# Factors determining habitat choice of the smooth-coated otter, *Lutra perspicillata* in a South Indian river system

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**This study has characterized spraint sites of the smooth-coated otter in the Cauvery Wildlife Sanctuary. Otters use specific sites on land ('otter sites'/'spraint sites') for feeding and social activities; 'non-otter sites' are those not used by the otters. Various habitat parameters were identified and assessed. Otter sites varied significantly from non-otter sites, and comprised of loosely packed sand and rock, and lacked hard-packed sand, stone, gravel, vegetation and canopy cover. We believe these site features are important in facilitating grooming, and are prominent territorial markers. Otters avoided areas with high levels of anthropogenic disturbance, though avoidance was temporal rather than spatial. This study has categorized the preferred habitat of otters, which is of importance to conservation.**

**Keywords:** Anthropogenic disturbance, Cauvery Wildlife Sanctuary, spraint sites, social interactions, wetland conservation.

OTTERS form a distinct sub-family Lutrinae within the family Mustelidae[1]. Three species of otters are found in India – *Lutra perspicillata* (smooth-coated otter), *Lutra lutra* (Eurasian otter) and *Amblonyx cinereus* (small-clawed otter)[2–5].

The *IUCN Red List 2004* categorizes *L. perspicillata* as 'vulnerable', and the Wildlife (Protection) Act of India, 1972 prohibits hunting, trapping and killing of the species, indicating its vulnerable status. Major threats to Indian otter populations include habitat destruction due to developmental projects, reclamation of wetlands for settlement and agriculture, reduction in prey biomass, poaching and contamination of waterways[6]. To date, no research pertaining to otters has been undertaken in the Cauvery river system. Some pockets along this river harbour sizeable populations of otters (K. Shenoy, pers. obs.) and may prove to be critical areas for otter conservation. This study is instrumental in contributing to the knowledge on the habitat preferences of the smooth-coated otter in India, which can in turn aid in preventing the loss of prime otter habitats to development and agricultural activities. If otter populations are to be conserved, it is essential that its ecology, behaviour and habitat preference be studied thoroughly.

Deposition of spraints (otter droppings) has been associated with territory-marking and communication of willingness to mate between sexes[7]. Otters are known to choose conspicuous places for spraint deposition[8–12], and fidelity to such sites has been observed by several researchers[13,14] (Claus Reuther, pers. commun.). Sprainting usually occurs before, during and after hunting bouts[7], and during grooming and other social interactions[13]. Spraints are often deposited at grooming sites, along regular travel routes, around entrances to holts (dens) or near foraging sites[2]; often most of these activities will occur at a spraint site (K. Shenoy, pers. obs.). The importance of spraint sites to social interactions in otter communities suggests that characterizing these and other habitat aspects should be the focus of conservation studies, particularly where habitat modification and disturbance play a significant role.

The objective of this study was to characterize the habitat of *L. perspicillata* along river banks and islands of a typical river system inhabited by this species. The first hypothesis we tested was that otter sites differ from non-otter sites in habitat features related to primary otter activities. Specifically, we predicted that otters would prefer sites with loose sand and little tree canopy to facilitate grooming and basking[13]. Stony and gravely substrates with dense vegetation and leaf litter would hinder grooming, which often entails rolling in the sand to dry fur (K. Shenoy, pers. obs.). Every visit to a site is marked by deposition of spraints on a conspicuous object, such as a rock or log[15]. We therefore predicted that some rock should be available in an otter site (logs were not present along the river banks and islands).

Secondly, we hypothesized that the anthropogenic activity would reduce the use of an area by otters. Some researchers have observed that the smooth-coated otter is less sensitive to human presence than other otter species[13,16,17]. However, Foster-Turley[18] noted that otters tend to be more nocturnal

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in areas of high anthropogenic disturbance. We predicted that frequency of otter visits and number of spraint sites would be negatively correlated to anthropogenic activity along stretches of river bank or islands.

## Methodology

### *Study area*

The study site, Cauvery Wildlife Sanctuary (CWS), was chosen after reconnaissance surveys and interviews with naturalists and local residents revealed that a sizeable population of otters inhabited the sanctuary. CWS is about 100 km south of Bangalore, South India, and covers an area of 527 $km^2$. River Cauvery within this sanctuary, extends about 35 km from Bhimeshvari (12°19′N, 77°17′E) to Hogenekal (12°6′N, 77°48′E). Boulders and sand banks are common along its course. The sanctuary is mainly a mix of degraded dry deciduous forest and scrub jungle. Dominant floral species along the river banks are *Terminalia arjuna*, *Diospyros montana*, *Tamarindus indicus* (K. Shenoy, pers. obs.). The climate is semi-arid with average temperatures above 25°C and average annual rainfall[19] of 60–100 cm. The Sholiga tribal village of Muttati lies within this sanctuary. The village temple receives weekend visitors from surrounding towns and villages, and the river is a major recreational attraction. Visitors often camp along the river banks, thereby adding to litter, noise and disturbance in the sanctuary. The visitor load increases almost tenfold during February, when the temple in a village about 6 km across the river from Muttatti conducts its annual festival.

We examined a 5 km stretch of the river between Bhimeshvari (12°19′N, 77°17′E) and Muttatti (12°00′N, 77°27′E; see Figure 1). An ecotourism fishing resort, the Cauvery Fishing Camp, is located in Bhimeshwari within the CWS. This resort regularly attracts anglers and other ecotourists between November and March.

### *Methods*

The study was conducted between January and mid-March 2002.

*Habitat:* The entire stretch was divided into 1 km lengths, and 5 m × 5 m plots were laid systematically every 50 m to quantify habitat availability. Plots were described using habitat parameters such as type of substrate (hard sand, loose sand, rock, stone and gravel), canopy cover, vegetation cover and leaf litter, all measured as percentage cover of the plot. 'Hard sand' was defined as fine-textured, tightly packed sand, while 'Loose sand' was coarse and loosely packed. Any boulder (mainly granite) was called 'rock', fist-sized pieces of rock were called 'stones', and 'gravels' are small-sized stones roughly under 5 mm in diameter.

The study area was surveyed on foot every other day for a period of 6 weeks. 'Otter-sites' were identified along both banks of the river. These were recognized as areas marked with spraints, pugmarks and signs of play typical of otters. Sites chosen for sampling availability of habitat were called 'non-otter sites' if these signs of otter use were not found there. Any burrow or rock crevice, distinctly marked at the entrance with spraints and otter pugmarks was considered a holt. Plots 5 m × 5 m were laid with spraints as the centre and described according to the site and holt criteria stated above. Frequency of usage of each otter site was recorded based on appearance of new spraints and pugmarks on each visit to a site. Old signs were not removed to minimize intrusive influences on otter behaviour. New pugmarks were recognized by the clarity of the imprints. Spraints aged rapidly due to the hot and dry climate, and new spraints were distinguishable by form, colour and odour. Eight islands which were thought to be representative of the surrounding habitat, approximately equidistant from each other, were chosen from a total of twenty-four and studied similarly. Islands were scanned by boat every alternate day for the same period. Surveys were conducted at the same time everyday and along the same route, so as to avoid bias.

*Anthropogenic disturbances:* Anthropogenic activities were given scores of 1, 2 or 3 based on the perceived effect the disturbance had on the otters. A score of '3' represented maximum disturbance, caused by commercial fishing; signs of picnickers such as trash, discarded food and signs of fire were scored 2; disturbance caused by local people and ecotourists was considered to have the least negative effect on otters, and was scored 1. A human activity incident was defined as a single collection of signs of the same activity.

We calculated disturbance levels for each 1 km stretch and island using the following relation:

$$\text{Disturbance level} = \sum_{i=1}^{3} \text{score}_i * \text{total no. of incidents of activity } i/\text{observer effort},$$

where $i$ was the type of activity.

We defined visit frequency as the number of visits by otters to a 1 km stretch or island, per otter site per unit observer effort. The number of otter-sites in a stretch could be a function of habitat quality rather than anthropogenic disturbance. To tease out this habitat effect while comparing visit frequency with disturbance index, the visit frequency was calculated by averaging the number of otter visits across all sites in the 1 km stretch or island.

Visit frequency = total number of visits by otters/number of otter sites/observer effort.

### *Analyses*

STATISTICA 5.0 was used for all statistical analyses[20]. As the data were not normally distributed, a Mann–

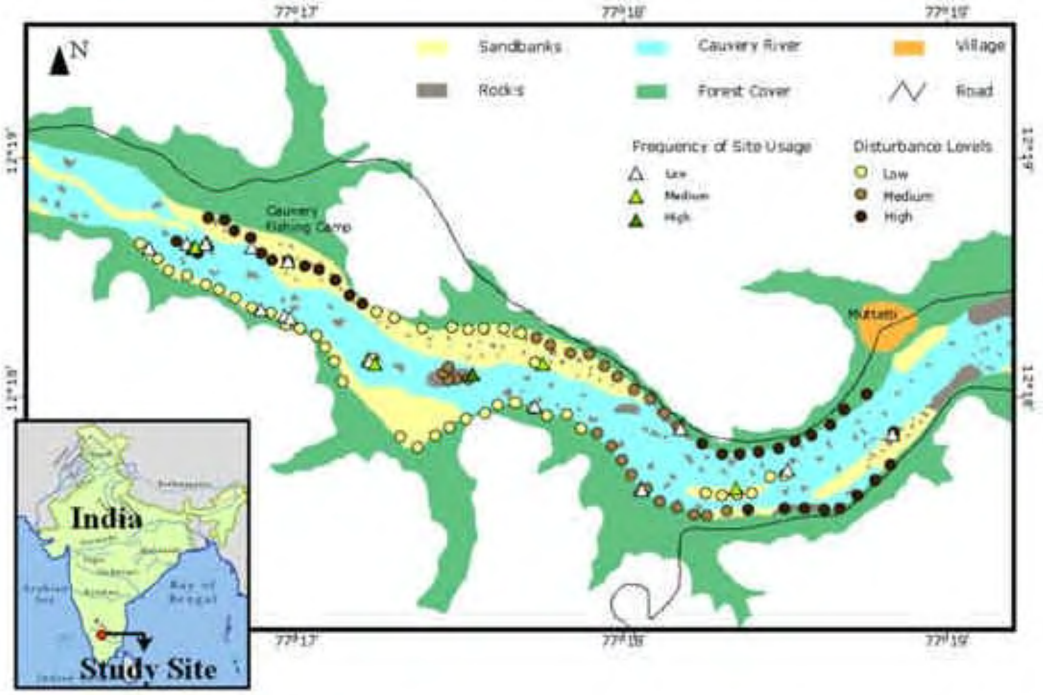


**Figure 1.** Map of the study area showing sites with varying intensities of disturbance levels and corresponding frequencies of otter visits to the areas. 'Low', 'medium' and 'high' were subjectively decided based on the perceived effects from field observations. Disturbance level value ≤ 0.01 was considered low disturbance, while disturbance levels were those > 0.5 (highest being 1.63); medium disturbance levels were values between low and high. Similarly, otter visit frequencies were ascribed as low (< 0.2), medium (0.2–0.4) and high (> 0.4); values for visit frequency ranged from 0 to 0.67 (Inset) Map of India from Wikipedia[36].

Whitney U test was used to test the hypothesis that otter sites are different in habitat make-up from non-otter sites, by comparing the difference in means for each habitat parameter. A Principal Component Analysis (PCA) was used to quantitatively and qualitatively describe otter sites and non-otter sites with respect to their composition of important habitat parameters, and understand how these sites diverge from each other according to their structural composition. Varimax-normalized rotations were used to obtain a clear pattern of factor loadings. Quantitative tests were not conducted for data on holts, as the number of observations was statistically insufficient. These data were examined qualitatively. The relationship between anthropogenic disturbance and number of otter sites, as well as otter visit frequency, in each 1 km stretch or island, was analysed using Spearman's correlation. The hypothesis that visit frequency is different in disturbed and undisturbed sites was tested using Mann–Whitney U-test, as the data were nonparametric. River bank stretches and islands with a disturbance level value < 0.3 were considered undisturbed, and those ≥ 0.3 were considered disturbed sites. These threshold values were determined subjectively, based on our perception of high and low disturbance. Geographic positions of all sites were recorded on a Garmin GPS receiver, and data were transferred to an Arcview shapefile. Landcover was digitized[21] on MapInfo 5.0 using topographic maps of the region from Survey of India, and transferred to ArcView 3.2, which was used to generate maps[22]. Sites were classified by disturbance (low, medium, high, based on values calculated earlier) and otter visit frequency (low, medium, high based on values calculated earlier). These data were represented as a map of the study site (Figure 1) showing otter visit frequencies at various disturbance levels.

## Results

### *Habitat*

A total of 23 otter sites were identified – 11 on riverbanks and 12 on islands. A total of 206 non-otter sites were sampled on islands as well as river banks. The correlation matrix (not shown) of the habitat parameters showed leaf litter and canopy cover to be highly correlated ($r = 0.84$, $P < 0.001$). As grooming and basking are important activities at a spraint site[13], we decided that canopy cover was of greater significance than leaf litter, the latter merely being a result of the presence of a canopy; hence leaf litter was eliminated from further analyses. The Mann–Whitney U-test (Table 1) compared the difference between mean percentage of cover of each parameter in otter sites and non-otter sites. Parameters that were significantly different at the 5% level of significance were

**Table 1.** Results of Mann–Whitney U-test – comparison of means between otter sites and non-otter sites. Several parameters emerge as being significantly different in otter and non-otter sites. Mean values are percentage cover of a particular habitat averaged over all sites

| Parameter | Mean for otter sites | Mean for non-otter sites | *Z* value | *P* value |
|---|---|---|---|---|
| Hard sand | 4.35 | 41.76 | –3.24 | 0.0002 |
| Loose sand | 72.39 | 32.33 | –3.70 | < 0.0001 |
| Rock | 23.26 | 13.32 | –1.13 | 0.1168 |
| Stone | 0.00 | 11.13 | –1.34 | 0.0328 |
| Gravel | 0.00 | 1.66 | –0.23 | 0.4080 |
| Vegetation | 18.04 | 51.05 | –3.72 | 0.0002 |
| Canopy | 7.61 | 30.59 | –2.54 | 0.0043 |

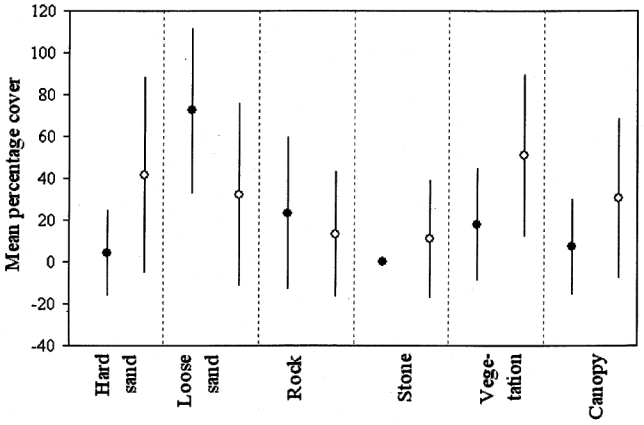


**Figure 2.** Comparison of mean percentage cover of various habitat parameters in otter sites and non-otter sites. Only parameters that emerged as being significantly different in otter sites and non-otter sites (Table 1) were used. Means are represented by open circles (for non-otter sites) and closed circles (for otter sites), while whiskers represent standard deviation. Dotted lines separate parameters from each other.

hard sand ($P = 0.0002$), loose sand ($P < 0.0001$), stone ($P = 0.0328$), vegetation cover ($P = 0.0002$), and canopy cover ($P = 0.0043$; Figure 2). Otter sites were unusual in having high percentage of loose sand cover, and zero to low percentage of hard sand, stone, vegetation and canopy cover.

The PCA extracted four principal components (PC) consisting of hard sand and loose sand (PC 1), rock (PC 2), stone (PC 3) and gravel (PC 4), cumulatively explaining 82.6% of the total variance (Table 2). Factor scores of the various components plotted against each other (Figure 3) brought out discernable patterns in habitat structure of otter and non-otter sites. While the two were distinctly different from each other with respect to percentage cover of hard sand and loose sand, the difference was not as pronounced with regard to rock, and rather minor with respect to stone. Though gravel (PC 4) was extracted as an important parameter, both otter and non-otter sites clustered together along this axis, showing slight separation from each other. The study site had small amounts of stone and gravel; though field observations revealed that otters did choose sites with no stone and gravel, this was statistically not obvious because of the low values of these parameters recorded in the study area.

Based on the results of the above analyses, it was found that the otter sites differed significantly from non-otter sites. The test hypothesis that otter sites differ significantly from non-otter sites, was supported at 5% significance level in the case of most habitat parameters (Table 1).

## *Holts*

Five holts were found, of which two were not being used, and one was used infrequently. All the holts were dug in loose sand on the riverbanks. They were heavily marked with spraints at the entrance. Thick vegetation cover, mainly the grass *Arundo donax*, surrounded each entrance. One was dug under the roots of the tree, *Diospyros montana*. The number of entrances to the holts varied from 2 to 4. Size of the entrances varied from 28 to 130 cm in width (mean = 53 cm, $n = 12$) and 20 to 51 cm in height (mean = 35.73 cm, $n = 12$). All holts found were located on islands.

Two holts were found about 2 km downstream from the study site. Both were located in rock crevices and marked at the entrance with old spraints.

## *Anthropogenic disturbance*

There was significant difference in otter visit frequency between disturbed and undisturbed areas ($P = 0.021$); the difference in the number of otter sites between disturbed and undisturbed sites was not statistically significant ($P = 0.18$). Spearman's rank correlation examined the relationship between anthropogenic disturbance and number of otter sites, as well as the visit frequency in a 1 km stretch or island. The number of otter sites was not correlated with disturbance levels ($r = –0.25$, $P = 0.34$); visit frequency and disturbance levels were moderately and negatively correlated ($r = –0.56$, $P = 0.019$; Figure 4). Figure 1 shows the distribution of sites with different disturbance intensities, corresponding to their usage by otters.

**Table 2.** Four principal components extracted, together explaining 82.6% of the total variance. Eigen values and related aspects of the components are given. For factor loadings, habitat parameters contributing to each component (factor loading > 0.7) have been marked in bold typeface

| | Eigen value | Percentage of total variance | Cumulative eigen value | Cumulative % variance explained |
|---|---|---|---|---|
| PC 1 | 2.23 | 31.90 | 2.23 | 31.90 |
| PC 2 | 1.31 | 18.78 | 3.55 | 50.67 |
| PC 3 | 1.21 | 17.35 | 4.76 | 68.02 |
| PC 4 | 1.02 | 14.58 | 5.78 | 82.60 |
| Habitat parameters | PC 1 | PC 2 | PC 3 | PC 4 |
| Hard sand | **–0.88** | 0.27 | 0.17 | 0.04 |
| Loose sand | **0.87** | 0.32 | 0.35 | 0.09 |
| Rock | 0.00 | **–0.94** | 0.04 | 0.09 |
| Stone | 0.06 | 0.08 | **–0.95** | 0.02 |
| Gravel | 0.03 | 0.01 | 0.03 | **–0.99** |
| Vegetation | –0.37 | 0.56 | -0.38 | 0.18 |
| Canopy | –0.53 | 0.40 | 0.20 | 0.17 |

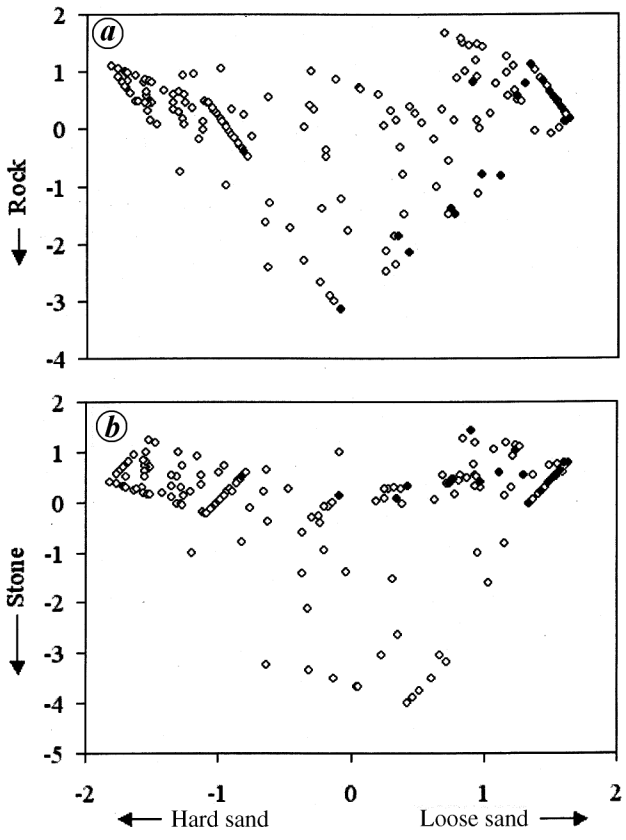


**Figure 3.** Otter sites (closed circles) and non-otter sites (open circles) characterized with regard to important habitat parameters extracted by the PCA. Sites characterized with respect to (*a*) PC1 and PC2 and (*b*) PC1 and PC3. Percentage of hard sand decreases along the positive x-axis, and percentage of loose sand increases along the positive *x*-axis (PC1), while percentage of rock (PC2) as well as percentage of stone (PC3) decrease along the positive *y*-axis. PC4 (gravel) was also extracted as an important variable in characterizing these sites. However, this has not been graphed, as otter sites and non-otter sites were similar to each other with respect to this variable, and the plot had a low degree of explanatory power.

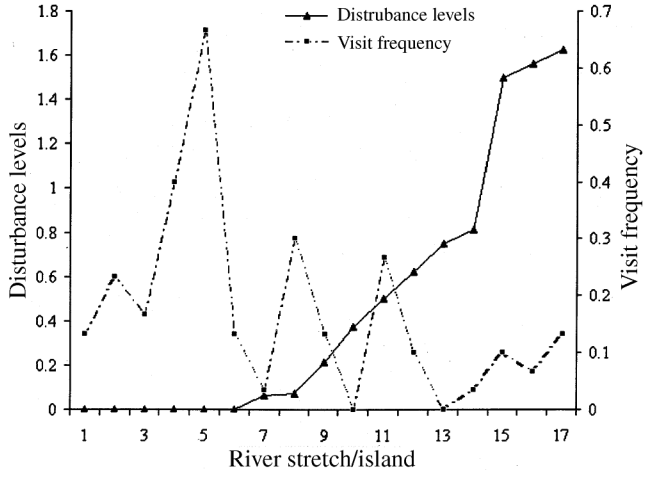


**Figure 4.** Varying levels of disturbance and otter visit frequencies in the different 1km stretches and islands surveyed for the study. As disturbance increased, there was an obvious though erratic decrease in otter visit frequency. (Values on *x*-axis are ordinal, and are merely labels for the 1 km stretches and islands).

Sites with high disturbance levels have low visit frequencies, and vice versa.

## Discussion

Otter sites (or spraint sites) in this study were those used by otters for important activities like feeding, grooming, resting, playing, mating and other social activities, and were always marked conspicuously with spraints. Our study clearly showed that otters were particular in selecting spraint sites, as has been observed in other places as well[13]. Several factors play a role in this choice, and knowledge of these factors is crucial in the understanding

of the behaviour and ecology of otters, especially *L. perspicillata*.

Sprainting is often associated with feeding and other social activities. Anoop[13] observed that sprainting usually follows or precedes basking and grooming. He noted the strong association of spraints with grooming sites. Otters are also known to deposit spraints before and after intensive hunting bouts, and sometimes while landing during a hunting bout[7]. Spraints deposited on conspicuous objects in a regularly used site within the otter's home range act as territorial markers. Thus spraint sites are crucial to the otter, and proper selection and placement of these is of importance. Spraint sites in the CWS, though sandy, almost always included some rock. On River Chambal, however, Hussain[2] found that otters preferred predominantly rocky areas. Spraint sites of smooth-coated otters in Penang were found on flat expanses of rocks along the shore[1]. In the CWS, spraints were usually deposited on rocks, or at a level slightly higher than the grooming sites. Marking on conspicuous objects or places has been observed before[15]. Such behaviour is typical of many carnivores. Otters almost never shifted their spraint sites. Such site fidelity was observed by Anoop[13] in his study in the Periyar Tiger Reserve, and Kruuk[14] in Shetland. This has also been observed in captive otters (Claus Reuther, pers. commun.). Otters regularly and consistently visit their spraint sites and may use them over several decades[1].

Most of the spraint sites in the study area consisted largely of loosely packed sand, and a small amount of rock, but lacked canopy cover, dense vegetation and stony or gravely substrates. Sites with these features are suited for grooming activities, which may explain why the substrate seemed to be the major factor in site selection by otters. In Periyar Tiger Reserve, grooming sites were found to have high sand cover[13]. Nolet *et al.*[23] observed that every hunting bout was followed by grooming. Fur maintenance plays a prominent role in the otter's activities[24], as thermal insulation is critical to these animals[25–27].

The importance of bank-side vegetation has been stated in many studies (smooth-coated otter[28–30], spotted-necked otter and cape-clawless otter[31–33] and Eurasian otter[34]). In this study, bank side vegetation seemed to be important only in the case of holt placements for providing the necessary security for young ones from potential predators, and not for grooming or spraint sites. Vegetation cover could probably hinder grooming. Thus, it would be necessary for otters to select a site with sparse to no vegetation, and high percentage of loose sand for grooming.

Though spraint sites were close to areas with low anthropogenic disturbance, the number of sites in a stretch did not seem to be affected by the level of disturbance in that stretch. Spraint sites were even found at points frequented by ecotourists. Avoidance of humans appeared to be temporal rather than spatial. While the visit frequency of otters to a disturbed area differed from that to an undisturbed area, the number of sites in these areas was not statistically different. Again, only visit frequency had a significant and moderate negative correlation with disturbance levels. This implies an avoidance of disturbed areas during daily visits to spraint sites by the otters. However, it also implies that site selection is not dependent on anthropogenic pressure. On the other hand, absence of anthropogenic pressure appeared to be important for holt placement, as all holts were found only on islands, far from human presence.

### *Conservation implications*

Commercial fishing is banned in the CWS. Incidents of illegal fishing within the sanctuary itself were rather infrequent. Thus, at present, prey species of otters are in no danger of extinction or depletion. However, until about two years ago, dynamite fishing was rampant in the area (Sunder Rajan, pers. commun.), which, while killing a large number of fish, also killed otters within an immediate radius. It is now under control in the region, but is still carried out in other parts of the river. To what extent this continues, as well as the impact on otters is not certain.

Otters in the CWS seemed to prefer visiting areas with less anthropogenic pressure. Though it is possible that they may have been habituated to some extent, human disturbance has been known to affect otters adversely[16,29]. The study site, though a protected area as under the Wildlife (Protection) Act, 1972, is under severe anthropogenic pressure, especially during weekends when the temple at Muttatti attracts tourists from surrounding towns and villages in large numbers.

Poaching of otters is higher in regions along the northern border of India (Ashok Kumar, pers. commun.). There have also been reports of poaching of otters in the Palni Hills, Tamil Nadu[35]. Otter skin is used for making drums, the meat is eaten, and the oil extracted from its fat is used for preparing traditional medicine[35]. In the study area, poaching of otters had not been recorded for almost a decade. Interviews with the local people revealed that otters were earlier poached for pelts and fat, used as a cure for an unidentified bovine disease. Several local people who were familiar with the study area were asked about the distribution and status of otters in the Cauvery, number of individuals seen, and incidents of poaching. They represented various economic and working classes, ranging from members of the Sholiga tribe, to local traders, to the manager of the Cauvery Fishing Camp, Bhimeshvari. They informed that the otter population in the region was stable. However, this is yet to be determined by rigorous scientific research, and calls for continued monitoring of otter populations in the region.

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ACKNOWLEDGEMENTS. The following people and organizations were instrumental in facilitating this study: We thank the Karnataka Forest Department and Mr Manjunatha, DCF, Cauvery Wildlife Sanctuary, for allowing us to conduct our work in the Sanctuary. We also thank Nityata Foundation Academic Division and the Priya Varma Wildlife Trust, for partial financial and technical aid, Joshua Barton for photography, Dr Philip Crowley, Dr David S. Maehr and Madhusudan Srinivasan for statistical assistance and valuable comments, R. Saandeep for GIS assistance, and Harish Bhatt for help to identify plant samples. We also thank Robin Vijayan, Narendra Babu, Nadini Rajamani, Dr S. A. Hussain and K. R. Anoop for discussions.

Received 9 January 2006; accepted 5 April 2006