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Roost and diet selection by Southern Spotted Owlet *Athene brama brama* (Temminck, 1821) in the Cauvery Delta of Nagapattinam District, southern India

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Abstract: The Spotted Owlet *Athene brama* is the commonest among the 62 species of owls of India and also a widely distributed bio-control agent of agricultural pests in India. We studied the roost site selection and diet composition of the Southern Spotted Owlet *A.b. brama* in the Cauvery Delta in southern India during 2007–08. The roost selection evaluated based on roost site characteristics observed from 22 roost sites revealed that the owlets preferred to roost closer to human habitation than in agricultural fields, with all the roosts found among trees. *Albizia saman* (Rain Tree) was the most commonly used roost tree species. Tree species with 20–30 m height and 1–3 m gbh were most preferred for roosting due to the presence of a greater number of branches. Roost species and size class selection appeared to depend on availability of suitable locations with better protection from weather and concealment to avoid disturbance from humans and other birds. Diet composition examined through analysis of 55 regurgitated pellets revealed that undigested food items from insects constituted the bulk of the owls' diet (57%) followed by mammals (rodents) (24.4%), reptiles (7.8%) and birds (7.3%). However, it is argued that mammals in the form of digestible parts could have contributed more to the diet of the owlet than any other taxa. Higher consumption of rodents and insects is discussed in the light of reducing agricultural pests; adequate roosting sites (mature trees) and creating awareness among the local community about the role of Spotted Owlets will improve their population and help control agricultural pests more effectively.

Keywords: Cauvery Delta, diet composition, insects, rodents, roosting site, Spotted Owlet.

Owl species congregate at pest outbreed areas and their role in biological control of agricultural pests has become significant (Santhanakrishnan et al. 2010; Patki et al. 2014). Their role in controlling rodent population cannot be under-estimated, as rats eat away a third of India's total food produce (Sridhar 1981). The Spotted Owlet *Athene brama* (Temminck, 1821), a Least Concern species (Birdlife International 2012), is one of the most common of the 62 species of owls found in India. This species is also found in Bangladesh, Bhutan, Cambodia, Iran, Lao, Myanmar, Nepal, Pakistan, Thailand and Vietnam ranging across wide habitats from forest to savanna, shrub land, grassland and desert. It has adapted to varied environments such as parks, groves, agricultural fields, abandoned buildings in garden and villages, towns and crowded cities, indeed any open area with trees substantial enough to provide adequate roosts (Sridhar 1981). The species is nocturnal and is considered commensal (Fletcher 1936). It is a carnivorous raptor and its food consists of rodents, birds, reptiles, amphibians, annelids and arthropods (Mason & Lefroy 1912; Ali & Ripley 1969; Sridhar 1981). Therefore,

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it is recognized as an efficient bio-control agent of small mammals and insect pests of agricultural importance (Kumar 1985) both economical and eco-friendly (Jain & Advani 1984). Thus, understanding the species ecology and enhancing its survival are important for the economic value the Spotted Owlet accrues to society by feeding on the agricultural pests such as insects and rodents, which cause a significant loss to agriculture and stored grains (Prakash & Mathur 1987). In addition, the rodents are also reservoirs of a large number of pathogens, many of which cause outbreak of diseases to human and livestock, often with high morbidity and mortality (Gratz 1994). However, in India, most of the published data available on the species are from prior to 1950 and or from part of the bird community studies (Hume 1889; Dewar 1929; Bekar 1930; Ali 1933; Fletcher 1936; Ali & Ripley 1969; Ganguli 1975; Sridhar 1981).

There have been a few long term ecological studies (Kumar 1985; Santhanakrishnan et al. 2010, 2011; Pande et al. 2007) and short term or anecdotal observations on feeding, nesting and breeding (Jain & Advani 1984; Jadhav & Parasharya 2003; Ramanujam & Verzhutskii 2004; Pande et al. 2004; 2006; 2011). Nevertheless, site specific ecological data essential to understand the species status and its requirements are still lacking in many parts of India including areas where agriculture drives the regional economy. Nagapattinam District in Tamil Nadu is a part of the Cauvery Delta Region, which is known as the 'Rice Bowl' of the state. Agriculture being the predominant source of economy of this region, site specific ecological data on the southern Spotted Owlet, which is lacking still, would contribute vital information to the agricultural economy of the area. Considering the above reasons, this study was carried out in the Cauvery Delta Region of Tamil Nadu, India to provide baseline data on roost selection and diet composition of Spotted Owlet.

METHODS

Study area: The study was carried out in the Cauvery Delta region of Mannampandal (18^{0}18'N & 79^{0}50'E), Nagapattinam District, southern India from December 2007 to March 2008. The area is characterized by large-scale cultivation of Paddy *Oryza sativa*, Sugarcane *Saccharum* sp., Black Gram *Vigna mungo* and Green Gram *V. radiata* and Cotton *Gossypium* sp. with groundnut *Arachis hypogaea* and other cereals grown as minor crops. Woody vegetation is mostly restricted to the riverbank of the Cauvery, the A.V.C. College campus, on either sides of highway and human settlements. Tree species like *Tamarindus indica*, *Mangifera indica*, *Albizia saman*, *Madhuca indica* and *Azardirachta indica* are common in the study area (Images 1–3). This area has a prolonged summer or dry season from March to August, a short monsoon or wet season from September to November, and winter from December to February. The area in and around the study site is under the Cauvery based, canal fed irrigation. Two thirds of the area cultivate a single wet crop (paddy) followed by cultivation of a dry crop of pulses mostly black and green grams. While the remaining one third area, using bore well irrigation goes for two wet crops cultivation.

Survey and evaluation of roost sites: The southern Spotted Owlet is known to roost in natural hollows found in tree trunks, holes in dilapidated walls, between the ceiling and roof in deserted or occupied dwellings, in eaves of houses, in nest-boxes, in holes in stone walls of open wells and earth cuttings (Jerdon 1862; Ali & Ripley 1969; Kumar 1985; Naik 2004; Jadhav & Parasharya 2003; Pande et al. 2006). Through a systematic survey, examining the above listed sites across human habitation, crop fields and riverbanks, Spotted Owlets roosting/nesting were identified using indirect signs such as regurgitated pellets, droppings and prey remains with confirmation of the species by direct sightings during late evening when the owls leave the roosts. In addition, inquiring from local people about the roost sites enabled locating the Spotted Owlets easily. In total, 22 roost sites were located during the study period. On locating each roost site, we recorded the roost perch and in the case of tree roosts, the species name, its gbh (m) and distance to the nearest agricultural field, human habitation, footpath, road, electric post (acted as perch pole) and water source. In addition, we have quantified the roost tree characters such as tree height, its gbh (m),

Image 1. A Spotted Owlet near to its roost

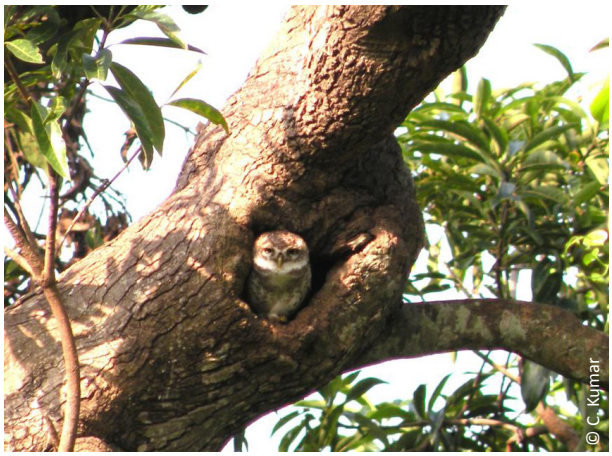

Image 2. A Spotted Owlet in its roost

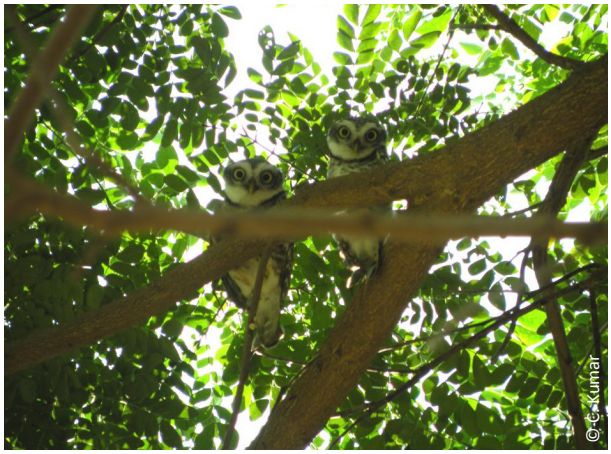

Image 3. A pair of Spotted Owlet near its roost

roost height (m) from the ground, the type of branch used for nesting (primary/secondary), branch thickness and the number of live and dead branches. To find how the roosting trees were different from non-roosting ones, we assessed tree height, gbh and the number of live and dead branches of the nearest non-nest tree with similar characteristic features. This exercise was restricted to only six roosting sites.

Analysis: Data on all land use parameters from 22 roosts were pooled to arrive at mean distance (±SE) of roost to each land use attribute. Similarly, all roost and non-roost tree characters recorded were pooled separately to arrive at mean value (±SE) for each character. Difference in characters between roost and non-roost trees were tested using 'T' test following the methods described by Sokal & Rohlf (1981).

Food habits: In general, owls swallow their prey as a whole or at times the head alone based on the size of the prey; the fleshy portions of the prey eaten are digested and undigested fur and bones cast-up and regurgitated as pellets (Welty 1982). In this study, we adapted the analyses of regurgitated pellet method, which is a more reliable technique to study the diet composition of owls (Errington 1932; Glading et al. 1943). In total, 12 roost sites, located within the study area, were identified during the first quarter of December 2007. On locating each roost site, the remains of prey parts and old pellets accumulated at the roost were cleared first, carefully, without disturbing the owls. Subsequently, the roost site was visited on alternate days until February 2008 and 52 freshly regurgitated pellets were collected from all the roost sites. The pellets were collected in separate polythene bags labeled with details (date, site name and texture of pellets) and oven dried at 70^{0}C for 24h to kill the associated invertebrate parasites (Santhanakrishnan 1987). They were eventually analyzed individually following Schueler (1972) by dissolving each pellet in 3% NaOH solution held at 60–65 ^{0}C. Hair and other debris were dissolved in sodium hydroxide, leaving the hard parts of prey. The hard prey parts were segregated broadly into invertebrates (insects): using chitinous exoskeleton of head, elytra, mandibles, legs, proboscis, pedipalps, stings, and vertebrates: based on their distinctive cutaneous, dental, cranial, and other skeletal characteristics (Errington 1932), they were dried and stored for further segregation. The insect remains were further identified and segregated up to order level, by scanning through a binocular microscope or hand lens, comparing their structural characteristics with standard literature on insects (Mani 1980). Identification of small mammals, especially rodents, was based on Neelanarayanan et al. 1998 and Agarwal 2000. To understand the contribution of each prey species in the diet of the Spotted Owlet, the segregated items were weighed (dry weight) and arrived at percent composition of various food items.

OBSERVATIONS AND RESULTS

Roost site selection: In total, 22 roosting sites were located during the study period. The data on distance from roost site to various land-use elements showed that all the roosts, except one, were within 100m from human habitation, with a mean distance of <50m (Fig. 1). While the proximity to agricultural land was within 100m, to nearly 50% of the roosts (10 out of 22), followed by 250–500 m to 27% (6) roosts, 100–250 m to 18% (4) roosts; only two roosts (9%) were located at a range of 500–1000 m away from the agricultural lands. The estimated mean distance to agricultural land was about 220m (Fig. 1). Further, majority of the roosts were

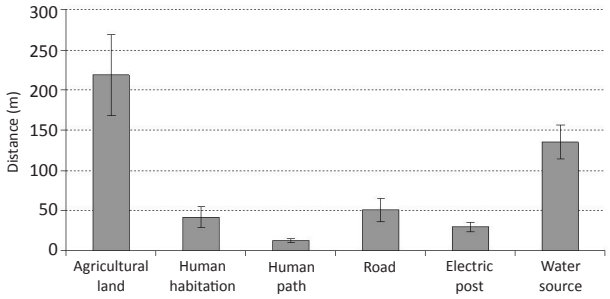

Figure 1. Mean distance to various land-use patterns observed around 22 roost sites of spotted owlets in Cauvery Delta region during December 2007 –March 2008.

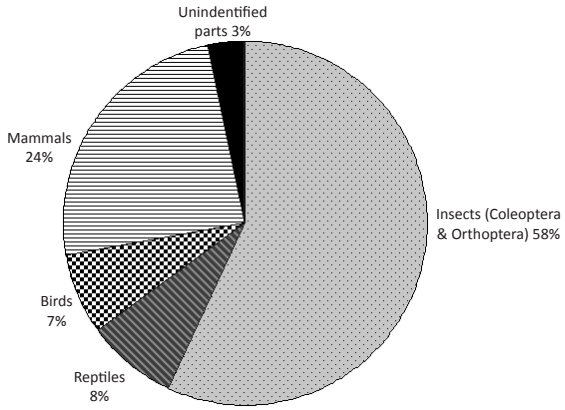

Figure 2. Diet composition of spotted owlets recorded from 52 regurgitated pellets collected in Cauvery Delta region during December 2007–February 2008.

close (within 100m distance) to walkways (100%, mean distance 13m) and roads (82%, mean distance 51m). All the roost sites had an electric post within 100m (mean 30m). These results show that the species roosts closer to human habitation than to agricultural lands and are not much disturbed by human activities in the nearby areas.

All the 22 roost sites observed in this study were located in tree cavities, with rain tree *Albizia saman* being the most commonly used (41%) tree species, followed by *Alangium* sp. (23%). Other species used for roosting include neem (*Azadirachta indica* 14%), tamarind (*Tamarindus indica* 9%), banyan (*Ficus benghalensis* 9%) and the peepal tree (*Ficus religiosa* 5%).

The roost trees selected by owlets varied in height from 10–35 m (mean 24.4±1.67) with a strong preference to 20–30 m height class trees, as 13(60%) out of 22 roots were on this height class trees. Over 85% of the roost trees were 1–3 m gbh classes (2.1±0.19). Of the 22 roosts, over two thirds (64%) were in secondary branches, mostly at 15–20 and 20–25 m height from the ground (mean 16.6±1.32), with mean roost branch thickness of 1±0.16 m. Comparison of the tree characters of roost trees with nearest non-roost trees revealed that roost trees were significantly taller than the nearby non-roost trees in height (roost tree 29.5±2.39 m, non-roost tree 27.3±3.55 m, t=5.87, df=10, P>0.05), gbh (roost tree 2.2±0.53 m and non-roost tree 1.1±0.13 m, t=1.93, df=10, P>0.05), and the number of live branches (roost trees 6.5±2.78 and non-roost trees 4.5±0.53, t=2.78, df=10, P>0.05), and dead branches (roost tree 3.75±0.59 and non-roost tree 1.08±0.34, t=3.19, df = 10, P>0.05), indicating their strong preference to larger height and gbh class trees with thicker canopy.

Diet composition: The analyses of 52 pellets reveal that invertebrates formed the bulk (57%) of the diet during December–February with the rest being constituted of vertebrates (39.6%) and unidentified items (3.4%) (Fig. 2). The invertebrate prey parts represented were insects belonging to orders Coleoptera (beetles) and Orthoptera (crickets and grasshoppers) and the vertebrates included mammals (24.4%), reptiles (7.8) and birds (7.3). Among the vertebrate prey parts, only the mammal body parts could be identified as Musk Shrew *Suncus murinus*, and Field Mouse *Mus booduga*; the prey parts belonging to other vertebrate taxa could not be identified up to genus level, but were categorized as reptiles and birds. The finding highlights the importance of the species as bio-control agent of insects and rodents, which are potential pests of agriculture ecosystems in the study area.

DISCUSSION

The present study shows that two thirds of the roost sites (64%) of the southern Spotted Owlets were located within 250m or 91% within 500m distance from agricultural lands similar to the observations on the same species elsewhere in Tamil Nadu (Naranthiran 1989) and Andhra Pradesh (Kumar 1985). A similar finding was also reported in Long-eared Owls in south Western Idaho (Marks & Marti 1984). In addition, the species were also found to roost near (<50m) human habitations. The Spotted Owlets mainly fed on rodents and insects (results from present study and Naranthiran 1989), which are found both in agricultural fields and human habitations (Sivaprakasam 1988; Neelanarayanan et al. 1996). Roosting in such areas would be appropriate to optimize the food intake that could enhance the life history strategy of reproductive success of the species. Therefore, closer proximity shown to agricultural land and human habitation could be related to food abundance. The other possible reason for the closer

proximity of roost site to human habitation (mean 41m) than agricultural land (mean 218m) could be the greater availability of suitable roost trees in the human habitation compared to agricultural land, as farmers do not grow large woody vegetation in agricultural areas to enhance availability of sunlight to crop fields.

The species being widely distributed in nature has extensively adapted to roost itself in natural hollows in tree trunks, holes in dilapidated walls, between ceiling and roof, in deserted or occupied dwellings (Ali & Ripley 1969; Pande et al. 2006), in eaves of houses (Jerdon 1862), in nest-boxes (Jadhav & Parasharya 2003; Naik 2004; Mahmood-ul-Hassan 2008), in holes in stone walls of open wells (Kumar 1985), ravines (Ramanujam & Verzhutskii 2004) or earth cuttings (Pande et al. 2006). However, in the present study all the roosts were recorded in tree cavities, possibly due to common availability of mature trees in our study area, especially at the A.V.C. College campus, which has a large number of mature trees. The findings of roost selection revealed that the Spotted Owlet in the study area depended only on mature trees for roosting, unlike in southern Tamil Nadu, where the species partly relies on man-made structures for roosting (Santhanakrishnan et al. 2011). The results of the present study further showed that owlets most frequently selected the *A. saman* tree for roosting (41%) followed by *Alangium* sp. (23%), *Azadirachta indica* (14%), *Tamarindus indica* (9%), *Ficus benghalensis* (9%) and the *Ficus religiosa (*5%). The tree species selection for roosting recorded in the present study area is different from that of in southern Tamil Nadu that showed *Ficus benghalensis* (48%), *Enterolobium saman*, which is presently, renamed as *Albizia saman* (30%), *Cocos nucifera* (15%) and *Tamarindus indica* (7%) (Santhanakrishnan et al. 2011). The observed differences in roost substrate and in tree species selection could be related to spatial difference in mature trees and availability of various tree species. The *A. saman* is a fast growing soft wood species, grows larger in height, branches high with a broad canopy and thick foliage. Due to soft wood nature of the species, the secondary branches that often break from primary branch because of natural and man-made reasons results in creations of cavities in primary branches. Such cavities provide ideal nest/roost sites for cavities/hole nesting birds like spotted owlets. Apart from the availability of natural cavities, larger trees with wide canopy and thick foliage could also provide better protection from weather conditions like rain, sunlight and wind, and concealment from other bird species like Crow *Corvus splendens* and human beings during the daytime as reported elsewhere (Forsman et al. 1984; Kumar 1985; Naranthiran 1989). Therefore, the *A. saman* was used by southern Spotted Owlets more commonly than any other tree species for roosting in the present study area.

Data on diet composition shows that the southern Spotted Owlets selected prey items in the order: insects (57%), mammals (24.4%), reptiles (7.8%) and birds (7.3%) during December 2007 to February 2008 in the Cauvery Delta of Nagapattinam District. The present findings on the proportion of invertebrates versus vertebrates in the diet of Spotted Owlets are similar to the trend reported for the species from the adjoining states of Andhra Pradesh (Kumar 1985). A similar pattern in the diet composition of Spotted Owlets has been reported from the adjoining district of the Cauvery Delta: insects 86%, mammals 7%, reptiles 1.26% and birds 0.025% with unidentified food items being the rest (5.71%), based on analysis of 590 pellets (Narenthiran 1989) and in Pondicherry: insects 94%, reptiles 2% and mammals 4% based on 197 pellets (Ramanujam & Verzhutskii 2004). However, the actual difference in the percent composition of various prey items between the present study and the earlier studies (Narenthiran1989; Ramanujam & Verzhutskii 2004) could be due to the shorter duration (three months) and the smaller sample size (52 pellets) of the present study. It is evident from the earlier studies, as well as from the present study, that the species with an opportunistic feeding strategy, preying upon a wide spectrum of prey species available locally, are able to thrive widely across the Indian sub-continent (Kumar 1985; Ramanujam & Verzhutskii 2004). Based on the indigestible food remains in the pellets, the invertebrate in the form of insects contributed the highest proportion of owlets' diet. However, it is likely that vertebrates, especially mammals, may have actually added a higher quantum of digestible parts to the diet of owlets, as vertebrates have a higher biomass of weight (as observed by Kumar 1985) in the form of flesh per unit of body mass, compared to invertebrates, that is digested in the process, as reported elsewhere (Ramanujam & Verzhutskii 2004). These findings support Kumar (1985) and Naranthiran (1989) that Spotted Owlets play an important role in controlling agricultural pests like rats and insects. By providing adequate roosting sites in preserving mature tree species and creating awareness among the public would enhance the population and conservation of Spotted Owlets.

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