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Roosting ecology of spotted owlet (*Athene brama*) and barn owl (*Tyto alba*) in agroecosystem of Punjab

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Abstract
The Spotted Owlet (*Athene brama)* and Barn Owl (*Tyto alba*) are the most common owl species in Punjab. The roosting ecology of Spotted Owlet and Barn Owl was observed at different sites of Punjab Agricultural University, villages Baranhara and Ladhowal of district Ludhiana. The preferred habitat of owls in selected locations was observed to record their utilization for roosting. Different trees utilized for roosting by Spotted Owlet were mulberry (*Morus spp.)*, mango (*Mangifera indica*), banyan (*Ficus spp.*), peepal (*Ficus religiosa*) and dek (*Melia azedarach)*. Barn Owl preferred peepal and jamun trees for roosting. Barn Owl also preferred closed grain sheds and empty building crevices for roosting. Mean tree height was observed to be 13.00±1.22 m at Punjab Agricultural University, 15.33±2.85 m at Baranhara and 12.50±0.50 m at Ladhowal. Most preferred tree utilized for roosting by Spotted Owlet was mulberry and dek tree and that of Barn Owl was peepal tree. Seasonal variation was also observed in roosting behaviour. Spotted Owlets were seen shifting from one roosting sites to another or spending more time in their cavities during the winter season. All the roosting sites were observed very near to the nesting sites and around field areas.

Keywords: Spotted Owlet, Barn Owl, roosting, habitat

Introduction
Owls are the nocturnal raptorial birds belonging to order strigiformes. They are well known for their important role in pest control [1]. The Spotted Owlet, *Athene brama* and Barn Owl, *Tyto alba* are the most common owl species found in Punjab and throughout India. The Spotted Owlet belongs to family Strigidae and Barn Owl belongs to family Tytonidae. Both the species are cavity nesters and are associated with agricultural and human habitation where they mostly feed on insects and rodents [2]. They have adapted to various environments such as agricultural fields, empty buildings in villages, towns and cities and any open area with trees enough to provide proper roosting place [3]. For many ways, Barn Owls have been associated with death and bad-luck [4]. Both rural and urban environments contain large old ruins, trees, temples and buildings which are suitable for roosting and nesting of the Spotted Owlet [5]. They usually remain inactive during the day, unless disturbed by anyone, and become active at dusk [6]. Barn Owls heavily depend on man-made sites, especially temple, towers for use as roosting sites [4]. These raptors are recognized as an important bio-control agent of small mammals and insect pest of agricultural crops, thus understanding the ecology of these species and enhancing its survival are important for the economic value of the society [7]. Although some information is available about the food habits of Spotted Owlet and Barn Owl; less is known regarding its nesting, roosting and other behaviour. Keeping in view the beneficial role of Spotted Owlet and Barn Owl in agricultural areas, the present study was carried out to study roosting ecology of these species.

Materials and methods
The present study involves observation on ecological aspects of Spotted Owlet and Barn Owl. All the observations were carried out in villages Baranhara and Ladhowal of district Ludhiana, field areas of Punjab Agricultural University, Ludhiana. In addition the roosting ecology of Barn Owl was also observed in field area of village Machaki Mal Singh of district Faridkot. The Ludhiana is located at 30.9° North and 75.85° East and Faridkot is located at 30.67° North and 74.76° East. The roosting was observed before sunrise and after sunset. Different structures including trees, crevices, poles, empty buildings were observed to identify the

roosting sites of Spotted Owlet and Barn Owl in the selected locations. These observations were made using a binocular. Different tree species which were preferred over other tree species as roosting site were observed. Height of the tree or building was measured using Ravi altimeter. Variation in roosting behaviour due to seasonal changes has also been observed which include variation in their roosting time with change in temperature. The statistical analysis was carried out by applying Kruskal-Wallis Test to find the difference in preference of roosting sites.

Results and Discussion

Roosting ecology of Spotted Owlet

In total, 12 sites were located during the study period. Out of these 7 sites were observed at Punjab Agricultural University, 3 at village Baranhara and 2 at village Ladhowal. As Spotted Owlet is nocturnal, so it roosts during the day time. During the non breeding season Spotted Owlet was observed to utilize its nesting cavities as roosting sites. The selected locations were characterised by cultivation of different crops such as pearl millet (*Pennisetum glaucum*), rice (*Oryza sativa*), wheat (*Triticum aestivum*), berseem (*Trifolium alexandrinum*) and corn (*Zea mays*). In PAU at site 1, Spotted Owlet was found roosting on 5 species of trees i.e. mulberry (*Morus* spp), dek (*Melia azedarach*), tun (*Cedrela tuna*), peepal (*Ficus religiosa*) and bottle brush (*Callistemon*). Height of the roosting trees was 9-10 m above the ground. At site 2, roosting trees like mango (*Mangifera indica*), peepal and banyan (*Ficus bengalensis*) tree were utilized by Spotted Owlet. Height of the roosting trees was 15-21 m above the ground. At site 3, three dek trees along with a cemented building present near the trees were used for roosting. Height of the roosting structure was about 9-10 m above the ground. The roosting trees found at site 4 were dek, mulberry (*Morus alba*) and peepal trees. Height of the roosting structure was about 13-15 m above the ground. The roosting trees like silver oak (*Grevillea robusta*), jamun (*Syzygium cumini*), gulmohar (*Delonix regia*) and dek were utilized by Spotted Owlet for roosting at site 5. Height of the roosting structure was about 10-14 m above the ground. At site 6, the trees used for roosting were kachnar (*Bauhinia purpurea*) and chakrasia (*Chakrasia tabularis*). Height of the roosting structure was about 10-14 m above the ground. The trees used for roosting at site 7 were dek and mulberry. Height of the roosting structure was about 10 m above the ground. Seasonal variation in roosting behaviour was also reported at all the sites (Table 1). Maximum number of Spotted Owlets was seen during month of April when average temperature was 37.80ºC whereas least number of Spotted Owlets was reported during December when temperature was 22.52ºC.

Table 1: Seasonal variation in roosting behavior of Spotted Owlet

Months	Average air temperature (ºC)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Total
Jan 2016	18.52	9	10	8	7	9	6	8	58
Feb	24.34	17	15	14	10	12	9	10	87
March	29.26	16	17	16	13	15	9	14	105
April	37.80	18	17	17	13	16	10	14	105
May	39.26	9	10	10	10	10	9	10	68
June	38.37	9	8	8	8	9	6	9	57
July	33.84	10	10	11	9	9	7	8	64
August	36.00	15	13	12	9	10	9	10	78
Sept	34.27	14	15	13	12	12	11	12	89
Oct	33.45	16	16	14	11	13	11	11	92
Nov	28.87	11	13	12	10	12	10	10	78
Dec	22.52	6	5	4	5	7	2	5	34
Jan 2017	19.58	8	8	9	8	8	6	9	56
Total		158	157	148	125	142	111	130	971

The roosting preferences were found to be significantly different at 5% level of significance by Kruskal-Wallis test. Most preferred site with highest number of Spotted Owlet was site 1, followed by site 2 and 3. At village Baranhara, three roosting sites were located. At site 1, roosting structures were banyan trees and housing structures present around the tree. Height of the tree was about 21 m above the ground. The roosting structures reported at site 2 were dek tree and a cemented room. Height of the structures was about 8-12 m. The structures used for roosting at site 3 were cemented structure above the entrance gate and a building near the gate. Height of the structure was about 10-14 m. At village Ladhowal, two roosting sites were seen. At both the sites dek and mulberry trees were used for roosting with an average height of about 12.5 m above the ground.

Fig 1: Roosting of Spotted Owlet on banyan tree

Fig 2: Roosting of Spotted Owlet on dek tree

Spotted Owlets are nocturnal and roost in the day under thick, shady vegetation, cavities in tree, human structures, including functional or nonfunctional irrigation wells and crevices rock cliffs [8]. The findings of roost selection revealed that Spotted Owlet mainly depends on indigenous trees for roosting [9]. The secondary branches of trees utilized for roosting often break from primary branch because of natural or man-made reasons which results in formation of cavities in primary branches. These cavities provide proper nesting or roosting sites for cavity nesting birds like Spotted Owlets. Apart from presence of cavities, these trees have thick foliage and wide canopy that provide protection from weather conditions like sunlight, rain and wind and also protect disturbance from other bird species like crow and human beings during the day time. Vanitha *et al* [7] reported that the Spotted Owlets utilized roosting sites near to the agricultural lands in Tamil Nadu and Andhra Pradesh. In addition, this species also found to roost near human habitation. Roosting in these areas would be considered appropriate to optimize the food intake because of more availability of food which in turn enhances the reproductive success of the species. Other reasons for close proximity to human habitation and agricultural fields could be availability of proper trees and other roosting sites [10] with dense canopy that provide more thermal cover than sparse canopies [2]. The species is widely distributed in nature and has adapted itself to roost in natural cavities present in tree trunks occupied or deserted dwellings, in nest boxes, ravines or earth cuttings.

Moreover in present study, roost trees were located close to electric poles with light sources because they attract a variety of insects during night hours. Many times Spotted Owlet was seen perching on electric power lines and catching insects from light sources. Ali and Sanathanakrishnan [11] have also observed roosting sites of this species close to electrical posts for perching and capturing of prey. During the study period Spotted Owlets were also seen shifting from their roosting sites or spending more time in their cavities during the winter season but the change was temporary. They returned to their old place with onset of favourable climate. The reason for the change may be that the Spotted Owlet mostly prefer deciduous tree, which shed their leaves in winter and left these birds exposed to predators.

Roosting Ecology of Barn Owl

Roosting of Barn Owl was observed only at two locations i.e. village Ladhowal and village Machaki Mal Singh. Barn Owl was not observed in the field areas of PAU and village Baranhara during the study period. Sanathanakrishnan *et al* [4] also reported that population of Barn Owl has been declining in many parts of the world due to loss of quality hunting habitat, loss of suitable nesting site, changes in agricultural practices and climate change. At village Ladhowal, structures used for roosting were iron grills present at the top of the seed storage sheds for roosting. Height of the roosting structure was about 15-17 m above the ground. Maximum number of owls was seen during month of December whereas least number of owls was seen during April (Table 2). This suggests that as compared to Spotted Owlet the Barn Owl prefer colder climate conditions. Barn Owl utilized seed sheds as roosting sites until it did not get open. Once it gets opened, the owls were observed to fly away immediately to the other roosting sites like trees in the surroundings. At village Machaki Mal Singh, jamun tree and a closed building were used as roosting structures. Building used for roosting was an empty wheat straw storage room, which remained close for long time. Average height of roosting structure was 10-14 m above the ground. Habitat around the roosting structure was comprised of agricultural fields, shrubs and trees. Frequent use of man-made sites by Barn Owls is common throughout the world [12, 13, 14]. Man-made sites comprising 73.2% made up the greatest proportion of Barn Owl roosting sites in Madurai district of Tamil Nadu [4], the other structures were unused wells, artificial wooden nest boxes and natural trees. The Barn Owls are often found in close proximity to humans, and their occurrence is strongly associated with the presence of buildings with suitable places for roosting or nesting [15]. Barn Owls were flushed from their roosting site during the day time by the flock of crows and were observed to come back to the roosting site when they had left.

Table 2: Seasonal variation in roosting behaviour of Barn Owl at village Ladhowal

Months	Total number of Spotted Owlets seen roosting in whole month	Average Air temperature (ºC)
Jan 2016	8	18.52
Feb	6	24.34
March	5	29.26
April	4	37.80
May	4	39.26
June	5	38.37
July	6	33.84
August	6	36.00
Sept	7	34.27
Oct	7	33.45
Nov	8	28.87
Dec	10	22.52
Jan 2017	7	19.58

Fig 3: Barn Owl roosting on peepal tree

Fig 4: Roosting of Barn Owl in building

The Barn Owl and the Spotted Owlet are known to coexist and use the same habitat in southern India [10]. But in present study, both the species did not inhabit the same habitat. During the study period, the most preferred trees utilized by Spotted Owlet for roosting were mulberry and dek with average height of 10-14 m above the ground level. Literature also revealed that six tree species *viz. Moringa oleifer*, *Melia azaderach*, *Ficus benghalensis*, *Mangifera indica*, *Tamarindus indicus* and *Ficus religiosa* were preferred for roosting by the Spotted Owlet in Maharashtra, India [16] whereas in case of Barn Owl it preferred mostly peepal tree for roosting. This means that both owl species prefer indigenous or traditional trees more because of large trunk, natural tree cavities and protection from predators due to dense branching. These raptors tried to sit on that branch of tree which was hidden under thick canopy to avoid predators. Barn owl also preferred closed grain sheds and other empty buildings for roosting. Sanathanakrishnan *et al* [4] reported that Barn Owls depend heavily on man-made sites like temple towers and buildings for roosting. Man-made sites provide many advantages like protection against extreme temperatures, rainfall and wind. According to the observations made Spotted Owlet prefers moderate temperature whereas Barn Owl prefers colder temperature. Seasonal variation in the abundance of Barn Owl at a local scale has been reported by Tome and Valkama [17] in Central Portugal. During the colder months, buildings provide better insulation and warmer conditions for Barn Owls than natural sites [4]. A sheltered place to roost may enable Barn Owls to conserve energy otherwise lost through thermogenesis, thus allowing them a wider margin for survival when temperatures are low and small mammalian prey are few due to heavy rain.

The availability of surrounding microhabitats is another important factor determining roosting site preferences in owls. The present study indicates that human habitation, cavities of trees, a water source and agrifield area are generally to be found close to the roosting sites of owls. These habitats harbour and supply a variety of food material to survive in a particular area. In recent years, tree felling in rural/urban areas and changing land use (urbanization) are threats to these bird species and may result in reduced roosting sites and decreased food availability. Thus, it may be concluded from the present study that the owls had access to a variety of habitat types within their home ranges but mostly preferred to roost at sites that were highly secured closer to foraging ground, limited disturbances from human and escape cover from enemies and predators.

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