uprety: Field Work, Data curation, Writing – review & editing. Purna Man Shrestha: Writing – review & editing, Laxman Prasad Poudyal: Writing – review & editing, Amar Kunwar: Analysis, Writing – original draft, Writing – review & editing. All authors contributed to the drafts and gave final approval for publication

ETHICAL STATEMENT

This research is original work and has not been previously published or submitted for publication elsewhere

DECLARATIONS CONFLICT OF INTEREST

The authors declare no competing interests.

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