Online ISSN: 2588-3526

Journal of Wildlife and Biodiversity

*Volume 9(1): 1-16 (2025) (http://www.wildlife-biodiversity.com/)*

**Research Article**

# Coexistence and potential of smooth-coated otter (*Lutrogale perspicillata*) as biological control for invasive Nile Tilapia (*Oreochromis* spp.) in Southern Peninsular, Malaysia

**Nurfatiha Akmal Fawwazah Abdullah-Fauzi[1], Nur Hartini Sariyati[1], Thevarajan Narrshen[1], Hidayah Haris[1], Nursyuhada Othman[1], Farah Farhana Ramli[1], Mohd Lokman Ilham-Norhakim[1,2,3], Pazil Abdul-Patah[4], Hiroshi Sasaki[5], Daisuke Waku[6], Badrul Munir Md-Zain[7], Muhammad Abu Bakar Abdul-Latiff[1]***

[1]Environmental Management and Conservation Research Unit (eNCORe), Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), 84600 Muar, Johor, Malaysia
[2]Kim Ichthyologist Centre, Kampung Parit Samsu, Jalan Temenggong Ahmad, 84150 Parit Jawa Muar, Johor, Malaysia
[3]Naturetech Resources Enterrise TL MRBP F32/A, Jalan Temenggong Ahmad, 84150, Parit Jawa, Muar, Johor, Malaysia.
[4]Ex-Situ Conservation Division, Department of Wildlife and National Parks (DWNP), KM10 Jalan Cheras, 56100, Kuala Lumpur, Malaysia
[5]Chikushi Jogakuen University Junior College, Dazaifu, Japan
[6]Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, 1-1-1 Sakuragaoka, Setagaya-ku, Tokyo, 156-8502, Japan
[7]Department of Biological Sciences and Biotechnology, Faculty of Science and Technology Universiti Kebangsaan Malaysia, Bangi 43600, Selangor, Malaysia
*Email: latiff@uthm.edu.my

Received: 25 June 2024 / Revised: 14 September 2024 / Accepted: 14 September 2024/ Published online: 14 September 2024.
How to cite: Abdullah-Fauzi, N.A.F, et al. (2024). Coexistence and potential of smooth-coated otter (*Lutrogale perspicillata*) as biological control for invasive Nile Tilapia (Oreochromis spp.) in Southern Peninsular, Malaysia, Journal of Wildlife and Biodiversity, 9(1), 1-16. DOI: https://doi.org/10.5281/zenodo.14570372

## Abstract

The smooth-coated otter, scientifically known as *Lutrogale perspicillata*, is a key species in maintaining the ecological balance of freshwater ecosystems. However, increasing human-otter conflicts, particularly in southern Peninsular Malaysia, pose challenges to conservation and local livelihoods. The distribution of this species remains understudied, especially in southern Peninsular Malaysia. Hence, this study aimed to map the distribution patterns of smooth-coated otters and identify conflict hotspots where otters come into close contact with human activities. Data were collected through surveys and interviews across eight study sites in Johor state, with 49 respondents participating. The findings revealed that 89.80% of otter sightings were concentrated near riverine habitats, underscoring their preference for freshwater environments. In Johor, otters were typically observed in small groups of three to five individuals, in contrast to the larger groups reported in neighboring Singapore. The conflict involved otter predation on farmed fish, particularly Nile Tilapia (*Oreochromis* spp.), an invasive species that disrupts local ecosystems and biodiversity. Local communities faced significant economic losses due to otter predation and the resulting damage to fishing equipment. Contributing factors included habitat degradation and land-use changes. Suggested mitigation strategies from local respondents included physical barriers, improved habitat management, and educational programs to promote coexistence. These findings emphasize the need for targeted conservation efforts and conflict mitigation strategies to ensure the long-term survival of smooth-coated otters in rapidly urbanizing regions.

**Keywords**: Aquaculture, fishery, human-wildlife conflict, human-otter conflict, Southeast Asia

## Introduction

The smooth-coated otter (*Lutrogale perspicillata*) is a species with a broad distribution across Iraq, South Asia, Southeast Asia, and parts of China (Narasimmarajan et al., 2021; Abdul-Patah et al., 2020). Characterized by their sleek fur, smooth-coated otters are larger than other otter species, with an elongated body, flattened tail, and webbed feet that aid in swimming (Mason & Macdonald, 2009). Their fur is typically dark brown with a smooth texture, and they have a distinctive, rounded head and shorter, broader muzzle (Mason & Macdonald, 2009). All thirteen otter species are found worldwide, except in Antarctica and Australasia. However, the smooth-coated otter is categorized as Vulnerable by the IUCN Red List, with its population in decline due to illegal wildlife trade and habitat loss, primarily driven by human encroachment and environmental degradation (IUCN, 2022). In Peninsular Malaysia, this species inhabits various wetland settings, including mangrove swamps, major estuaries, inland rivers, lakes, artificial wetlands, dams, and even mature ex-mining pools. It is a widespread but rather localized species (Chong, 2019). Smooth-coated otter (*Lutrogale perspicillata*), Asian small-clawed otter (*Aonyx cinereus*), and hairy-nosed otter (*Lutra sumatrana*) are three species of the Old World Otter that can be found in Peninsular Malaysia (Rosli et al., 2015).

These otters typically inhabit rivers, mangroves, and coastal areas and were not previously known to thrive in human-dominated environments (Kamjing et al., 2017; Narasimmarajan et al., 2021). However, smooth-coated otters have shown adaptability to altered landscapes, inhabiting paddy fields in Malaysia and aquaculture ponds in Thailand (Foster-Turley, 1992; Kamjing et al., 2017). With their increased availability of food from human activities, urban ponds and waterways provide feeding opportunities in these modified environments (Kamjing et al., 2017). However, using these habitats brings otters closer to humans, leading to human–otter conflicts. Given their status as top predators, otters are especially vulnerable to habitat changes and environmental contamination, as they serve as important keystone species and biological markers for assessing ecological health (Acharya, 2017).

As a riparian species, *L. perspicillata* is significantly impacted when riparian habitats such as peat swamp forests, mangroves, and other freshwater ecosystems are converted for agricultural activities or development. This conversion directly causes habitat loss and reduces their prey due to the decline in stream quality and changes in vegetation structure (Foster et al., 2011; Pianzin et al., 2019). Due to this fact, given their naturally opportunistic nature, *L. perspicillata* has adapted well to foraging in paddy fields, which offer a variety of food resources. This adaptation has been particularly noted in the northern Peninsular Malaysia population, as highlighted by Abdul-Patah et al. (2014) and Burhanuddin and Norizan (1990). However, the presence of otters near human settlements is often met with negative perceptions, primarily due to competition for fish resources and damage to aquaculture facilities (Pianzin

et al., 2019; Andeska et al., 2023). These issues are seen as direct threats to local fishermen's and aquaculture operators' livelihoods. Consequently, this conflict has led to the culling of otters, a situation further worsened by environmental pollution in their habitat and other contributing factors (Latorre-Cárdenas et al., 2023).

Surveying otters can be challenging given their cryptic behaviors, semiaquatic lifestyle, and extensive home ranges (Boitani et al., 2012). The otter is a nocturnal and elusive species, with its presence typically inferred from its feces or footprints. Although smooth-coated otters have a broad regional range across Southeast Asia (SEA), their exact distribution in Peninsular Malaysia remains poorly understood. This lack of knowledge regarding the distribution, abundance, and ecology of otters in Malaysia has hindered effective conservation efforts. As a result, *L. perspicillata* populations are monitored using indirect survey methods such as track and sign surveys, camera traps, and local interviews (Kamjing et al., 2017; Palei et al., 2020). While track and sign studies provide information on otters' existence, they cannot indicate population structure (Yoxon & Yoxon, 2014). Most otter surveys that have been carried out use feces to indicate their existence (Schenck & Staib, 1992). Feces are made up of partially digested materials and digested animal components. Fecal examination of undigested materials is commonly used to examine otters' diets. It is an important approach to detecting what kind of prey is represented (Mason & Macdonald, 1986). Thus, this study aims to i) map the current distribution of smooth-coated otters in southern Peninsular Malaysia based on local observations and ii) identify conflict hotspots where these otters come into close contact with human activities. Understanding the spatial distribution of these otters and the sites where human-otter conflicts are most likely to occur will provide crucial insights into the species' habitat preferences and the problems posed by increased human encroachment. The findings will be useful in guiding conservation efforts, reducing human-wildlife conflicts, and guaranteeing the long-term survival of smooth-coated otters in fast-developing locations.

## Material and methods

### Study area

The research was conducted in eight locations in southern Peninsular Malaysia: Ulu Tiram, Johor Lama, Sungai Telor, Tanjung Surat, Johor Bahru, Parit Tiram, Gersik, and Kundang Ulu (Fig. 1). These areas were selected based on several local reports that indicated otter activity and human-otter interactions in these regions. These study sites represent various ecosystems, enabling a broad understanding of the distribution patterns and conflict issues related to smooth-coated otters.

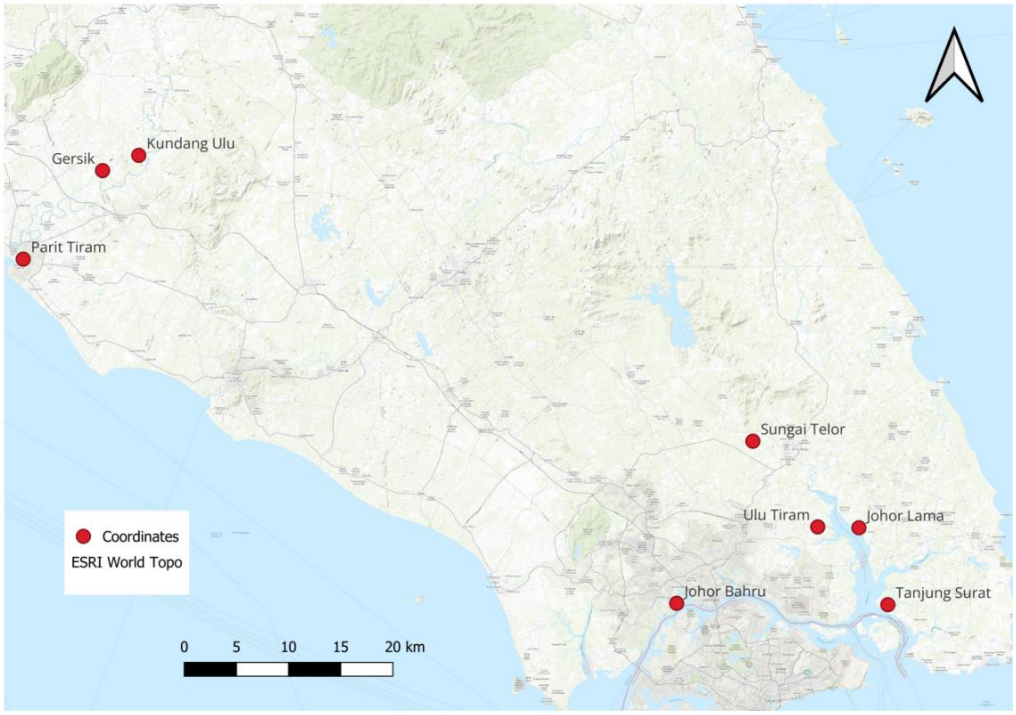


Figure 1. Map of the study area

**Survey and Questionnaire Design**

Data was collected using a structured survey and a questionnaire adapted from the EthnoKIT™ framework (a copyrighted ethnobiological instrument developed by UTHM) to ensure methodological reliability. The questionnaire was divided into three sections: (1) demographic information of the respondents, (2) otter distribution in the study area, and (3) conflicts between otters and local communities. Surveys were administered in Malay to accommodate the linguistic needs of the local population, ensuring that all respondents fully understood the questions. The respondents were mainly local villagers familiar with their environment and wildlife (Fig. 2).

Figure 2. Conducting interviews with local villagers regarding otter sightings and conflicts in Tanjung Surat, Kota Tinggi, Johor, Malaysia

### Field Data Collection

Photographic documentation of otters was obtained during fieldwork using a Canon R7 camera paired with a Sigma 150-600mm lens to ensure high-quality images. To aid in species identification, photos of all otter species: smooth-coated otter (*L. perspicillata*), Asian small-clawed otter (*A. cinereus*), and hairy-nosed otter (*L. sumatrana*) were presented to respondents to confirm otter species sightings. This approach was critical in minimizing misidentifications and improving data accuracy regarding otter sightings.

### Data Management and Analysis

Data collected from the surveys were cleaned and organized using Microsoft Excel. Descriptive statistics were then applied to analyze the survey responses, with the results displayed in figures, charts, and tables for clarity. To illustrate otter distribution patterns, GPS coordinates linked to the study areas provided in the questionnaires were generated and mapped using QGIS Desktop 3.30.2 software.

## Results

### Respondent Demographics

The survey included 49 respondents across eight study sites in southern Johor, Malaysia (Table 1). The highest proportion of respondents (26.53%) were from Johor Bahru, followed by Sungai Telor and Parit Tiram, each contributing 16.33% of the respondents. Respondents were male (87.76%) and between 36

and 55 years old (57.14%). A significant portion of the respondents were self-employed (61.22%), and most had resided in their respective locations for over ten years (87.76%). The predominance of long-term residents may influence the accuracy of otter sightings.

**Table 1.** The demographic information of the respondent

| **Distribution of respondent** | | **N** | **%** |
|---|---|---|---|
| Ulu Tiram | | 2 | 4.08 |
| Johor Lama | | 5 | 10.20 |
| Sungai Telor | | 8 | 16.33 |
| Tanjung Surat | | 5 | 10.20 |
| Johor Bahru | | 13 | 26.53 |
| Parit Tiram | | 8 | 16.33 |
| Gersik | | 3 | 6.12 |
| Kundang Ulu | | 5 | 10.20 |
| **Total** | | **49** | |
| **Demographic factor** | | **N** | **%** |
| Gender | | | |
| | Male | 43 | 87.76 |
| | Female | 6 | 12.24 |
| Age | | | |
| | 15-25 | 1 | 2.04 |
| | 26-35 | 13 | 26.53 |
| | 36-55 | 28 | 57.14 |
| | >55 | 7 | 14.29 |
| Occupation | | | |
| | Unemployed | 11 | 22.45 |
| | Self-employed | 30 | 61.22 |
| | Gov sector | 7 | 14.29 |
| | Private sector | 1 | 2.04 |
| Years of living in the area | | | |
| | <1 year | 0 | 0.00 |
| | 1-5 years | 4 | 8.16 |
| | 6-10 years | 2 | 4.08 |
| | >10 years | 43 | 87.76 |

### Otter Sighting Distribution and Invasive Fish Consumption

Otter sightings were reported in all eight study sites, with the most significant number of sightings in Johor Bahru (13 sightings) and Sungai Telor (7 sightings) (Fig. 3). Sightings occurred most frequently during both morning and evening periods (36.73%), with a substantial proportion of respondents (34.69%) reporting sightings throughout all times of the day (Table 2). Rivers were identified as the primary habitat for otter sightings, with 89.80% of respondents observing otters in riverine environments (Fig. 4 & 5).

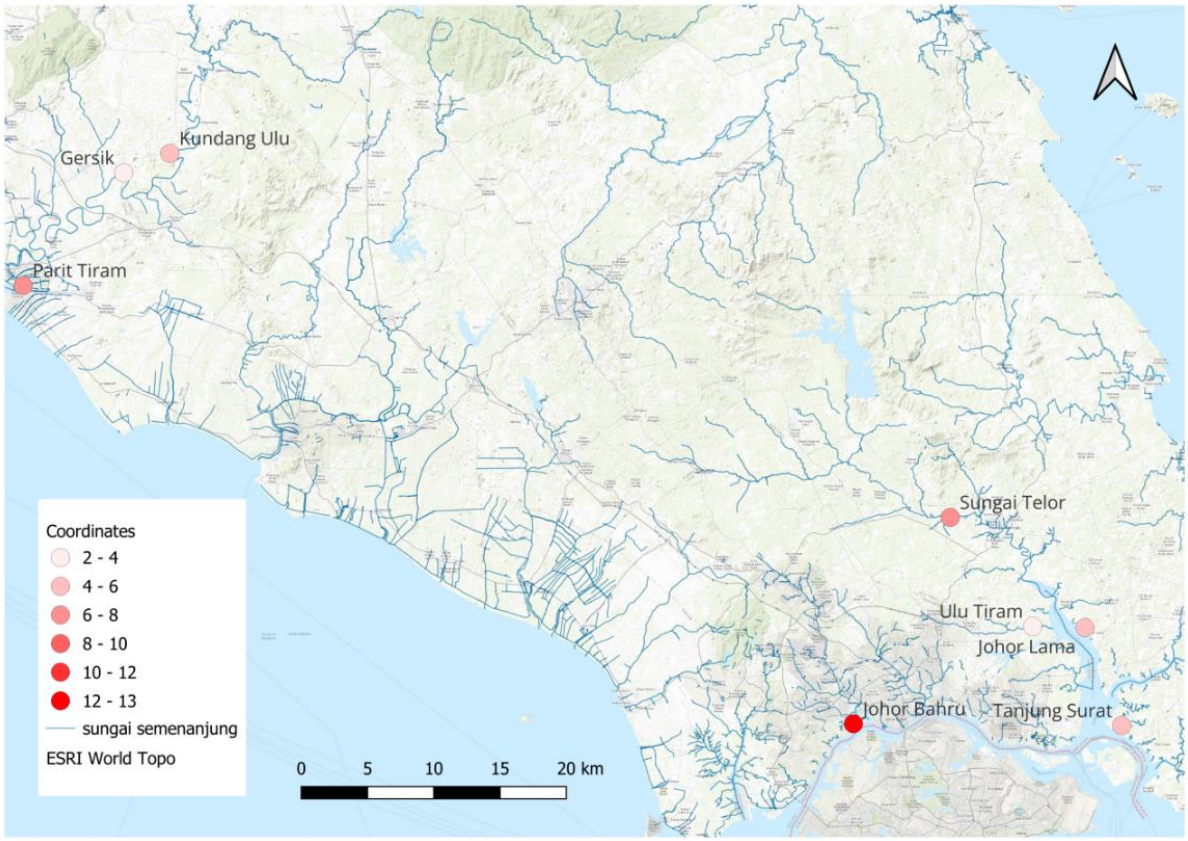


**Figure 3.** Distribution map of smooth-coated otters in southern Peninsular Malaysia. The map illustrates sighting locations, with darker red points representing higher sightings and lighter red points indicating lower frequencies

**Table 2.** Distribution of otter sightings by time period

| Time period | Count |
|---|---|
| Morning only | 1 |
| Evening only | 10 |
| Night only | 0 |
| Morning and Evening | 18 |
| Morning and Night | 1 |
| Evening and Night | 0 |
| All times | 17 |

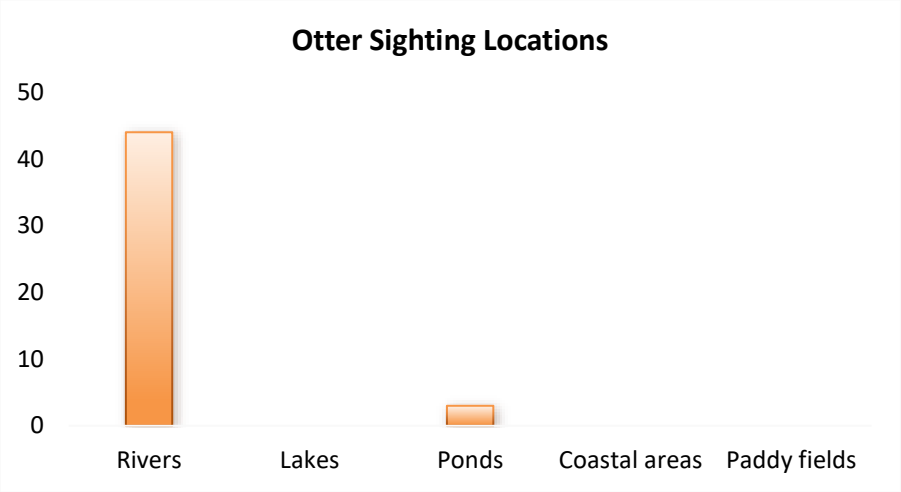


**Figure 4.** Locations of otter sightings reported by the local community


**Figure 5**. Presence of smooth-coated otters in southern Peninsular Malaysia: A: Johor Lama, B: Sungai Telor. © Mohd Lokman Ilham-Norhakim

The survey responses indicated that smooth-coated otters commonly consume a variety of freshwater fish species across the study areas. As shown in Table 3, the nine fish species most frequently reported by the local community include the Malaysian Mahseer (*Kelah*), River Catfish (*Baung*), and Barramundi (*Siakap*), Flathead Mullet (*Belanak*), Sagor Catfish (*Belukang*), Walking Catfish (*Keli*), and Rasbora (*Seluang*). Significantly, Nile Tilapia (*Tilapia*), listed as an invasive species, and Pangasius Catfish (*Patin*), categorized as an introduced species, were also reported as a significant part of the otters' diet.

**Table 3.** Fish species commonly consumed by smooth-coated otters reported by the community, with Nile Tilapia noted as an invasive species and Pangasius Catfish as an introduced species

| | Species name | Common name | Local name |
|---|---|---|---|
| 1 | *Tor tambra* | Malaysian Mahseer | *Kelah* |
| 2 | *Hemibagrus* spp. | River Catfish | *Baung* |
| 3 | *Pangasianodon hypophthalmus*** | Pangasius Catfish** | *Patin*** |
| 4 | *Oreochromis* spp.* | Nile Tilapia* | *Tilapia** |
| 5 | *Lates calcarifer* | Barramundi | *Siakap* |
| 6 | *Mugil* spp. | Flathead Mullet | *Belanak* |
| 7 | *Hexanematichthys* spp. | Sagor Catfish | *Belukang* |
| 8 | *Clarias* spp. | Walking Catfish | *Keli* |
| 9 | *Rasbora* spp. | Rasbora | *Seluang* |

*invasive species **introduced species

## Frequency and Group Size of Otter Sightings

The frequency of otter sightings varied across the study sites, with most respondents (46.94%) reporting daily sightings. The most commonly observed group size consisted of three to five individuals (51.02%), while 18.37% of respondents reported groups of six to 10 otters (Fig. 6).

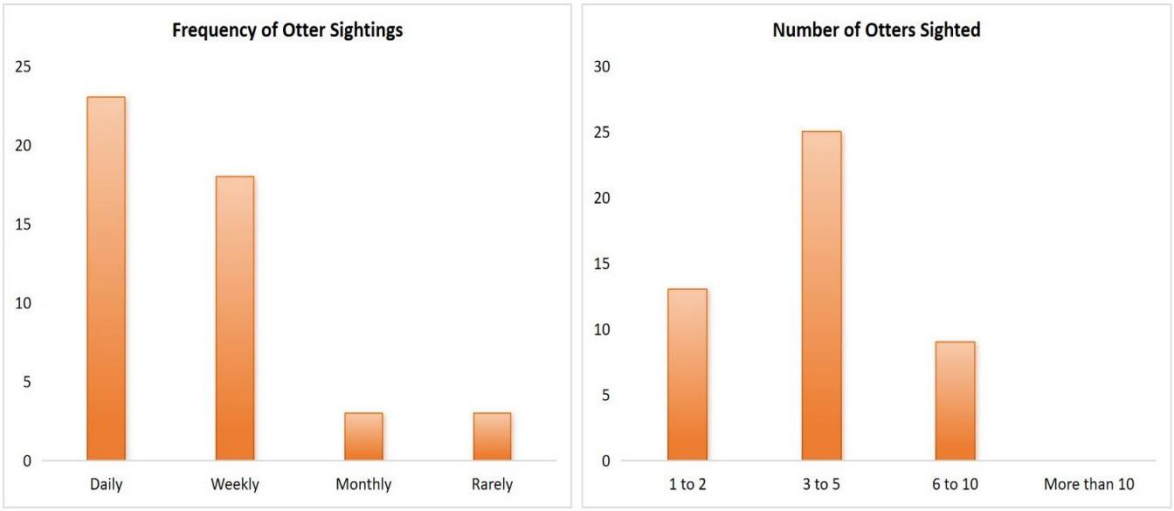


**Figure 6.** Frequency of otter sightings and associated group sizes reported by local residents

## Human-otter Conflicts and Mitigation Strategies

Conflicts between otters and local communities were predominantly associated with predation on farmed fish (53.06%) and damage to fishing nets (55.10%). The primary factor contributing to these conflicts was a lack of food resources for otters (87.76%). The conflicts had significant economic impacts on local communities, with 77.55% of respondents reporting a loss of income and 57.14% experiencing damage to fishing equipment. In response to otter-related conflicts, most respondents (67.35%) employed

deterrent methods such as blinking lights or using guard dogs to scare the otters away. A summary of human-otter conflicts in southern Peninsular Malaysia is presented in Fig. 7.


**Figure 7.** Summary of human-otter conflicts in southern Peninsular Malaysia. The charts illustrate the types of conflicts experienced, main contributing factors, impacts on local people, and their responses to these conflicts

Local communities suggested several ways to reduce conflicts with smooth-coated otters (Fig. 8). The most popular suggestion was physical barriers, which was recommended by 31 respondents (63.3%). Better habitat management was proposed by 15 respondents (30.6%) to improve natural habitats and keep otters away from human areas. Additionally, seven respondents (14.3%) suggested implementing education and awareness programs to promote non-lethal methods of conflict resolution. Four respondents recommended using blinking lights, while another four suggested using dogs to guard against otters, making up 16.3% of the responses under “other” suggestions.

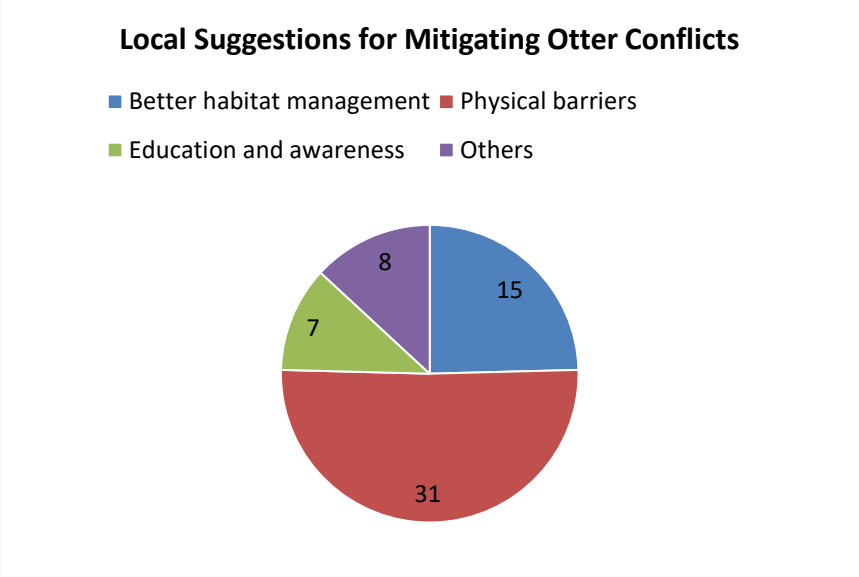


**Figure 8**. Suggestions from the local community for mitigating otter conflicts

## Discussion

### Habitat Preferences, Distribution Patterns, and Ecological Role of Smooth-Coated Otters

This study emphasizes the smooth-coated otter's (*L. perspicillata*) strong preference for riverine environments, with 89.80% of sightings recorded near rivers. These habitats offer abundant food sources, such as fish and crustaceans, and provide relatively undisturbed environments crucial for their survival and reproduction (Mason & Macdonald, 2009; Abdul-Patah et al., 2014). Spatial data from the distribution map further supports these findings, revealing a clustering of sightings around key river systems, particularly in Johor Bahru, Sungai Telor, Ulu Tiram, Tanjung Surat, and Johor Lama. These areas showed the highest density of sightings, likely due to the availability of ideal conditions for foraging and breeding (Rosli et al., 2014). Sightings were less frequent but still considerable in Gersik, Kundang Ulu, and Parit Tiram, suggesting that otters may also utilize secondary habitats when necessary (Basak et al., 2021). This indicates some habitat flexibility, which may be driven by fluctuations in food availability or disturbances in primary habitats (Kamjing et al., 2017).

The otters' temporal activity patterns, with most sightings occurring in the morning and evening, suggest that smooth-coated otters are primarily crepuscular, consistent with the findings of Wai et al. (2020). This activity pattern may be influenced by prey availability, human disturbances, and ambient temperatures (Hussain, 2013; Wai et al., 2020). However, depending on environmental conditions or disturbances in their habitat, they may also exhibit more nocturnal or diurnal behavior (Khan & Hasnain, 2008; Khan et al., 2010). Though riverine habitats remain their primary preference, occasional sightings in non-riverine environments, such as ponds, indicate their adaptability to different habitats when

necessary. This adaptability is further demonstrated by their use of paddy fields and aquaculture ponds (Foster-Turley, 1992; Kamjing et al., 2017; Shivram et al., 2023). Such findings contrast with previous research emphasizing a strict dependence on river systems (Rosli et al., 2014), showcasing the otters' behavioral flexibility in response to habitat modifications.

In terms of diet, local communities reported that the fish species most commonly consumed by *L. perspicillata* include Malaysian Mahseer (*Kelah*), River Catfish (*Baung*), and Barramundi (*Siakap*), Flathead Mullet (*Belanak*), Sagor Catfish (*Belukang*), Walking Catfish (*Keli*), and Rasbora (*Seluang*). Notably, Nile Tilapia stands out as an invasive species, introduced for aquaculture but now posing a significant threat to local biodiversity due to its rapid proliferation (Linde et al., 2008). By preying on Nile Tilapia, smooth-coated otters serve as biological control agents, helping to regulate invasive species populations and maintain ecosystem stability (Gowtham et al., 2022). Although Pangasius Catfish (*Patin*) is categorized as an introduced species, the ecological focus remains on controlling invasive species like Nile Tilapia, emphasizing the importance of otter conservation in promoting biodiversity and sustaining freshwater ecosystems.

**Group Size, Sightings, and Emerging Human-otter Conflicts**

Based on the findings, otters in Johor state are typically seen in small groups of three to five individuals, in contrast to the larger groups of 16 to 24 individuals observed in Singapore (Shivram et al., 2023). The presence of otters in southern Peninsular Malaysia appears to be closely linked to food resources, leading to conflicts with local communities. Interview responses emphasize the negative economic impacts of these conflicts, particularly the loss of income due to otter predation on farmed fish and damage to fishing equipment. Contributing factors to the high number of conflicts include habitat degradation, land-use changes, and otter behavioral patterns, consistent with the findings of Jayasooryan and Chandini (2024). These conflicts also have socioeconomic impacts on local communities, as reported by interview respondents. Therefore, it is critical that we take action in Malaysia to ensure the safety of both local people and otters, as mentioned by Cook et al. (2022) and Jayasooryan and Chandini (2024).

**Mitigation Strategies for Human-otter Conflicts and Promoting Coexistence**

Otter-related conflicts arise when these animals interfere with human activities, such as aquaculture, fishing, and habitat encroachment, leading to economic and environmental challenges (McMillan et al., 2019). Local communities respond in various ways, striving to balance wildlife conservation with protecting their livelihoods. In areas where otters prey on fish stocks or damage fishing equipment, communities often advocate for regulations to safeguard fisheries and seek compensation for their losses (Václavíková et al., 2011). For example, in Southeast Asia, fish farmers have reported significant losses

due to otter predation, prompting calls for improved management strategies (Khoo & Lee, 2020). Some communities employ protective measures such as fencing, noise, or light devices to mitigate these conflicts to deter otters from farms and water bodies. Motion-activated lights and sound alarms have proven effective in keeping otters away from vulnerable areas (Nunny, 2020). In more conservation-minded regions, however, communities lean toward co-existence strategies, utilizing educational campaigns, public awareness efforts, and conservation programs to emphasize otters' ecological benefits, such as controlling invasive species and maintaining healthy ecosystems (Duplaix & Savage, 2018).

Additionally, some communities create ecotourism opportunities, such as otter-watching tours, which generate income while protecting the animals (Stevens et al., 2011). This approach mirrors the concept of PrimaTourism, where primate-based tourism promotes both conservation and sustainable economic growth, as discussed by Abdul-Latiff et al. (2019), Najmuddin et al. (2019), Siti-Kauthar et al. (2019), Najmuddin et al. (2021), and Haris et al. (2023). Compensation programs also play a key role in addressing conflicts. Farmers and fishers affected by otter activity can receive compensation from government or conservation programs, fostering a more positive attitude toward wildlife (Muchapondwa et al., 2012). Balancing economic needs with environmental protection is crucial for reducing otter-related conflicts and promoting sustainable coexistence. As Duplaix and Savage (2018) note, when communities understand the ecological benefits otters offer, such as invasive species control and prey population regulation, they are more likely to support peaceful cohabitation efforts.

## Conclusion

The findings of this study illuminate the ecological importance of smooth-coated otters in southern Peninsular Malaysia, particularly in maintaining freshwater ecosystem balance. Their strong preference for riverine habitats and ability to adapt to modified landscapes show their potential role as natural regulators of invasive species. However, ongoing human-otter conflicts, especially the economic losses of predation on farmed fish and damage to fishing equipment, pose significant challenges. Habitat degradation and land-use changes further worsen these issues, leading to negative socioeconomic impacts on local communities. To address these conflicts, effective conservation strategies, such as physical barriers and public education campaigns, are necessary to promote coexistence. Continuous monitoring of otter populations and conflict-resolution strategies will protect both otters and local livelihoods as development in the region progresses.

## Acknowledgment

This project is funded by the UTHM-W031 grant and the UTHM-GPPS-Q669-2024 postgraduate grant by Universiti Tun Hussein Onn Malaysia. We are grateful and deeply indebted to YBhg. Dato' Abdul Kadir bin Abu Hashim, Director General of the Department of Wildlife and National Parks (PERHILITAN), for granting permission to carry out this research and providing us with the necessary facilities and assistance. This research was conducted under research permit KeTSA600-2/2/21 JLD. 18 (2) by PERHILITAN. The authors acknowledge the Tokyo University of Agriculture Japan, Chikushi Jogakuen University Japan, and Universiti Tun Hussein Onn Malaysia for providing the necessary funding, facilities, and assistance.

## References

Abdul-Latiff, M.A.B., Najmuddin, M.F., Haneef, S.K., Nabil, A., Shahrool-Anuar, R., & Md-Zain, B.M. (2019). PrimaTourism: Preliminary study on activity budget of *Presbytis neglectus* with insights on local people perception on the product's potential economic value in Johor. In IOP Conference Series: Earth and Environmental Science, 269(1), 012006. IOP Publishing.

Abdul-Patah, P., Nur-Syuhada, N., Md-Nor, S., Sasaki, H., & Md-Zain, B.M. (2014). Habitat and food resources of otters (mustelidae) in Peninsular Malaysia. AIP Conference Proceedings 161, 693–699.

Abdul-Patah, P., Sasaki, H., Sekiguchi, T., Shukor, M. N., Mohd-Yusof, N. S., Abdul-Latiff, M.A.B., & Md-Zain, B.M. (2020). Molecular DNA-based spatial mapping technique predicting diversity and distribution of otters (Lutrinae) in Peninsular Malaysia using non-invasive fecal samples. Mammal Research, 65, 691-700.

Acharya, P.M. (2017). Status of smooth-coated otters (*Lutrogale perspicillata*) (Geoffroy, 1826) in the Khauraha River of Bardia National Park, Nepal. Otter, the Journal of the International Otter Survival Fund, 3, 23-37.

Andeska, F., Novarino, W., & Nurdin, J. (2023). An ecological study of the prey of the otter in an asynchronous paddy field landscape. IUCN Otter Specialist Group Bulletin, 40(2).

Basak, S., Pandav, B., Johnson, J.A., & Hussain, S.A. (2021). Resource utilisation by smooth-coated otter in the rivers of Himalayan foothills in Uttarakhand, India. Global Ecology and Conservation, 32, e01896.

Boitani, L., & Powell, R.A. (Eds.). (2012). Carnivore ecology and conservation: a handbook of techniques. Techniques in Ecology & Conser.

Burhanuddin, M.N. & Norizan, A. (1990). A survey on the distribution of otters in Pulau Pinang and Perlis. The Journal Wildlife and Parks, 9.

Chong, M.H. (2019). Observation on Mating of Smooth-Coated Otter, *Lutrogale perspicillata*, at Putrajaya Lake and Wetland, Malaysia. IUCN Otter Spec. Group Bull, 36(2), 77-82.

Cook, P., Hawes, J.E., Campos-Silva, J.V., & Peres, C.A. (2022). Human-wildlife conflicts with crocodilians, cetaceans and otters in the tropics and subtropics. PeerJ, 10, e12688.

Duplaix, N., & Savage, M. (2018). The Global Otter Conservation Strategy. IUCN/SCC Otter Specialist Group, Salem, Oregon, USA.

Foster, W., Snaddon, J., Turner, E., Fayle, T., Cockerill, T.D., Ellwood, F., Broad, G., Chung, A., Eggleton, P., Chey, V.K., Yusah, K.M. (2011). Establishing the evidence base for maintaining biodiversity and ecosystem function in the oil palm landscapes of South-East Asia. Philosophical transactions of the Royal Society of London. Series B, Biological Sciences, 366, 3277-3291.

Foster-Turley, P.A. (1992). Conservation Aspects of the Ecology of Asian Small-Clawed and Smooth Otters on the Malay Peninsulas IUCN Otter Spec. Group Bull, 7, 26-29.

Gowtham, R., Sharma, K., & Sathishkumar, S. (2022). Smooth-coated otter (*Lutrogale perspicillata*) preys on invasive fishes in Vaduvoor Bird Sanctuary, Tamil Nadu, Southern India: can otters be potential bio-controllers. IUCN Otter Spec. Group Bull, 39(2), 73-80.

Haris, H., Nurfitri-Ezatie, Y., Othman, N., Ramli, F.F., Sariyati, N.H., Abdullah-Fauzi, N.A.F., Najmuddin, M.F., Ilham-Norhakim, M.L., & Abdul-Latiff, M.A.B. (2023). Preliminary assessment on primate diversity and potential of PrimaTourism among local people and Orang Asli Jakun (Aborigines: Proto-Malay) in Tasik Chini Biosphere Reserve, Pahang, Malaysia. Journal of Sustainable Natural Resources, 4(10), 60-67.

Hussain, S.A. (2013). Activity pattern, behavioural activity and interspecific interaction of smooth-coated otter (*Lutrogale perspicillata*) in National Chambal Sanctuary, India. IUCN Otter Specialist Group Bulletin, 30(1), 5-17.

IUCN. (2022). The IUCN Red List of Threatened Species. Retrieved from https://www.iucnredlist.org.

Jayasooryan, K.K., & Chandini, P.K. (2024). Emerging human-otter conflicts in the wetlands and rivers of Kerala, India. Current Science 127(1), 00113891.

Kamjing, A., Ngoprasert, D., Steinmetz, R., Chutipong, W., Savini, T., & Gale, G.A. (2017). Determinants of smooth-coated otter occupancy in a rapidly urbanizing coastal landscape in Southeast Asia. Mammalian Biology, 87, 168-175.

Khan, W.A., & Hasnain, S.A. (2008). Large mammals at Indus for all programme sites (Unpublished Report). WWF-P, Karachi, 88.

Khan, W.A., Qasim, M., Ahmad, E., Chaudhry, A.A., Bhaagat, H.B., & Akhtar, M. (2010). Status of smooth coated otter (*Lutrogale perspicillata sindica*) in Pakistan. Pakistan Journal of Zoology, 42(6).

Khoo, M.D.Y., & Lee, B.H. (2020). The urban smooth-coated otters *Lutrogale perspicillata* of Singapore: A review of the reasons for success. International Zoo Yearbook, 54(1), 60-71.

Latorre-Cárdenas, M.C., Hernández-Romero, P.C., Gutiérrez-Rodríguez, C., & Porter-Bolland, L. (2023). Evaluation of the human-otter conflict in central Veracruz, Mexico: recommendations for mitigation. Human Dimensions of Wildlife, 1-17.

Linde, A.R., Izquierdo, J.I., Moreira, J.C., & Garcia-Vazquez, E. (2008). Invasive tilapia juveniles are associated with degraded river habitats. Aquatic Conservation: Marine and Freshwater Ecosystems, 18(6), 891-895.

Mason, C.F., & Macdonald, S.M. (1986). Otters: Ecology and Conservation. Cambridge University Press, Cambridge.

Mason, C.F., & Macdonald, S.M. (2009). Otters: ecology and conservation. Cambridge University Press.

McMillan, S.E., Wong, T.C., Hau, B.C.H., & Bonebrake, T.C. (2019). Fish farmers highlight opportunities and warnings for urban carnivore conservation. Conservation Science and Practice, 1(8), e79.

Muchapondwa, E., Biggs, H., Driver, A., Matose, F., Mungatana, E., & Scheepers, K. (2012). Providing economic incentives for biodiversity conservation in an emerging bioregional context. Journal of Sustainable, 5(1).

Najmuddin, M.F., Haris, H., Haneef, S., Nabil, A., Norazlimi, N.A., Md-Zain, B.M., & Abdul-Latiff, M.A.B. (2021). Perception and challenges of PrimaTourism (Primate-based tourism) in Kota Tinggi, Johor, Malaysia. Malayan Nature Journal, 73(4), 613-623.

Najmuddin, M.F., Haris, H., Shahrool-Anuar, R., Norazlimi, N., Md-Zain, B.M., & Abdul-Latiff, M.A.B. (2019). Primatourism: Plant selection by Schlegel's banded langur *Presbytis neglectus* in Johor. In IOP Conference Series: Earth and Environmental Science, 269(1), 012036. IOP Publishing.

Narasimmarajan, K., Hayward, M.W., & Mathai, M.T. (2021). Assessing the occurrence and resource use pattern of smooth-coated otters *Lutrogale perspicillata* Geoffroy (Carnivora, Mustelidae) in the Moyar River of the Western Ghats biodiversity hotspot. IUCN Otter Specialist Group Bulletin, 38(1), 45-58.

Nunny, L. (2020). Animal welfare in predator control: lessons from land and sea. How the management of terrestrial and marine mammals impacts wild animal welfare in human-wildlife conflict scenarios in Europe. Animals, 10(2), 218.

Palei, N.C., Rath, B.P., Palei, H.S., & Acharya, B.P. (2020). Population status and activity pattern of smooth-coated otter (*Lutrogale perspicillata*) in Bhitarkanika National Park, Odisha, Eastern India. IUCN Otter Specialist Group Bulletin, 37, 205-211.

Pianzin, A., Wong, A., & Bernard, H. (2019). Relationship between Microhabitat Structure and Otter Presence in an Oil Palm Dominated Landscape of Sabah, Malaysia. In Proc. 14th Int. Otter Congress, IUCN Otter Spec. Group Bull 36, 28-38.

Rosli, M.K.A., Abdul-Patah, P., Syed-Shabthar, S.M.F., Burhanuddin, M.N., Sekiguchi, T., Sasaki, H., Shukor, M.N., Yaakop, S., & Md-Zain, B.M. (2015). Phylogenetic relationships of the Malay Peninsula otters (*Lutra sumatrana*, *Lutrogale perspicillata*, and *Aonyx cinereus*) based on DNA sequences of mitochondrial D-loop region. The Journal of Animal and Plant Sciences, 25(3), 836-843.

Rosli, M.K.A., Syed-Shabthar, S.M.F., Abdul-Patah, P., Abdul-Samad, Z., Abdul, S. N., Burhanuddin, M.N., Zulkifli, N.A., Shukor, M.N., Budsabong, K., Chantragoon, S, Sekiguchi, T., & Md-Zain, B. M. (2014). A new subspecies identification and population study of the Asian small-clawed otter (*Aonyx cinereus*) in Malay Peninsula and Southern Thailand based on fecal DNA method. The Scientific World Journal, 2014(1), 457350.

Schenck, C., & Staib, E. (1992). Giant Otters in Peru. IUCN Otter Spec. Group Bull, 7, 24-26.

Shivram, A., Sivasothi, N., Hsu, C.D., & Hodges, K.E. (2023). Population distribution and causes of mortality of smooth-coated otters, *Lutrogale perspicillata*, in Singapore. Journal of Mammalogy, 104(3), 496-508.

Siti-Kauthar, M., Najmuddin, M.F., Md-Zain, B.M., & Abdul-Latiff, M.A.B. (2019, July). PrimaTourism: Preliminary study on activity budget of Dusky leaf monkey *Trachypithecus obscurus obscurus* in Bukit Soga Perdana, Batu Pahat, Johor. In IOP Conference Series: Earth and Environmental Science, 269(1), p. 012045. IOP Publishing.

Stevens, S.S., Organ, J.F., & Serfass, T.L. (2011). Otters as flagships: social and cultural considerations. In Proceedings of Xth International Otter Colloquium, IUCN Otter Specialist Group Bulletin A (Vol. 28, pp. 150-161).

Václavíková, M., Václavík, T., & Kostkan, V. (2011). Otters vs. fisherman: stakeholders' perceptions of otter predation and damage compensation in the Czech Republic. Journal for Nature Conservation, 19(2): 95-102.

Wai, L., Evans, M.N., Bernard, H., & Goossens, B. (2020). Holt-based activity patterns of smooth-coated otter (*Lutrogale perspicillata*) in the lower Kinabatangan Wildlife Sanctuary, Sabah, Malaysia. IUCN/SCC Otter Specialist Group Bulletin, 37(1), 20-28.

Yoxon, P., & Yoxon, K. (2014). Estimating otter numbers using spraints: Is it possible? Journal of Marine Sciences, 2014(1), 430683.