**A R T I C L E**

# OTTERS AND TIDES: A HABITAT STUDY OF SMOOTH-COATED OTTERS (*Lutrogale perspicillata*) IN VELLAR ESTUARY, TAMIL NADU, INDIA

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**Abstract:** Coastal ecosystems, particularly mudflats and estuaries, harbor diverse essential components that result in high productivity. Despite their ecological significance, these regions remain understudied compared to the adjacent seas and oceans. The smooth-coated otters (*Lutrogale perspicillata*), an apex predator yet vulnerable species, found across Asian, including Indian inland water bodies, faces population decline due to urbanization, infrastructure development, and hunting. The absence of comprehensive, even baseline studies and long-term monitoring program exacerbates the condition to study otters in India, which is essential to implement and govern conservation strategies. Limited existing research on the species impedes an inclusive understanding of relevant ecological factors. Our observations establish a benchmark directory on ecological datasets of smooth-coated otters in the Vellar estuarine complex. The research details preferred habitats and seasonal patterns, influenced by freshwater availability and tidal dynamics. The distribution of otters within the study area is influenced by substrate, with silty substrates downstream and sandy substrates upstream playing a crucial role. Human activities in the region have largely maintained a harmonious coexistence with otters.

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**Key words:** Habitat selection, Smooth-coated otters, Space usage, Tamil Nadu, Vellar estuary

## INTRODUCTION

Studying food chain length is important for assessing energy transfer from producers to apex predators, which in turn can be helpful in analyzing the community structure of an ecosystem (Vander Zanden et al, 2007). Studying the higher trophic levels thus becomes important, but scarce datasets and the absence of benchmark studies at regional scale hinders the integration of further research. Globally, otters hold the position of apex predator in inland waterbodies, including lakes, streams, lagoons, and estuaries. Though occurrence data is clear in some cases, habitat selection and preference in many regions are still unstudied. Biomes such as rivers and estuaries, which are essential for the survival of otters, are dynamic. These ecosystems are highly productive and, in turn, the recovery rate when they are influenced by threats such as

fluctuating climatic events is very slow (Mitsch and Gosselink, 2000; Vitousek et al., 1997; Revenga et al., 2000; Khan et al., 2014).

In India, three species of otters are found: Smooth-Coated Otters (*Lutrogale perspicillata* Geoffroy), Eurasian Otters (*Lutra lutra)* and Asian Small-Clawed Otters (*Aonyx cinerea)* (Savage, 2022). Of these, smooth-coated otters are found nearly all over the country's waterbodies (Hussain et al., 2008), in freshwater (Arivoli and Narasimmarajan, 2021) and estuarine brackish water (Utthamapandian et al., 2022). Smooth coated otters are listed as 'Vulnerable' by the IUCN Red List (Savage, 2022).

Otters are confronted with severe threats stemming from modifying wetlands for settlements, river damming leading to reduced water flow, conflicts with fishermen, and heightened hunting pressure (Hussain et al., 2008). Despite such threats, a long-term monitoring program of the distribution and abundance of the three otter species is yet to be started in India (Gupta et al., 2016). Based on pre-existing data, there is a clear decline in the otter population demanding a comprehensive understanding of their habitat and behavioral patterns to devise appropriate conservation strategies (Hussain and Choudhary, 1997; Anoop and Hussain, 2004; Narasimmarajan et al., 2021).

A complex network of wetlands, estuaries, ponds and river streams exist all along the coastal stretch of the state of Tamil Nadu, India. Yet exploratory studies on otters and the interwoven aquatic system within these complex networks remains minimal. A few studies have reported the occurrence of smooth-coated otters (Narasimmarajan et al., 2021; Siva et al., 2021; Arivoli et al., 2021; Prakash et al., 2012; Shenoy et al., 2003) in the upstreams of the natural drainage tributaries of Tamil Nadu, while no systematic studies have been done in estuaries and backwaters of the coastal stretch. The present study is a non-invasive survey for otter presence and space use in relation to environmental variables, along the estuary of River Vellar, Southern Cuddalore, Tamil Nadu, India.

## MATERIALS AND METHODOLOGY

### Study Area

Originating from Servarayan hills of Salem district, Tamil Nadu, River Vellar runs and converges into the Bay of Bengal at Parangipettai, southeast coast of India, forming a dynamic bar-built estuary. It is also referred to as a "true estuary" since the mouth region is not permanently closed (Prakash et al., 2012). Classified as a semi-diurnal estuary due to tidal patterns occurring every six hours, it experiences high tide marks with an amplitude of approximately 90 cm and a littoral zone width ranging from 30 to 100 meters (Chertoprud et al., 2012). The Vellar estuary (Fig. 1), located at 11º29'N and 79º46'E, carries neritic waters upstream, making the ecosystem more productive, with an average depth between 2 and 5 meters (Prakash et al., 2012). While previous studies indicated the estuary distribution for 16 km, the present study reveals that saline circulation persists towards 30 km (till Sethiathope) during summer months, with a salinity of 15 PSU, favoring the inhabitation of jellyfishes.

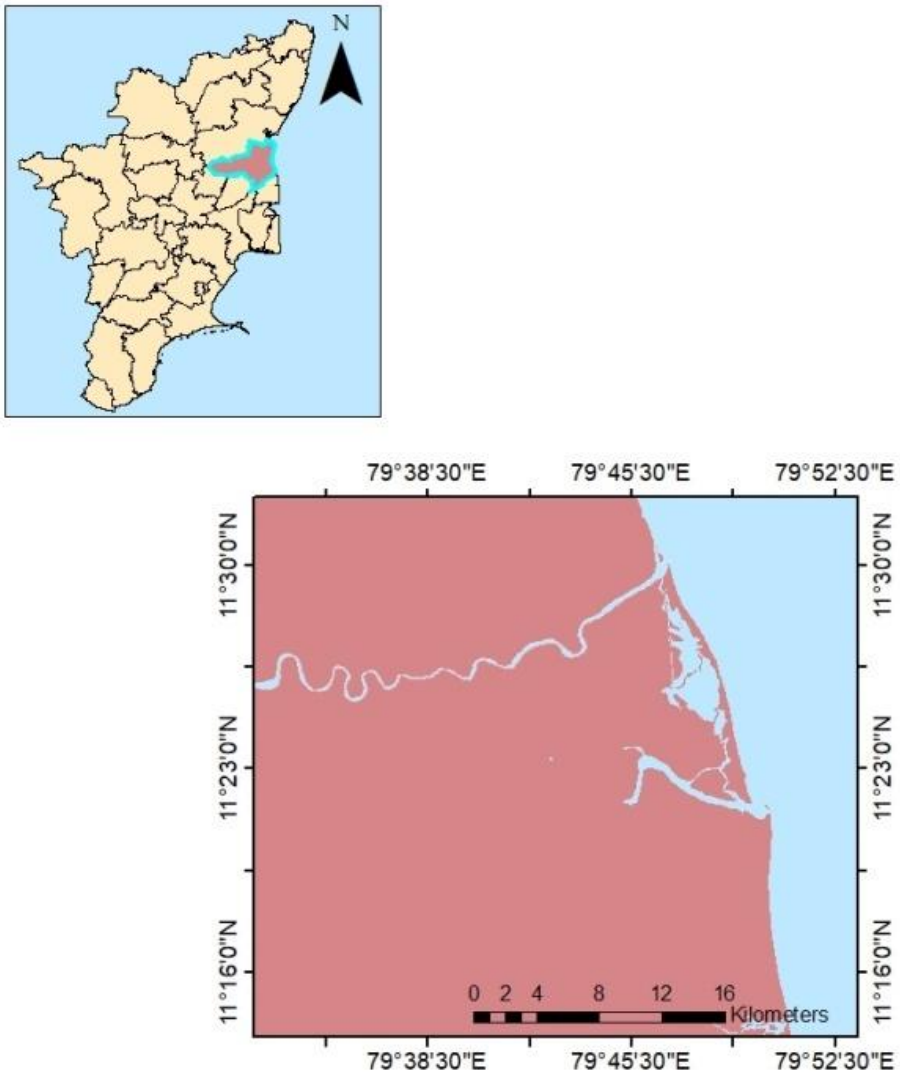


**Figure 1.** Vellar estuarine complex

**Methods**

The estuary was surveyed from the mouth to 30 km upstream as biannual seasonal time series between 2021 and 2022. The 30 km stretch was divided into 15 sections (zones) with 2 km per section (Fig. 2). To facilitate the analysis of environmental variables and to ensure the comprehensive coverage of space usage, each section was laid with five stripes (sites) of a length of 400m and breadth of 25m. Collectively the 150 sites, with 75 on each bank, were surveyed seasonally. The signature evidence that validates the presence of otters such as pugmarks, spraint sites and grooming sites, were recorded by direct walking visual observations in these sites. Direct observations of otters were opportunistic along the banks and estuary.

As suggested by *Pteronura brasiliensis* (giant otter) work (Groenendijk et al., 2005), survey interviews were conducted among local fishermen to acquire basic knowledge of the native people, mainly about interactions, using the questionnaires recommended by Groenendijk et al., 2005, modified appropriatedly for the study area. The questionnaire covered details of the native peoples' interactions in any form, and sightings including time, date, numbers, description of habitats, and feeding behavior. A total of 33 interviews were conducted.

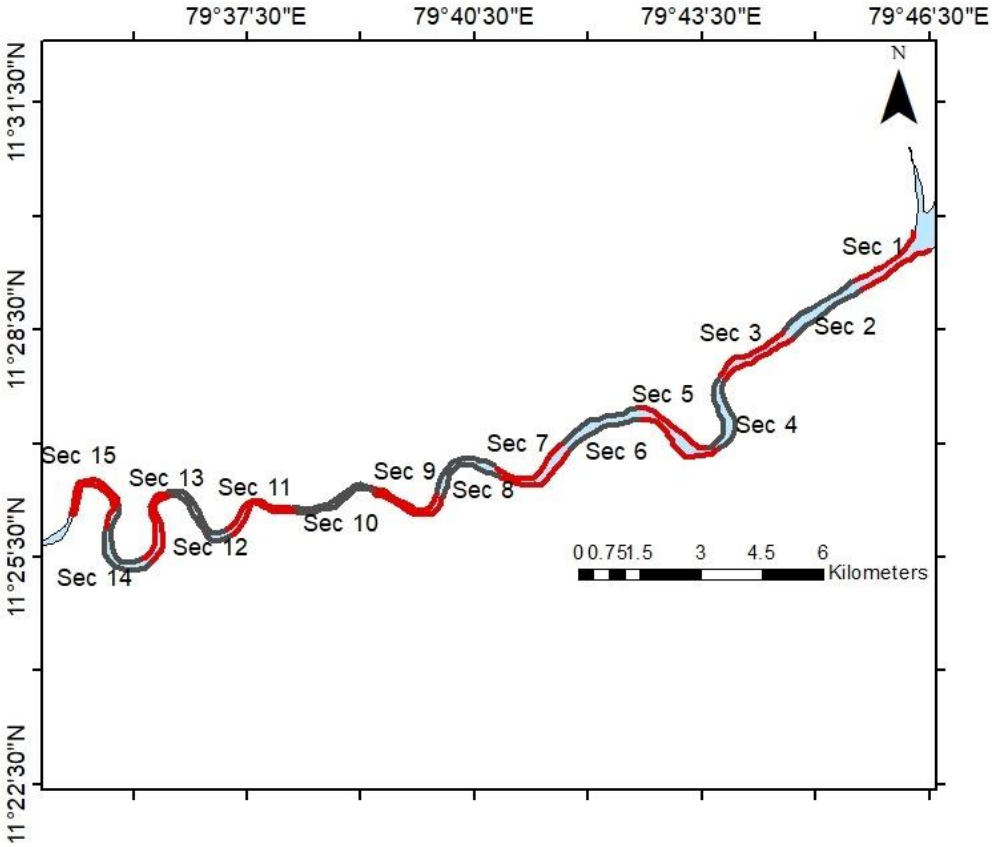


**Figure 2.** Study area

**Statistical Analysis**

Referring to the methods of Anoop and Hussain, 2004, additional estuarine variables were added for the habitat selection study. The datasets for habitat preference were collected during summer. A total of 15 variables for the sites were included for the analysis of habitat selection. The variables included average depth of the river in selected sections, angle of the slope, number of streams, mean width of the river, mean water current during high tides, mean water current during low tides, escape distance from the water course on the banks, % of vegetation cover, % of sand, % silt, % of clay, % of rockiness and boulders, presence or absence of disturbance, number of adjacent aquaculture ponds in each site in relation to the percentage of direct sightings observed during low tides. The variables were measured from the centre of all the sites and averaged for the whole section, and a total of 15 mean values were collected for each variable. Further, 12m x 12m plots were laid out at each site to measure the vegetation cover. Among the variables, 13 components, other than the percentage of rockiness and presence/absence of disturbance, were taken into account for the Principal Component Analysis. The performance was done using R studio software of version 4.0.5. on Windows platform. “Psych” groupage in R software was used to extract the PCA plots and analysis and “ggcorrplot” groupage was used to extract the correlation plot. The variables and the four principal components (PC1, PC2, PC3, PC4) were also utilized with Man-Whitney U-test.

## RESULTS

### Distribution and Factors influencing Distribution

During the survey, on a section basis, 46.7% of the area showed positive evidence (Fig. 3), while 53.3% had no otter evidence. Among the 75 sites, 15 sites showed positive evidence of otter presence, constituting 24%, while the remaining 76% were negative sites.

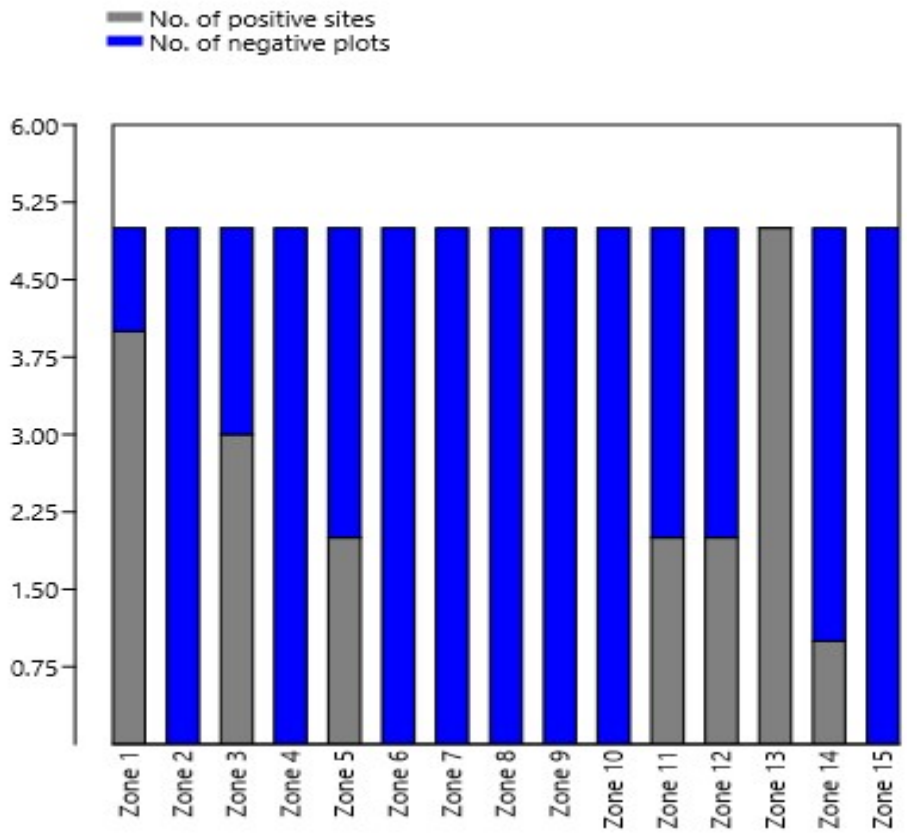


**Figure 3.** Percentage of positive sites

In the downstream part of the estuary, the recorded sites were predominantly located on the silty banks. Zones 1 and 3 had high silt concentrations of 94.28% and 78.01% respectively. Conversely, in the upstream banks, the utilized sites mainly featured sandy substrate. Considering the overall soil texture in positive sections, otters inhabitations were found on 34.38% silt, 61.46% sandy, and 3.86% clayey soils (Fig. 4).

Mangroves, dense patches of mesquites and large perennial grasses were among the variety of vegetations found at the positive sites. The vegetation also provided hiding and den spots which were strategically located within the otters' escape distance.

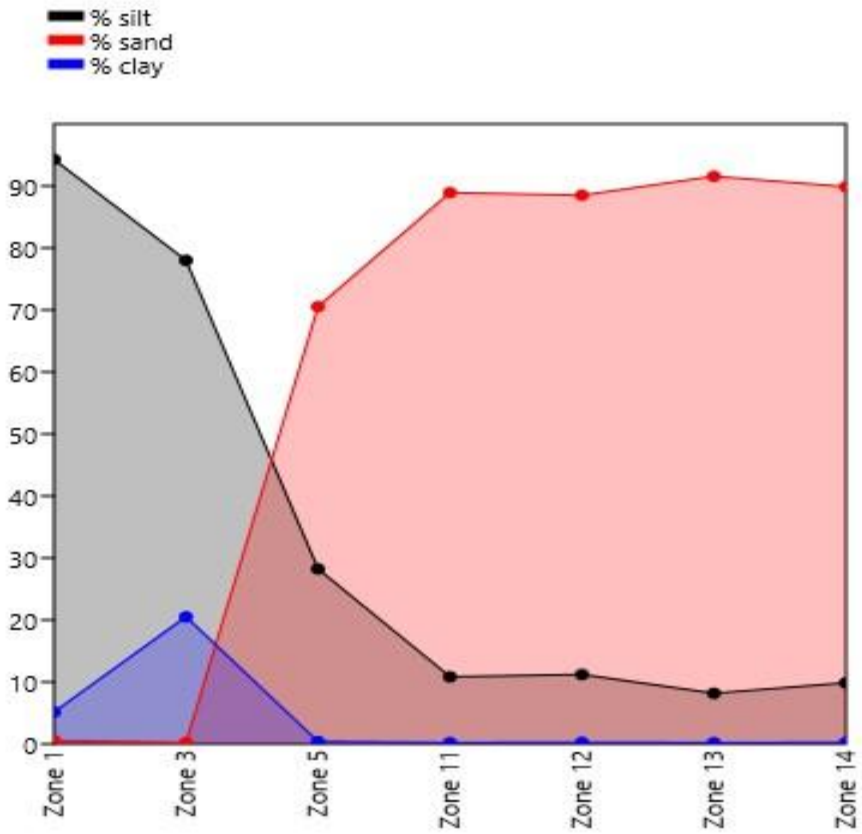


**Figure 4.** Soil texture in positive sites

## Habitat Selection

The first two principal components (Table 1) of PCA were used for the plots and further analysis.

**Table 1:** Principal components loadings of Principal Component Analysis in Vellar estuary (PC1 – 55.22% and PC2 – 15.26%)

| Variables | PC1 | PC2 |
|---|---|---|
| **Depth** | **0.90** | -0.01 |
| **Angle** | **0.93** | -0.11 |
| **NoS** | **0.77** | -0.40 |
| **RW** | **0.95** | -0.02 |
| **WCH** | **0.90** | -0.11 |
| **WCL** | **0.83** | 0.33 |
| **ED** | **0.70** | 0.06 |
| **VC** | 0.19 | 0.60 |
| **Sand** | -0.08 | **0.82** |
| **Silt** | **0.65** | 0.35 |
| **Clay** | **-0.59** | **-0.62** |
| **NoAP** | **0.82** | -0.34 |
| **SLT** | **0.75** | -0.19 |

Depth – Average river depth; Angle – Angle of slope; NoS – No. of Streams; RW – River width; WCH – Water current during High tides; WCL – Water current during Low tides; ED – Escape distance; VC – Vegetation; Sand – Sand concentration; Silt – Silt concentration; Clay – Clay concentration; NoAP – No. of Aquaculture Ponds; SLT – Sightings during Low Tides

Cumulative percentage of variance for PC1 is 55.22, PC2 is 70, PC3 is 81, PC4 is 90. Figure 5 describes the PCA plots. PC1 represents the influence of all the parameters to the full extent of the occurrence patterns. The influence of the number of streams and aquaculture ponds on the likelihood of silt accumulation is significant and multifaceted, ultimately impacting the selection process for aquaculture sites. The water currents during high and low tides influence the occurrence. PC2 showed the impacts of tidal fluctuations as prominent constituents. The existence of aquaculture ponds results in the occurrence of favored silt texture as prominent substrata.

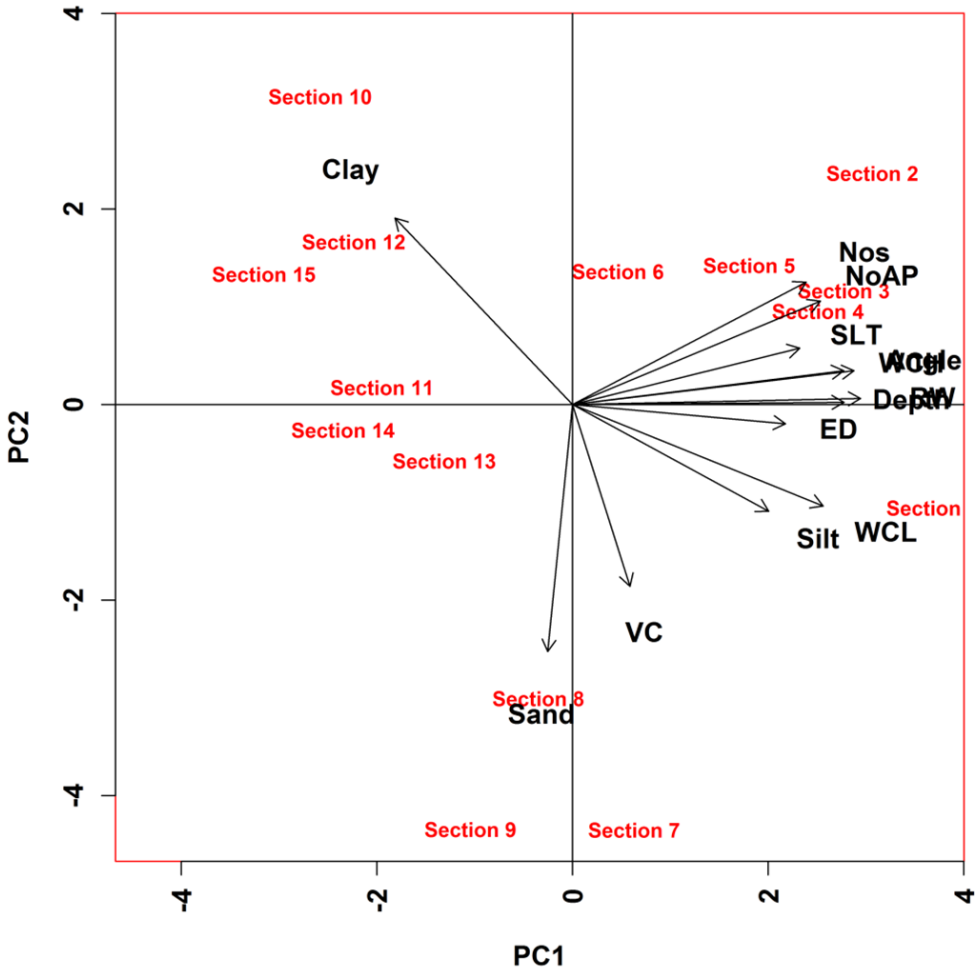


**Figure 5.** PCA plot for first two principal components

The selection of habitat by otters seems to be in the far corners of the study sites in the deep to shallow water regions. Based on the PCA and correlation analysis (Fig. 6), the vegetation cover moderately correlates with the occurrence, the existence of minimum escape distance, the availability of sustained low tides and silt particles. The presence of a large number of streams and aquaculture ponds determines the probability of otter occurrence significantly.

The Mann-Whitney U-tests that were done for four principal components corroborate with the results observed. The test results were W=345.5, *P*=0.898 for PC1, W=237, *P*=0.06588 for PC2, W=485, *P*= 0.007338 for PC3 and W=360, *P*=0.6871 for PC4.

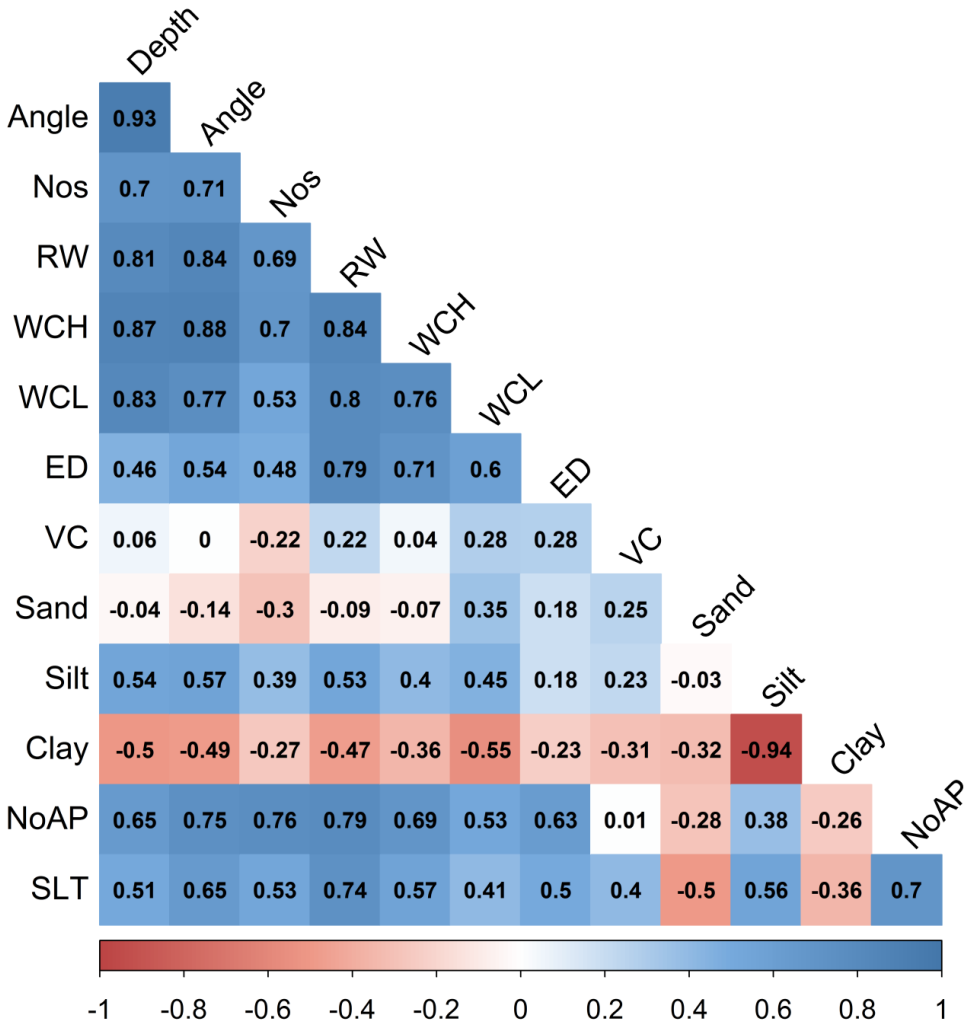


**Figure 6.** Correlation between the variables

**Sighting Records**

Zone 1, closest to the estuary mouth, is a less stratified region where abundant nutrients occur during all seasons. Evidence found in the southern and northern banks of this section included spraint sites and pugmarks. A group of otters with six individuals observed through direct sighting (Fig. 7).

**Figure 7.** Group of six otters foraging

In Zone 3, upstream, a group of nine otters (Fig. 8) was observed utilizing sites 2, 4 and 5 for feeding, grooming and sprainting. The otters were moving and acting in groups, foraging for fishes, and taking them from nets laid by the fishermen. The group comprised of four pups and five adults or subadults.

**Figure 8.** The group of nine otters foraging (Zone 3)

**Space Utilization**

During summer and pre-monsoon season, in site 3 of Zone 1, evidence including two major grooming sites and one major spraint site were observed during walking surveys. Opportunistic records including the group of six individuals observed utilizing the estuarine water and an aquaculture pond as feeding grounds.

During monsoon, evidence of sprainting and grooming was found on high ground around 1m higher than the previous spraint site from previous seasons, which was submerged during the monsoonal flood (Fig. 9).

**Figure 9.** A group of smooth-coated otters spotted in the previous spraint site which was submerged due to the monsoonal flood

During the post-monsoon season, there was no new evidence in the previous spots, but new evidence was recorded very near to the mouth, in site 1 of Zone 1, in the form of two major spraint and grooming sites, plus part-eaten fish, near a seasonal rain bed lying few meters inside the banks.

## DISCUSSION

### Occurrence and Distribution

The occurrence of otters can be ascertained straightforwardly by indirect evidence such as pugmarks and grooming sites, and by direct sightings. However, the process of assessing the population of otters is problematic (Melquist and Dronkert, 1987). Without finding a better way, assessing the count of otters remains entirely dependent on the primary evidence (Macdonald and Mason, 1983, 1985). Sites where no evidence was found were marked as regions with zero space usage by otters. Macdonald and Mason (1985) considered that the occurrence of less evidence can be an indicator or a sparse or declining population, as stronger populations present stronger evidence. During the study, there were sites with no, or very little, otter sign, which were not recorded as positive sites. However, in rare cases, habitats utilized by otters may not exhibit any evidence due to various factors including rare usage of those sites and human disturbance (Hussain, 1993; Jenkins and Burrows, 1980; Melquist and Hornocker, 1983; Cheheber, 1985).

### Habitat Preference

The occurrence of otters in various watercourses in Tamil Nadu has been frequently reported. The datasets describing the population and distribution are insufficient to draw conclusions on the current status of otters. In the present study, sprainting and grooming sites were largely found in areas of high silt concentration, followed by sandy stretches upstream. Hence silt soil is recorded as the preferred type of habitat of otters. Water currents did not impact the activities; however, there were alterations in the choice of spraint sites during the monsoonal floods. Flexible adaptation among various aquatic habitats results in the widespread distribution of the species (Pocock, 1941). Escape distance, shallow depth and gentle slopes also correlate well with the presence of otters. The vegetation at the banks is generally composed of *Porsopis juliflora* and *Calotropis gigantea,* very small patches of mangrove species *Avicennia marine, Rhizophora apiculate* and *R. mucronata* and sand dune plant *Ipomoea pes-caprae.* They are negatively correlated to the otter occurrence as minimal activity was observed around them.

At the estuary mouth, in Zone 1, direct and indirect evidence occurred on the southern bank of the estuary. The northern bank is constructed with breakwaters which form a steep rocky substrate and is exposed to frequent anthropogenic disturbance due to the Annankoil fish landing centre. Moving upstream, in Zone 2, evidence was recorded on the northern bank where there is silty substrate and inlets that are dredged to carry saline water during high tides. The occurrence of otters in Zone 5 was recorded in abandoned aquaculture ponds which not only provide perfect escape cover but also temporarily contain trapped fish during low tides.

### Seasonal Habitat Utilization

In addition to the large water bodies in the Cuddalore district, such as Veeranam Lake (Veera Narayanan Lake) and Perumal Lake, the channels which connects the large water bodies with rivers are resources for enhanced productivity. The banks in site 3 of

Zone 1 form a natural suitable habitat for otters with seasonal influence of water and nutrients. During the summer and pre-monsoon, the occurrence of brackish water fish is high in these regions, and most inland fishing happens there at that time. Otters drink fresh water, so when this part of estuary becomes saltier during summer and pre-monsoon, there is a shortage of potable water for otters; they rely on rainfall-fed sources during this time. Shifting of spraint sites to higher elevations during monsoon is observed, but shifting of the whole range towards site 1 of Zone 1 during post monsoon is a major adaptive feature. During post monsoon, the surface water of Vellar estuary is occupied by riverine input, thus providing otters with potable water and paving a way to move further seaward. In the case of the majority of adults, home range is determined by food, potable water, swimming water and shelter (Brown, 1966). The occurrence of freshwater fish on the surface makes it easy for otters to capture their prey as the fish cannot dive further depths because of high dense saline water beneath the freshwater layer. Vegetation cover also plays an important part. Most of the spraint sites and grooming sites were observed on or within the cover of escape distance from the water.

The increased water level during monsoon submerges the banks, and induces otters to search for other sites, increasing their time on land, posing additional threats (Anoop and Hussain, 2004), such as anthropogenic activities and other carnivores including Indian golden jackals (*Canis aureus)* which were spotted often during the study. Anthropogenic activities including construction of riverine dams exploit the baseline habitats (Nawab, 2007). The Vellar estuary is free of such constructions, but the major anthropogenic threat is the materials used for fishing activities.

**Human-Otter Relationships**

The conflict between humans and otters arises due to damage to fishing gear that can have a direct impact on human livelihoods. 33 interviews were recorded from native fishermen and aquaculture farmers; 26 of them detailed the interactions that are going on currently. The surveys reveal that damage to gear occurs when the otters forage and eat fish from the fishing nets. Due to their foraging activities around fishing nets, otters are also at risk of ingesting plastics. Spraints photographed from the sites are hard evidence of plastic accumulation.

Despite various precautionary measures, fish farms continue to experience significant otter invasions. This is due to the location of the farms. These farms are situated along the tidal areas where otters are accustomed to travel and hunt. The farmers face severe financial loss in terms of investment and profit.

## CONCLUSIONS

The streams and natural tributaries in the state of Tamil Nadu, India remain highly vulnerable due to settlements and increasing commercial needs. Studies aimed at exploring vulnerable species are often constrained by narrow criteria, which limit the comprehensive understanding of the factors impacting these animals. |Our surveys were made to examine the occurrence of otters in the Vellar estuarine complex as no studies have previously been carried out on these animals, which occupy the apex trophic level of the food chain. Our results confirm the presence of smooth-coated otters and their habitat preference in the estuarine complex of river Vellar. During the study period, only smooth-coated otters were observed in the opportunistic records and no other otter species were recorded. The observations unveiled the seasonal patterns of habitat used, with the underlying causes attributed to the consistent replenishment of freshwater resources due to the continuous tidal action downstream of estuaries. The habitat selection of otters within the complex reflects their inclination to remain inconspicuous

and undisturbed, creating an intricate distribution which complicates prey accessibility. Fresh water availability is one of the key factors that play a vital role in determining their seasonal movement. In some cases, this seasonal movement involves the perilous task of crossing high traffic roads. The presence of silty substrates in the downstream and sandy substrates in the upstream play a crucial role in identifying the influence of substrate on otter distribution in the study area. Conflicts are arising due to depredation of otters on fishing nets and aquaculture ponds, and this will become an inevitable issue in the near future.

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**RÉSUMÉ: LOUTRES ET MARÉES: ÉTUDE DE L'HABITAT DES LOUTRES À PELAGE LISSE DANS L'ESTUAIRE DU VELLAR, AU TAMIL NADU, EN INDE**

Les écosystèmes côtiers, en particulier les vasières et les estuaires, abritent divers composants essentiels qui se traduisent par une productivité élevée. Malgré leur importance écologique, ces régions restent sous-étudiées par rapport aux mers et océans adjacents. Les loutres à pelage lisse (*Lutrogale perspicillata*), un prédateur au sommet de la chaîne trophique, mais une espèce vulnérable, que l'on trouve dans les plans d'eau intérieurs d'Asie, y compris en Inde, sont confrontées à un déclin de leur population en raison de l'urbanisation, du développement des infrastructures et de la chasse. L'absence d'études de base complètes et uniformes ainsi qu'un programme de surveillance à long terme aggravent les conditions d'étude des loutres en Inde, ce qui est essentiel pour mettre en œuvre et gérer les stratégies de conservation. Les recherches actuellement limitées sur l'espèce ne permettent pas une compréhension inclusive des facteurs écologiques pertinents. Notre enquête établit un répertoire de référence sur la distribution et les ensembles de données écologiques des loutres à pelage lisse dans le complexe estuarien du Vellar. La recherche détaille les habitats préférés et les schémas saisonniers, influencés par la disponibilité en eau douce et la dynamique des marées. La distribution des loutres dans la zone d'étude est influencée par les substrats avec des substrats limoneux en aval et des substrats sableux en amont qui jouent un rôle crucial. Les activités humaines dans la région ont largement maintenu une coexistence harmonieuse avec les loutres.

**RESUMEN: NUTRIAS Y MAREAS: UN ESTUDIO DE HÁBITAT DE NUTRIAS LISAS EN EL ESTUARIO VELLAR, TAMIL NADU, INDIA**

Los ecosistemas costeros, particularmente los llanos de inundación, albergan diversos componentes esenciales, lo que resulta en una alta productividad. A pesar de su significación ecológica, estas regiones permanecen sub-estudiadas en comparación con los mares y océanos adyacentes. Las nutrias lisas (Lutrogale perspicillata), una especie de predador tope pero al mismo tiempo vulnerable, que se encuentra en los cuerpos de agua interiores de Asia, incluyendo la India, enfrentan una declinación poblacional debido a la urbanización, el desarrollo de infraestructura, y la caza. La ausencia de un estudio de base abarcativo y de un programa de monitoreo a largo plazo exacerba la condición para estudiar las nutrias en la India, lo que es esencial para implementar una comprensión inclusiva de los factores ecológicos relevantes. Nuestra investigación establece un directorio o catálogo de referencia sobre la distribución y los sets de datos ecológicos de nutrias lisas en el complejo estuarino de Vellar. La investigación detalla los hábitats preferidos y los patrones estacionales, influenciados por la disponibilidad de agua dulce y la dinámica de mareas. La distribución de las nutrias en el área de estudio está influenciada por los sustratos, jugando un rol crucial los sustratos arcillosos corriente abajo y los sustratos arenosos corriente arriba. Las actividades humanas en la región han mantenido mayormente una coexistencia armónica con las nutrias.

**சுருக்கம்: நீர்நாய்கள் மற்றும் ஓதங்கள்: இந்தியா, தமிழ்நாடு, வெள்ளாறு கரையோரத்தில் மென் - தோல் நீர்நாய்களின் (லுட்ரோகேல் பெர்ஸ்பிசில்லாட்டா) வாழ்விட ஆய்வு**

கரையோர சுற்றுச்சூழல்கள், குறிப்பாக சேற்று நிலங்கள் மற்றும் முகத்துவாரங்கள் ஆகியன அதிக உற்பத்தித்திறனை விளைவிக்கும் பல்வேறு அத்தியாவசிய கூறுகளைக் கொண்டுள்ளது. அவற்றின் சுற்றுச்சூழல் முக்கியத்துவம் வாய்ந்தபோதிலும், இந்த பகுதிகள் அருகிலுள்ள கடல்கள் மற்றும் பெருங்கடல்களுடன் ஒப்பிடும்போது குறைவாகவே ஆராய்ச்சிகளுக்கு உட்படுத்தப்பட்டுள்ளன. ஸ்மூத்-கோடட் ஓட்டர்ஸ் (லுட்ரோகேல் பெர்ஸ்பிசிலாட்டா), இந்திய உள்நாட்டு நீர்நிலைகள் உட்பட ஆசிய நாடுகளில் காணப்படும் ஒரு உயர் வேட்டையாடும் ஆனால் எளிதில் பாதிக்கப்படக்கூடிய இனமாகும். இந்த இனம், நகரமயமாக்கல், உள்கட்டமைப்பு மேம்பாடு மற்றும் வேட்டையாடுதல் காரணமாக எண்ணிக்கை வீழ்ச்சியை எதிர்கொள்கின்றன. விரிவான, அடிப்படை ஆய்வுகள் மற்றும் நீண்ட கால கண்காணிப்புத் திட்டம் இல்லாமை, இந்தியாவில் நீர்நாய்களைப் படிப்பதற்கான நிலைமையை மோசமாக்குகிறது. அடிப்படை ஆராய்ச்சிகள், பாதுகாப்பு உத்திகளைச் செயல்படுத்தவும் நிர்வகிக்கவும் இன்றியமையாதது. இனங்கள் குறித்த வரையறுக்கப்பட்ட ஆராய்ச்சி, தொடர்புடைய சூழலியல் காரணிகளை உள்ளடக்கிய புரிதலைத் தடுக்கிறது. எங்கள் அவதானிப்புகள், வெள்ளாறு கழிமுக கரையோரங்களில் மென்-தோல் நீர்நாய்களின் சுற்றுச்சூழல் தரவுத்தொகுப்புகளில் ஒரு முக்கிய கோப்பகத்தை நிறுவுகிறது. ஆராய்ச்சி விவரங்களின்படி, மென்-தோல் நீர்நாய்களின் விருப்பமான வாழ்விடங்கள் மற்றும் பருவகால வடிவங்கள், நன்னீர் இருப்பு மற்றும் ஓதங்கள் ஆகியவற்றால் பாதிக்கப்படுகிறது. ஆய்வுப் பகுதிக்குள் நீர்நாய்களின் பரவல் மண்ணின் ஆதி மூலக்கூறுகளால் பாதிக்கப்படுகிறது, கீழ்நிலை வண்டல் மண் மற்றும் மேல்நிலை மணல் ஆராய்ச்சி இடத்தில் மென்-தோல் நீர்நாய்களின் பரவலில் முக்கியப் பங்கு வகிக்கின்றன. இப்பகுதியில் மனித நடவடிக்கைகள் பெரும்பாலும் நீர்நாய்களுடன் ஒரு இணக்கமான சகவாழ்வை பராமரிக்கின்றன.