

**ROOST SITE CHARACTERISTICS AND FOOD HABIT
OF SPOTTED OWLET, *Athene brama* Temminck – AN
INSECTIVOROUS NOCTURNAL PREDATOR**

BY

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**ALL INDIA NETWORK PROJECT ON AGRICULTURAL ORNITHOLOGY
B. A. COLLEGE OF AGRICULTURE
ANAND AGRICULTURAL UNIVERSITY
ANAND – 388 110 (GUJARAT)
2008**

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NOCTURNAL PREDATOR**

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ABSTRACT

The present investigations on “Roost site characteristics and food habits of Spotted Owllet *Athene brama* Temminck” were carried out at Anand Agricultural University and its surrounding areas in Gujarat State from January to May, 2008.

A total 42 roosting sites of Spotted Owllet were studied during study period. Out of seventeen species of trees available, only nine tree species were used by the owllet for roosting. The data revealed that nearly half (54.76%) of roosts were located exclusively in *Peltophorum* tree. Both Rain tree and Neem occupied 11.90% each while the other tree species with substantial number of roosts were Pipal (7.14%) and Khijado (4.76%). The Selectivity index of tree species like Umber (0.54) and Pipal (0.53) which neared + 1 shows that these tree species were utilized in much greater proportion than they were available. The mean roost tree height was 12.90 ± 1.93 m and it ranged from 8.35 to 16.1 m whereas the mean roost height of the perching site was found to be 6.95 ± 1.57 which

ranged from 4 to 10 m, while the minimum roost height ranged from 3.3 to 9.6 m and maximum roost height ranged from 4.3 to 10.5 m. The mean number of owl roosted was 2.7 and their number ranged from 1 to 6. This indicates that at least one non-breeding owl remains with a breeding pair.

There were no significant differences in the roosting tree and roost site characteristics of Spotted Owlet between residential and agricultural area. There was no significant difference in the roost site characteristics between breeding (32 sites) and non-breeding (10 sites) of Spotted Owlet.

Tree height and roost height were function of the tree species used for roosting by Spotted Owlet. During the non-breeding season (3.79 birds) the number of owls roosted was higher as compared to the breeding season (2.7 birds). The values suggest that during non-breeding season, entire family might be roosting together on a same tree branch. Even when a pair was breeding at least 2.63 birds roosted together suggested possibility of nepotistic behaviour.

Appendages of potential insect parts were photographed and it was used as a key to identify prey species from the pellet remains. Such an identification key is prepared for the first time.

A total of 223 pellets were examined from all three locations of the University campus. The diet composition of Spotted Owlet *Athene brama* of the present study area revealed that the relative abundance of insects (96.57%) occupied most preferred position mainly consisted of Orthoptera (41.54%), Coleoptera (37.23%), Dermaptera (16.33) etc., while in small mammals (2.40%) which mainly contributed *Mus booduga* (0.65%), *Mus musculus* (0.38%), and unidentified vertebrate (1.03%). The relative occurrence of insects

mainly consisted of Orthoptera (86.55%) which was highest as compared to Coleoptera (70.85%), Dermaptera (37.22%), unidentified insects (8.07) and Hymenoptera (1.79%) while mammals contributed 17.49% and unidentified vertebrate 8.52%. Relative frequency of insects (91.46%) was also very high which mainly constituted Coleoptera, Orthoptera and Dermaptera while in small mammals (5.74%) and unidentified vertebrate (2.80%) had low relative frequency, they were important component of diet with reference to biomass constitution.

The number of major prey items such as *Gryllotalpa africana*, *Labidura reparaia*, *Agriotes* sp., *Allecula* sp. and *Maladera* sp. were significantly different at three different locations however other prey items and mammals were not significantly different. Earlier studies carried out in India and Pakistan have reported insects as food were identified up to order level only. In the present study, we have identified both the insects and small mammals up to species level, because many of the insects consumed are also ‘pests’ of agricultural crops and therefore, the identification of insects to the species level is very important.

Key words: Spotted Owlet *Athene brama* (Temminck), Roost site characteristics and food habit, Anand, Gujarat

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CERTIFICATE

This is to certify that the thesis entitled **“ROOST SITE CHARACTERISTICS AND FOOD HABIT OF SPOTTED OWLET, *Athene brama* Temminck. – AN INSECTIVOROUS NOCTURNAL PREDATOR”** submitted by **Mr. Naim Gulab Patel** in partial fulfillment of the requirement for the award of the degree of **Master of Science (Agriculture)** in **Agricultural Entomology** of the Anand Agricultural University, Anand is a record of bonafide research work carried out by him under my personal guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

Place : Anand

Date : / 10 / 2008

(B. M. Parasharya)

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PLACE: ANAND

(PATEL NAIM G.)

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I. INTRODUCTION

Owls are unique and interesting creatures of nature. People, throughout history and across many cultures, have different and contradictory beliefs about them. They mull over them both with enthrallment and trepidation. Owls have been feared and acclaimed, loathed and admired, considered astute and foolish, and associated with witchcraft, medicine, weather, birth and death. To date, 26 owl genera encompassing more than 225 species have been recognized throughout the world (Mahmood-ul-Hassan, 2006).

Spotted Owlets are largely crepuscular and nocturnal in habits and generally keep in pairs or family parties of three to four birds (Ali and Ripley, 1983). Owls are raptors or birds of prey, which means they hunt other living things for their food, using their special adaptations and unique abilities that set them apart from other creatures. Owls are of great importance to agriculturists. They are unnoticeably serving the farmers by guarding their cereal and cash crops while they are asleep at night. They annually destroy millions of rodent pests which eat up thousands of tons of grain and other farm produce (Mahmood-ul-Hassan, 2006). There are about 32 owl species found within Indian subcontinent (Grimmett *et al.*, 1999). Spotted Owllet *Athene brama* Temminck is probably the commonest and most familiar.

The generic name ‘Athene’ of this Spotted Owl is probably derived from “Athene” the goddess of wisdom according to Greek mythology. Earlier, there were four species present in the genus ‘Athene’ like *Athene brama* Temminck, *Athene noctua* Scopoli, *Athene blewitti* Hume and *Athene cincularia* Molina (Kumar, 1985) but recently the name of *Athene blewitti* Hume has been changed to *Heteroglaux blewitti* Hume. There

are five sub-species of *Athene brama* recorded all over the world viz. *Athene brama brama*, *Athene brama indica*, *Athene brama ultra*, *Athene brama albida* and *Athene brama pulchra* (Anon., 2005); however, the sixth sub-species of this owlet *Athene brama mayri* was recently mentioned by Lewis (2006). Within Indian limits, only three subspecies are found. Amongst them *Athene brama indica* is restricted to Afghanistan, Pakistan and North West India up to 20° N latitude; *Athene brama brama* is distributed over entire south India below 20° N and *Athene brama ultra* is found in north eastern states of India. The subspecies found in Gujarat is supposed to be *Athene brama indica* as per the boundary arbitrarily fixed at 20° N between the north Indian race *indica* and the south Indian *brama* (Ali, 1954).

Spotted Owlet *Athene brama* is a common resident bird found throughout India (Ali and Ripley 1983) including Gujarat (Ali, 1954). The size of Spotted Owlet is 21 cm. It is nocturnal in habit and remains unnoticed by diurnal human beings spite of the fact that these owlets spend their time in close proximity to human beings. This might be one of the reasons for inadequate attention paid by naturalists to the Spotted Owlet and owls in general.

Spotted Owlet *Athene brama indica* is largely crepuscular and nocturnal, but is frequently abroad and even hunting in the full glare of day light. Normally it retires at sunrise to the seclusion of a tree hollow or some leafy branch and the pair remains sitting cuddled closely together. In some localities almost every venerable banyan, tamarind or mango tree holds a resident pair or two of these little owls, and one has but to tap on the trunk to bring up an inquiring and surprised little staring face to the entrance of a hollow, or dislodge the pair from some shady recess (Ali and Ripley, 1983).

Though general information about the roost site of Spotted Owllet is known, a detailed study of roost site characters has not been done in much detail.

Spotted Owllet is a carnivore raptor. Its food chiefly consists of insects and occasionally rodents, birds, reptiles, amphibians and annelids (Marshall 1877; Mason and Lefroy 1912; Whistler 1929; Ali and Ripley 1983; Roberts 1991). According to Ali and Ripley (1983) its food is mainly beetles, moths, locusts and other insects; also earthworms, lizards, mice, and small birds. Spotted Owllet eats insects attracted by street lamps. Lizards and small toads which also come to the street lamp at night are also devoured (Nilakanta, 1972).

Spotted Owllet *Athene brama* is the commonest and most widely distributed of all the owl species in Indian subcontinent. Although insects have been reported to form a significant part of its diet, rodents are also eaten and tend to be a staple food item in agricultural areas (Akhtar and Beg 1985; Beg *et al.*, 1990). According to Shah *et al.* (2004) five species of small mammals, namely, *Suncus murinus*, *Rattus meltada*, *Mus musculus*, *Mus booduga* and *Tatera indica* were represented in bony remains and in the trapped samples from the fields in Pakistan. The house mouse *Mus musculus* and the soft furred field rat *Rattus meltada* were the most frequent rodents consumed during a study by Mahmood-ul-Hassan *et al.* (2007).

According to Shah and Beg (2001) twelve species of small mammals were identified on the basis of characteristics of the cuticular scales of their hairs and bones separated from the pellets in Pakistan. The Indian desert gerbille (19.3%), short-tailed mole rat (15.9%), Indian gerbille (12.5%) and soft-furred field rat (11.5%) were better consumed than the other mammalian preys. The small mammals such as *Mus musculus*,

Suncus murinus, and *Rattus rattus* were the most dominant food item eaten by Spotted Owlet at Faisalabad, Pakistan (Mushtaq-ul-Hassan *et al.*, 2003).

General information about the diet of Spotted Owlet in India is available however; there is only one detailed study (Kumar, 1985) from Hyderabad. In the studies carried out in Pakistan, rodents were identified to species level but insects were identified to the level of orders only. Since many of the insects consumed are also ‘pests’ of agricultural crops, identification of insects at the species level is very important. Therefore, detailed study of the diet of Spotted Owlet is very much needed.

Considering these aspects, it appears that these owlets act as efficient predators of insects and small mammals of agricultural importance. Since this raptor is found in considerable numbers in the environment, an attempt is made in this investigation to understand roost site characteristics and food habits of Spotted Owlet.

Objectives:

- 1) To study the roost site characteristics of Spotted Owlet *Athene brama*
- 2) To study the diet composition of Spotted Owlet *Athene brama*

II. REVIEW OF LITERATURE

With modern research throughout the world, it has become evident that owls utilize a wide range of prey items including a variety of small mammals, birds, reptiles, amphibians, fish and insects and in no way should be considered as “vermin”. They should not be believed as symbol of bad omen, bad luck, ruination or desolation. It is indeed quite reverse of the truth: the owls are by far farmer friendly in their attitude. All owls hunt at night when almost all the farm-yard fowls are at roost or under cover. In contrast, they concentrate mainly on rats and mice that are active at night and are serious pests of agriculture owing to their destructive habits. They are unnoticeably serving the farmers by guarding their cereal and cash crops while they are asleep at night. They annually destroy millions of rodent pests which eat up thousands of tons of grain and other farm produce and were these animals not kept down by the owls, they would, in some parts of the country, have completely ruined the farmers and agriculturists compelling them to seek other employment for a livelihood. Indeed, it would be an excellent idea not only to encourage the owls to breed and multiply in the neighbourhood of large farms, but also to introduce and protect the bird, in such localities where it does not normally occur (Mahmood-ul-Hassan, 2006).

Most owls are active at dusk or during the night. They feed chiefly on small vertebrates, especially rodents, but also on insects and worms. Indigestible parts of the prey (fur, feathers, bones, and chitin) are regurgitated; these boluses contain very tiny bones. Examination of owl boluses furnishes an excellent record of the small mammalian fauna within the owl’s habitat (Moehlman, 2003).

Rats and mice inflict great economic losses by destroying farm crops and stored grains in our country where natural control factors have rarely been used. The owls are universally acknowledged for their appetite for rodents and are thought to play an important role in the control of these agricultural pests (Hassan *et al.*, 2005).

As top predators, having generally low fecundity and requiring relatively large geographic areas, owls are among the most extinction-prone species. Changes in its distribution and abundance can serve as a measure of the human impact on landscape, even in remote areas. The owls of the world are increasingly feeling pressure of worldwide deforestation trends.

Considering every aspect of its role in nature, it can be said that the owls are good friends of human being and fully deserve protection and encouragement. It would be a grievous error to persistently destroy these birds, as in practically all the cases where man has upset the balance of nature; it has generally reacted in a boomerang fashion by giving him a fearful rap for his pains.

The available literature related to the present studies has been reviewed and presented under following headings:

2.1 Roost site characteristics of Spotted Owlet

2.2 Diet composition of Spotted Owlet

2.1 Roost site characteristics of Spotted Owllet

Roosting, derived from an old German word meaning ‘a sleeping house for fowls’; the term has been often used synonymously with sleeping, but while roosting birds usually sleep, at other times they simply rest. Roosting also includes the act of going to or taking up a roost, i.e. traveling, gathering and establishment of site.

Roost site:

Birds have two basic requirements of roost site, viz. protection from predators and shelter from the climatic factors. Holes are presumably both safe and warm. City centres are warmer than surrounding land, while street light may permit birds to find roosting perches later or even serve as warm roost sites themselves, while the better lighting should aid detection of predators (Bacon, 1985).

Spotted Owllet *Athene brama* is largely crepuscular and nocturnal, but frequently abroad and even hunting in the full glare of noonday. It normally retires at sunrise to the seclusion of a tree hollow or some leafy branch, the pair sitting cuddled closely together. In some localities almost every venerable banyan, tamarind or mango tree will hold a resident pair or two of these little owls, and one has but to tap on the trunk to bring up an inquiring and surprised little staring face to the entrance of a hollow, or dislodge a pair from some shady recess (Ali and Ripley, 1983).

Spotted Owllet are mainly nocturnal in activity and normally roost during day under thick shady trees or cavities inside the functional or non-functional irrigational wells in the agricultural farms and in open desert sites, in crevice or hole or cavity of the cliffs. They can survive in different types of habitats, adapt to the changing environment and usually absent on high mountains (Rasmussen, 1998).

Kumar (1985) studied the life history of the southern Spotted Owllet (*Athene brama brama*) in Andhra Pradesh. He reported that the height of the roosting site differed from tree to tree. The mean height of perching site was found to be 8.91 ± 2.68 m and ranged from 5.40 feet to 20.40 m. Spotted Owllet seems to prefer the 6.6 - 10.50 m height range. On 66.2% occasions the birds were observed to roost within this height range. Hence, the optimal height for roosting in this area may be 9 m.

Detailed studies on the roost site characters of Spotted Owllet or any other owl species have not been carried out in India. However, such studies on other owl species have been carried out elsewhere.

Barrows and Barrows (1978) studied roost characteristics and behavioural thermoregulation in Spotted Owllet (*Strix occidentalis*) at California. They reported that during the summer months Spotted Owllet roosts were consistently chosen low to the ground, in understory trees which form an umbrella of leaves over the perch site. Also, at temperatures ranging between 28° and 29°C they initiate gular flutter, a low energy means of increasing rate of evaporative heat loss. During the period of climatic stress, the effectiveness of these behavioural mechanisms in regulating body temperatures may be intimately tied to the availability of sheltered roost sites.

Barrows (1981) studied roost selection by Spotted Owl (*Strix occidentalis*) in California. He reported that owls showed signs of heat stress when temperatures reached and exceeded 27° to 31°C. The microclimate in summer roosts was effective in reducing the extent to which the owls used gular flutter. Winter roosts differed markedly from summer roosts, providing additional evidence supporting the importance of summer roosts to spotted owls.

Blakesley *et al.* (1992) studied Spotted Owl (*Strix occidentalis caurina*) roost and nest site selection in northwestern California. They revealed that owls selected forests at 300-900 m elevations for roosting ($P < 0.05$), the lower third of slope within a specific drainage and avoided the upper third for both roosting and nesting ($P < 0.05$).

Young and Valdez (1998) studied density and roost site characteristics of Spotted Owl (*Strix occidentalis lucida*) at Mexico. They reported that owls primarily roosted in medium sized trees (70%), which likely resulted from a paucity of mature and old-growth forest. Spotted Owl roosts had steeper slopes, more canopy layers, greater canopy closure, and greater live tree basal area than random sites.

Ganey *et al.* (2000) studied roost sites of Radio-marked Mexican Spotted Owls (*Strix occidentalis lucida*) at Arizona. They reported that micro site characteristics were similar between seasons within two study areas where owls roosted primarily in a mixed-conifer forest, but differed more between seasons within two study areas where owls roosted primarily in a pine-oak forest. This suggested that mixed-conifer forest provides stable and favourable conditions for owls year round, whereas owls residing in pine-oak forests are forced to make greater seasonal adjustments in roost site use.

Merson *et al.* (1983) studied roosting sites of Eastern Screech Owls (*Otus asio*) at Virginia. They revealed that owls roosted primarily in mixed hardwood forest, but also used thickets of pine (*Pinus virginianus*), honeysuckle (*Lonicera japonica*), and cherry (*Prunus spp.*), red cedar trees (*Juniperus virginiana*), and a farm shed. Owls most often roosted in the cavities, but also used open limbs.

Hayward and Garton (1984) studied roost habitat selection by three small forest owls at Idaho. They reported that roosts chosen by Boreal (*Aegolius funereus*), Saw-whet

(*A. accadicus*) and Screech Owls (*Otus asio*) were similar and virtually all the owls perched in trees rather than using cavities and the tree density immediately around the roosts was greater than that in the adjacent forest. Roosts of these species differed in the amount of cover which the roost trees provided and the positions of the perches on the branches.

Sproat (1990) studied roosting behaviour of male Eastern Screech Owl (*Otus asio*): possible effects from nesting stage and nest type in USA. He reported that owls roosted significantly closer to their nests during the nestling stage than during the egg stage. Additionally, males associated with nests in natural cavities roosted significantly closer to their nests than did males with nests in nest boxes.

Duguay *et al.* (1997) studied winter roosting behaviour of Eastern Screech Owls (*Otus asio*) at Central Kentucky. They revealed that eleven owls used 69 roost sites 563 times, with 29 boxes used 308 times, 25 cavities used 226 times and 15 limbs used 29 times. All conifer limb roosts were in eastern red cedars (*Juniperus virginiana*). Owls also roosted in conifers more frequently when temperatures were above freezing and in boxes and cavities more frequently on days with rain, drizzle, or snow, supporting the conclusion that roosting owls seek favourable microclimates.

Weller *et al.* (1955) studied winter roosts of Marsh Hawks (*Circus hudsonicus*) and Short-eared Owls (*Asio flammeus*) at Central Missouri. They reported that owls showed a preference for areas with dense cover of panic-grass (*Panicum dichotomiflorum*) and poverty grass (*Aristida sp.*) less than one foot high. Their roosts were on drier sites than those of Marsh Hawks and commonly in a form of a tuft of grass. Feces, pellets, and feathers were found in these forms.

Bosakowski (1985) studied roost selection and behaviour of Long-eared Owl (*Asio otus*) wintering in New Jersey. He revealed that owls selected conifers with dense foliage that concealed all or most of the main trunk with no apparent regard to tree species. Roosts were established only in clumps of 2 or more closely spaced conifers (3-15 m in height), always near a variety of open habitats.

Poulin *et al.* (2005) studied factors associated with nest and roost burrow selection by Burrowing Owls (*Athene cunicularia*) on the Canadian prairies. They reported that owls chose to nest and roost in badger-sized burrows, selecting those with taller tunnel entrances and soil mounds relative to unused burrows.

2.2 Diet composition of Spotted Owlet

The food of Spotted owlet is mainly beetles, moths, locusts, and other insects; also earthworms, lizards, mice, and small birds (Ali and Ripley, 1983). According to Roberts (1991) it also comprises of small birds, gecko, beetles, orthopterous insects, large moths, mice and shrews.

2.2.1 Nestling food of Spotted Owlet

Kumar (1985) studied the life history of the Spotted Owlet (*Athene brama brama*) in Andhra Pradesh. He reported that important invertebrate food consumed by owlets were members from Gryllotalpidae, Gryllidae, Acrididae, Scolopendridae and Blattidae. Several other invertebrate taxa were consumed in significant amounts. Scorpionidae and Arinae contributed significant amounts in the nestling diets. Lizards contributed very less amounts, blind snakes were significantly used.

Jadhav and Parasharya (2003) studied the nesting behaviour and food of the Spotted Owlet *Athene brama* at Anand, Gujarat. They reported that Marbled Toad *Bufo stomaticus* and Cockroach *Periplanata americana* were dominant food items in the diet of the young ones. Blind snakes and Bats were also recorded.

2.2.2 Food habit of Spotted Owlet

Jain and Advani (1981) studied winter food of Spotted Owlet *Athene brama indica* from Jodhpur. They reported that during the month of December about 60% of their food was composed of various types of insects like Hemiptera, Hymenoptera, and Coleoptera but during January their food consisted predominantly of rodents (60.2%).

According to Kumar (1985) mammals contributed about 61%, insects 21%, other arthropods 2%, reptiles 3% and amphibians 13% of total biomass in the diet of Spotted Owlet at Hyderabad, Andhra Pradesh. He also reported that the percentage of estimated biomass was more of field mouse, *Mus booduga* (28%). The other two rodent species, house mouse, *Mus musculus* and rat *Rattus rattus* scored second place with a percentage biomass weight of 16% each.

Patel (1988) from Anand reported that Spotted Owlets mainly fed on scarabids and great majority of food consisted of the adults of *Holotrichia* sp. It was also seen that maximum predation coincided with the peak emergence of the beetles during June and July. This gives an indication that Spotted Owlets play an important role in natural control of white grub which is a pest of several cereal crops as well as groundnut in the area.

Shah and Beg (2001) studied the food of Spotted Owl (*Athene brama*) at a place where a cropland and sandy wasteland met in Pakistan. They reported that three types of

pellets comprising: 1) largely of insect remnants; 2) mainly remnants of small mammals and; 3) remnants of insects, birds and mammals in almost equal proportions. The proportions of these three types of pellets in the sample were 9%, 45% and 46% respectively. Twelve species of small mammals were identified and amongst them the Indian desert gerbille (19.3%), short-tailed mole rat (15.9%), Indian gerbille (12.5%) and soft-furred field rat (11.5%) were better consumed than the other mammalian preys.

Mushtaq-ul-Hassan *et al.* (2003) studied the diet of Spotted Owlet (*Athene brama*) at Faisalabad and Sheikhpura, Pakistan. They revealed that most dominant food item eaten by owl from Faisalabad study area were the small mammals (47.36%) followed by insects (41.70%). The remains of mollusc shells (0.57%), amphibians (6.04%), birds (2.08%) and egg shell (2.26%) were also found. At Sheikhpura the most dominant prey item found in the pellets of the owl was insects (63.68%) followed by small mammals (32.71%). The remains of mollusc shells (0.49%), amphibians (0.74%), birds remains (1.99%) and egg shells (0.37%) were also found.

Tariq *et al.* (2003) collected 60 pellets of Spotted Owlet (*Athene brama*) during October 1994 from a roosting site in an agricultural farm at Gharo, Sindh, Pakistan. They revealed that owl preferred to consume insects belonging to orders Coleoptera (2584), Orthoptera (143), Hymenoptera (44) and Hemiptera (44). The remnants of insects belonging to order Coleoptera were found in all the pellets.

Mario and Boris (2004) studied diet composition of Spotted Owlet *Athene brama* Temminck in a forested ravine at Auroville, Pondicherry. They reported that the basic food consisted of beetles (22.19%) and hymenopterans (21.06%). Constant food of termite (19.88%) and orthopteran (15.64%), supplementary food of scorpions (1.03%),

spiders (4.09%), cockroaches (4.61), ant lion larvae (2.40), moths (2.35), lizards and mice (3.67) and chance food (< 1%) of centipede, dragon fly (0.04), bugs (0.51) and shrews was recorded.

Shah *et al.* (2004) collected a total of 362 pellets of Spotted Owlet (*Athene brama*) from Chadhar and Prokian areas in the district Faisalabad, Pakistan. They found that *per cent* relative frequency of occurrence of various food remains in the pellets of owlet indicate that insects (47%) occupy the most preferred position followed by small mammals (28%), birds (12%), plant tissues (11%) and reptiles (2%). Five orders of insect preys, *viz.* Orthoptera (grasshoppers), Dictyoptera (cockroaches), Hemiptera (bugs), Hymenoptera (ants) and Coleoptera (beetles) were represented in the food of owlet. Beetles were preyed upon most heavily amongst the insect preys.

Pande *et al.* (2004) found scorpions and molluscs, new dietary records for Spotted Owlet (*Athene brama*) in India. They reported that collected pellets contained remains of mammals, remnants of insects such as Orthoprera (crickets, grasshoppers, and acridids), Hymenoptera (wasps, ants, bees, etc.), and Coleoptera. A few molluscan gastropod shells were also identified from the pellet contents. The presence of scorpion body parts as a constituent of the diet of Spotted Owlet in India. Twenty four entire scorpion stings along with 10 patellae of pedipalps were identified in the pellets.

Hassan *et al.* (2005) studied the prey of Spotted Owlet (*Athene brama*) in Punjab, Pakistan. They collected total 498 pellets from 19 sites of Punjab and found that rats and mice, and insects were jointly recorded from 92.8% of the pellets. Shrews (3.5%) and birds (2.6%) were also consumed by the owlet but the contribution of bats (0.6%) and herpetiles (0.6%) was negligibly small. Insects (53.6%) were the staple food item in the

summer diet of the owlet as compared to rodents which formed a bulk of its diet in fall (74.3%), spring (58.0%) and winter (57.7%), respectively. *Mus musculus* (20.4%) and *Rattus meltda* (17.9%) were the most frequent amongst the rats and mice.

Spotted Owlet mainly fed on Coleopteran beetles and Lepidopteran moths. Beetles of the genus *Holotrichia* were of special interest as its immatures (white grub) are pests to several crops. Furs of small rodents were also recorded at Anand (Anonymous, 2005).

Feathers of Indian Robin *Sexicoloides fulicata* were recorded in the diet of Spotted Owlet from one of the samples indicating low frequency predation at Anand (Anonymous, 2006).

Pande *et al.* (2007) studied the effect of food and habitat on breeding success in Spotted Owlet (*Athene brama*) nesting in villages and rural landscapes at Pune. They collected 3445 pellets in two years; 1430 from Human Habitations (HH) and 2015 from Open Country (OC). Owlet diet differed between HH nest sites and OC nest sites. Average species richness of prey items at HH sites was significantly higher for rodents and other preys, compared to OC sites. Similarly for relative *per cent* biomass of prey items, HH nest sites had greater percentage of rodents and other preys in the pellets and correspondingly fewer insects in the pellets, compared to OC.

According to Mahmood-ul-Hassan *et al.* (2007) small mammals contributed 98.4% of the total prey biomass consumed by owlets in Pakistan. Insects, however were predominant (56.4%) numerically. The regurgitated pellets consisted of smooth fur and hairs, small pieces of vertebrate bones, pieces of insect integument, insect appendages, etc. Amongst small mammals, rats and mice (38.8%) were staple food items. Beetles

(42.8%) were the most frequent insect prey. Shrews (2.3%) and birds (1.7%) were also consumed. Roaches (6.4%), bugs (3.3%), grasshoppers (6.7%), and ants (3.2%) were the other insect preys consumed by owlets.

III. MATERIAL AND METHODS

3.1 STUDY AREA

Anand district is situated in the central part of Gujarat state. Total area of the district is 2, 94,751 hectares the plain land which is 1.52% area of the state and comprises of eight tahsils for the revenue record.

Entire district lies between two major rivers; Mahisagar on the eastern side and Sabarmati on the western side. Northern part of the district has common boundary with Kheda district. Ahmedabad district is on its western side and Vadodara on the eastern side. Southern side is attached to the Gulf of Khambhat. The region has typical fertile soil popularly known as “Goradu soil” with loamy sand of alluvial origin. Goradu soil is known for its productivity. Hence, intensive cropping is practiced throughout the year. Agriculture and dairying are the priorities of the rural area.

Net cropped area of the district is 2, 04,905 hectares with 1, 97,226 hectare area with irrigation facilities and therefore, irrigated farming is practiced. Important crops of the district are rice (*Oryza sativa* L.), pearl millet (*Pennisetum typhoides* L.), tobacco (*Nicotiana tabacum* L.), wheat (*Triticum aestivum* L.), mustard (*Brassica spp.*), sugarcane (*Sachharum officinarum* L.) and chickpea (*Cicer arientinum* L.). In some patches vegetables and fruits viz., Banana (*Musa paradisica* L.), lemon (*Citrus limon* L.), mango (*Mangifera indica* L.) etc., are also grown. Sorghum (*Sorghum vulgare* Pers.), cluster bean (*Cyamopsis tetragonoloba*) and lucerne (*Medicago sativa*) are grown as fodder crops. There is no real forest in the district, but has a great floral diversity. Babul (*Acasia nilotica*), Manila Tamarind (*Pithecellobium dulce*), Neem (*Azadirachta indica*)

and *Eucalyptus* spp. are the most common trees amongst many others grown on the farm borders and road sides. The density of trees is very high in most parts of the district.

Anand tahsil is located between 22° 37' (N) and 22° 43' (S) latitude and 72° 55' (E) and 73° 18' (W) longitude. Total area of Anand tahsil is 40109 hectares of which 32072 hectares are cultivable land and 91.5% of the cultivable land has irrigation facility. The land is plain and soil at most of the places is sandy clay loam.

Agriculture in the study area is dependant on canal and tube wells. Mahi canals are well distributed in most of the tahsils which provide most favourable conditions for cultivation of various crops in summer months as well.

Present study on roost site characteristics and food habits of Spotted Owlet was carried out from January to May 2008 at Anand Agricultural University, Anand and its surrounding areas such as Institute of Rural Management Anand, National Dairy Development Board (NDDB), Veterinary College of AAU, Anand, Vallabh Vidhyanagar, and villages like Jahangirpura, Hadgud Lamb vel, Navli, Vadod.

Anand Agricultural University campus has old and large trees only on the road sides, while the majority of the area has kitchen gardens consisting of small trees which are replaced after some years. Majority of the old trees present on the road sides are *Peltophorum*, Neem, Mango, etc. Major crops which are grown on the campus are cotton, maize, bajra, wheat, tobacco, pigeon pea, mustard, green gram, vegetables etc.

3.2 CLIMATE

Climate of the region is semi-arid, tropical monsoon type. South-western currents in the summer bring monsoon rain from the third week of June till September end. Average annual rainfall was 840 mm. Climate is influenced by its surrounding regions

through which the cold wind blows from northern side of India. Winter is mild cool and dry, while summer is hot and dry. October to May are sunny months generally receiving an average of bright sunshine for ten hours per day. Hot weather commences by about end of February and ends by about mid of June. Winter sets in the middle of October and continues till the end of February. Average temperature of winter and summer season was 23.47 °C and 28.2 °C, respectively.

Monthly average of meteorological data of the Anand Agricultural University's observatory at Anand is given in Table 3.1. Wind speed ranged between 3.5 km/h (during March) and 6.8 km/h (during May). Average monthly maximum temperature ranged between 27.6 °C (during January) and 38.2 °C (during April). Average monthly minimum temperature ranged between 9.6 °C (during February) and 25.00 °C (during May). Average monthly relative humidity ranged between 47 % (during March) and 57 % (during May).

Table 3.1: Monthly Meteorological data during study period at Anand

| Sr. No. | Month | Wind speed (km/h) | Temperature (°C) | | | Relative humidity (%) | | |
|---------|----------|-------------------|--------------------|------|------|-----------------------|-----------------|------|
| | | | Max. | Min. | Mean | RH ₁ | RH ₂ | Mean |
| 1. | Jan., 08 | 4.0 | 27.6 | 11.3 | 19.5 | 77 | 38 | 57 |
| 2. | Feb., 08 | 3.8 | 28.2 | 9.6 | 18.9 | 76 | 37 | 56 |
| 3. | Mar., 08 | 3.5 | 36.2 | 19.5 | 27.1 | 72 | 23 | 47 |
| 4. | Apr., 08 | 4.4 | 38.2 | 22.1 | 30.1 | 69 | 26 | 48 |
| 5. | May 08 | 6.8 | 37.9 | 25.0 | 31.4 | 78 | 37 | 57 |

Source: Department of Agril. Meteorology, BACA, AAU, Anand

Weekly meteorological data for the study period is given in Table 3.2. No rainfall was received from January to May. Minimum wind speed ranged between 2.1 km/h (during 4th week of February) and maximum 7.9 km/h (during 4th week of May). Average weekly maximum temperature ranged between 22.3 °C (during 2nd week of February) and

40.7 °C (during 1st week of May). Average weekly minimum temperature ranged between 6.7 °C (during 2nd week of February) and 25.00 °C (during 4th week of May). Average weekly relative humidity ranged between 43 % (during 1st week of March) and 69 % (during 1st week of February).

Table 3.2: Weekly Meteorological data during study period at Anand

| Month | Week No. | Wind speed (km/h) | Temperature (°C) | | | Relative humidity (%) | | |
|----------|----------|-------------------|--------------------|------|------|-----------------------|-----------------|------|
| | | | Max. | Min. | Mean | RH ₁ | RH ₂ | Mean |
| Jan., 08 | 1 | 4.3 | 27.1 | 13.0 | 20.0 | 77 | 46 | 61 |
| | 2 | 4.0 | 29.3 | 13.5 | 21.4 | 77 | 36 | 57 |
| | 3 | 4.2 | 29.7 | 11.8 | 20.8 | 73 | 38 | 55 |
| | 4 | 4.1 | 24.7 | 7.5 | 16.1 | 79 | 29 | 54 |
| Feb., 08 | 5 | 3.2 | 26.5 | 9.5 | 18.0 | 85 | 54 | 69 |
| | 6 | 5.1 | 22.3 | 6.7 | 14.5 | 81 | 53 | 67 |
| | 7 | 4.4 | 29.5 | 9.6 | 19.6 | 69 | 28 | 49 |
| | 8 | 2.1 | 32.3 | 12.2 | 22.2 | 80 | 23 | 52 |
| Mar., 08 | 9 | 2.7 | 33.7 | 11.8 | 22.8 | 72 | 15 | 43 |
| | 10 | 2.5 | 35.2 | 15.2 | 25.2 | 74 | 22 | 48 |
| | 11 | 4.8 | 35.5 | 19.7 | 27.6 | 66 | 24 | 45 |
| | 12 | 3.6 | 37.7 | 19.1 | 28.4 | 68 | 21 | 45 |
| Apr., 08 | 13 | 4.2 | 37.1 | 21.3 | 29.2 | 76 | 29 | 52 |
| | 14 | 5.0 | 34.2 | 20.8 | 27.5 | 73 | 36 | 55 |
| | 15 | 4.5 | 38.8 | 21.9 | 30.3 | 61 | 26 | 44 |
| | 16 | 3.8 | 39.6 | 21.2 | 30.4 | 69 | 17 | 43 |
| May 08 | 17 | 4.2 | 40.7 | 24.1 | 32.4 | 69 | 20 | 45 |
| | 18 | 5.3 | 37.9 | 24.2 | 31.0 | 81 | 35 | 58 |
| | 19 | 6.3 | 36.8 | 25.2 | 31.0 | 78 | 39 | 59 |
| | 20 | 7.9 | 37.8 | 25.0 | 31.4 | 80 | 40 | 60 |

Source: Department of Agril. Meteorology, BACA, AAU, Anand.

3.3 METHODS

3.3.1 Roost Site Characteristics of Spotted Owlet

The roosting behaviour of Spotted Owlet was monitored from January 2007 to May 2008 at Anand Agricultural University and surrounding areas. The area consists of cultivated fields such as cotton, maize, sorghum, bajra, red gram, green gram, black

gram, etc. and old trees habitation such as Peltophorum, Neem, Mango, Almond, Rain tree, etc.

Roost sites were identified during daytime by checking all the trees of the University campus and surrounding areas especially where Spotted Owls had been seen or heard. Owl roosts were distinguished by a large accumulation of white fecal matter and pellets on the ground. The study area mainly consisted of old trees like Peltophorum (*Peltophorum ferruginium*), Mango (*Mangifera indica*), and Almond (*Terminalia catapa*). The study was conducted over one and half year, though the data gathering was confined only from January to May 2008.

The roost site characteristics such as roost tree height, roost height, minimum and maximum roost height, bole height, circumference at breast height (CBH), distance to water source, distance to food/ light source, distance to next owl roost and nearest owl nest were measured. Characters of trees in 5 m radius of roost tree were also recorded to identify the preference factor, if any.

Methodology of Roost Site Characteristics of Spotted Owlet

Following parameters were considered to determine the roost site characteristics

- 1) Roost tree height:** Tree height is defined as a vertical height of the topmost point in the crown from the ground level. Height of the tree was measured from the ground. Tree height was measured by climbing on the tree up to the upper end of the trunk with the help of a measuring tape. An aluminium rod was used for measuring tree height from upper end of the trunk to the topmost point of the crown. These two measurements were added to get the actual tree height.

- 2) **Tree height of surrounding trees:** Tree height of surrounding trees were measured similar as describe in roost tree height.
- 3) **Roost height:** The positions of the owl on the roost tree were recorded by measuring the height above the ground.
- 4) **Minimum roost height:** Distance to nearest branch below the roost.
- 5) **Maximum roost height:** Distance to nearest branch above the roost.
- 6) **Bole height:** Height from ground to the first side branch developing from the trunk of each study tree.
- 7) **Circumference at breast height (CBH) of roost tree:** Outside bark circumference at breast height were measured to get CBH.
- 8) **Distance to food / light source:** The distance of each roost tree from the nearest light source was measured.
- 9) Temperature was recorded at roost level using thermometer.
- 10) Data on ambient temperature, humidity and wind speed were obtained from Department of Agricultural Meteorology, BACA, AAU, Anand.
- 11) **Inter-owl distance:** Approximate inter-owl distance was estimated visually from ground considering owl length (21cm) as unit gauge.
- 12) **Detectibility rank:** This was worked out for the roosts to determine the predation risk around the roost. On 0-4 point scale. 0 was assigned to the roost when it was not visible from any corner of the ground while 4 to the roost easily visible from ground.
- 13) **Measurement of nearest tree:** Measurement of nearby trees (within 5 m radius) was recorded for deciding the roost site characteristics / preference (if any).

3.3.2 Statistical Analysis

Statistical tools like mean, standard deviation, students' t' test, etc., were used for interpreting the data (Steel and Torrie, 1960). The relative abundance of available and utilized tree species in the environment were calculated.

Selectivity Index: To test the hypothesis and to find out the selectivity of tree species.

Selectivity index S is calculated using Ivlev's (1961) formula.

$$S = (C_i - A_i) / (C_i + A_i)$$

Where,

S = Selectivity Index

C_i = Proportion of utilized tree species

A_i = Proportion of available tree species in environment

This selectivity index ranges from + 1 to - 1. Tree species with near + 1 are utilized in much greater proportion than they are offered. Tree species with an index near zero are utilized in proportion to their availability. Species with an index - 1 are utilized well below the proportion offered. C_i and A_i may be expressed in terms of numbers, biomass or energy content.

3.3.3 Diet Composition of Spotted Owlet

Pellet: A compact mass composed of those undigested portions of a bird's food that have been retained in the stomach by a mechanical barrier for a period before being regurgitated and ejected through the mouth, rather than evacuated as faeces; sometimes described as 'castings'.

Many birds produce pellets. Owl pellets consist of the indigestible parts of birds food which are regurgitated. The diet of most owls consists mainly of insects and small mammals. The pellets accumulate at roosting sites and when analysed can be used as a good indicator of diet.

The nests and roosting sites of Spotted Owlet were identified to collect the regurgitated pellets from the ground. Diet composition of Spotted Owlet was studied by analysis of materials found in the pellets and the prey remains collected from the nest box and its vicinity. Active nests were visited at every 2 days interval to collect regurgitated pellets.

Methodology of Diet Composition of Spotted Owlet

- 1) Following three different sites in the University campus were selected to observe the diet composition of owlet and the variation/s if any.
 - a) Veterinary campus (In front of Hostel A)
 - b) Horticulture farm (B. A. College of Agriculture)
 - c) ECFP farm (Regional Research Station)

The birds were actually breeding at Horticulture and ECFP farm whereas at Veterinary campus they did not breed.

- 2) The pellets were collected from roosting site of the birds from January to May, 2008 at every 2 days interval, each pellet was kept separately in small polythene bags, labelled and brought to the laboratory.
- 3) Body parts of the insects present in the pellets were identified using taxonomic key. Detailed identification was verified by comparing the remains with sample specimens.

- 4) Insects were collected by using light trap and daily visit during night near the light source or street light.
- 5) Insect parts found in the pellets were counted to get a quantitative estimate. Each insect part found does not necessarily come from a different insect and so each head, cephalothorax was counted as one animal or spider respectively, number of spider and insect legs were divided by eight and six, elytra and paired wing by two; rounding up the fraction upwards.
- 6) Bony remains of small mammals and herpatofauna were identified with the help of taxonomist/s.
- 7) The numbers of identified food items in each pellet were recorded.

Pellets found just below the roosting site were considered to be that of adults only. The prey remains found within the cavity or just below the cavity were analyzed separately as 'prey remains in nest cavity' which probably belonged to the young ones.

Appendages of potential insect parts were photographed and it was used as a key to identify prey species from the pellet remains. Such an identification key is prepared for the first time.

3.3.4 Statistical Analysis

The following statistical tools were used for interpreting the data

- 1) Frequency (f_i) i.e. the frequency of a particular food component was the total number of pellets in which that particular food item was recorded.
- 2) *Per cent* frequency of occurrence (%F), i. e. the percentage of the frequencies related to the sum of frequencies.

$$\% F = \frac{f_i}{\sum_{i=1}^s X} \times 100$$

Where,

f_i is the frequency of the i^{th} food item in particular month.

n is the total number of food components.

- 3) Relative occurrence (% O): Percentage of the value of frequency of particular food item in total pellets.

$$\text{Occurrence (\%O)} = \frac{f_i}{n} \times 100$$

Where,

f_i = Frequency of a i^{th} food item

n = Total number of samples (Pellets)

- 4) Relative abundance of various taxa.

$$\% \text{ RA} = \frac{\text{No. of } i^{\text{th}} \text{ prey item}}{\text{Total no. of prey item}} \times 100$$

IV. RESULTS AND DISCUSSION

The present investigations on roost site characteristics and food habits of Spotted Owlet were carried out from January to May, 2008 at Anand Agricultural University campus and its surrounding areas. The results obtained are presented here under in following heads.

4.1 Roost site characteristics of Spotted Owlet

4.2 Diet composition of Spotted Owlet

4.1 ROOST SITE CHARACTERISTICS OF SPOTTED OWLET

The roosting behaviour of Spotted Owlet was monitored from January to May, 2008 at Anand Agricultural University campus and its surrounding areas consisting of cultivated fields and residential area having old trees grown on road side as avenue trees.

Fourty two roosting sites of Spotted Owlet were identified for the study and the results obtained are presented under.

The whole study area was arbitrarily classified into two different categories viz., (1) Residential area characterized by the presence of kitchen garden and roads having old avenue trees and (2) Agricultural area characterized by the presence of cultivable land on one or either sides of the roads with avenue trees.

4.1.1 Roosting tree species of Spotted Owlet

Table 4.1 shows that out of seventeen species of trees available within the study site only nine tree species were used by the owlet for roosting. The data revealed that nearly half (54.76%) of roosts were located exclusively in *Peltophorum* trees. Both Rain tree and Neem occupied 11.90% each while the other tree species with substantial

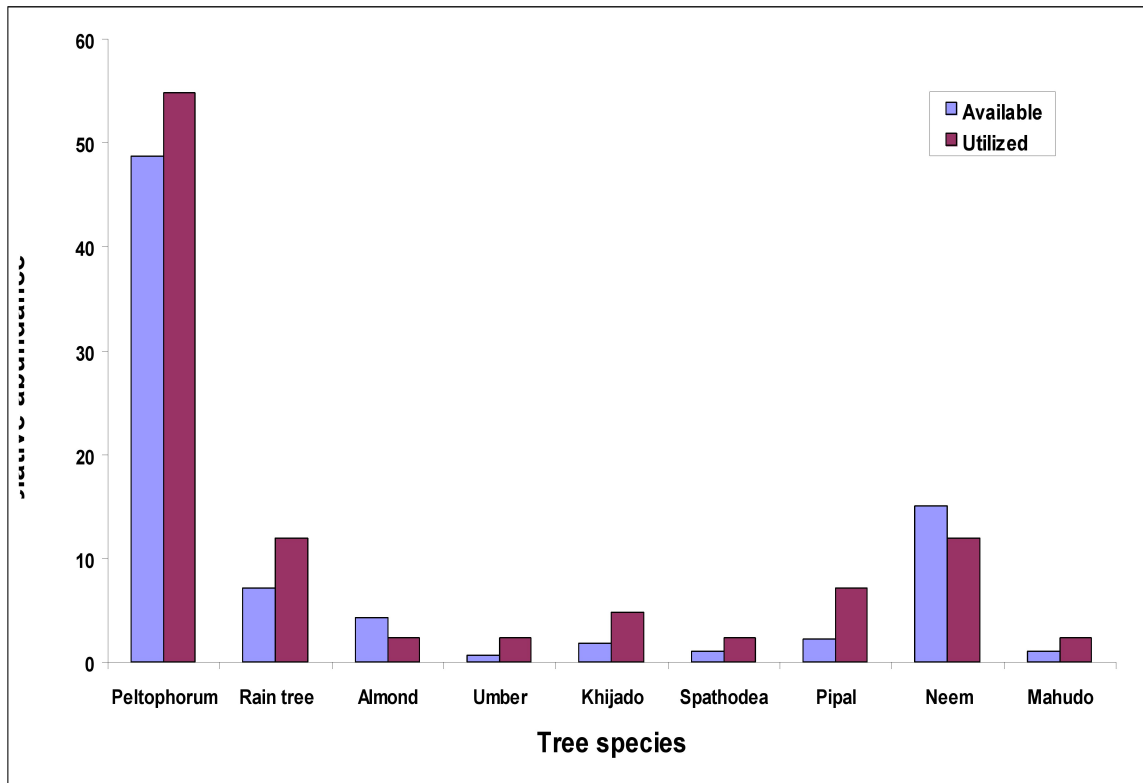
number of roosts were Pipal (7.14%) and Khijado (4.76%). One tree each of Almond, Umber, Mahudo and Spathodea contributed 2.38% of the roost sites.

Table: 4.1 Roosting tree Species of Spotted Owlet

| Sr. no. | Common name | Scientific name | Available trees | | Utilized trees | | Sel. index |
|--------------|-----------------|---------------------------------|-----------------|------------|----------------|------------|------------|
| | | | Num | % RA. | Num | % RA. | |
| 1 | Copper Pod Tree | <i>Peltophorum ferrungenium</i> | 136 | 48.74 | 23 | 54.76 | 0.05 |
| 2 | Rain Tree | <i>Samanea saman</i> | 20 | 7.16 | 5 | 11.90 | 0.25 |
| 3 | Almond | <i>Terminalia cattupa</i> | 12 | 4.30 | 1 | 2.38 | - 0.28 |
| 4 | Umber | <i>Ficus racimosa</i> | 2 | 0.71 | 1 | 2.38 | 0.54 |
| 5 | Khijado (Samdo) | <i>Prosopis cineraria</i> | 5 | 1.79 | 2 | 4.76 | 0.45 |
| 6 | Spathodea | <i>Spathodea campanulata</i> | 3 | 1.07 | 1 | 2.38 | 0.37 |
| 7 | Pipal | <i>Ficus religiosa</i> | 6 | 2.15 | 3 | 7.14 | 0.53 |
| 8 | Neem | <i>Azadirachta indica</i> | 42 | 15.05 | 5 | 11.90 | - 0.11 |
| 9 | Mahudo | <i>Madhuca indica</i> | 3 | 1.07 | 1 | 2.38 | 0.37 |
| 10 | Teak | <i>Tectona grandis</i> | 1 | 0.35 | - | - | - 1 |
| 11 | Champo | <i>Plumeria rubra</i> | 2 | 0.71 | - | - | - 1 |
| 12 | Ashok | <i>Polyalthia longi folia</i> | 20 | 7.16 | - | - | - 1 |
| 13 | Borsali | <i>Hymenodictyon excelsum</i> | 1 | 0.35 | - | - | - 1 |
| 14 | Mango | <i>Mangifera indica</i> | 14 | 5.01 | - | - | - 1 |
| 15 | Aonla | <i>Emblica officinalis</i> | 4 | 1.69 | - | - | - 1 |
| 16 | Drum stick | <i>Moringa oleifera</i> | 1 | 0.35 | - | - | - 1 |
| 17 | Palm | <i>Carpentaria acuminata</i> | 7 | 2.50 | - | - | - 1 |
| Total | | | 279 | 100 | 42 | 100 | |

Figure 4.1 shows a comparison of relative abundance of trees available and those utilized for roosting by the Spotted Owlet. The selectivity index of tree species like *Peltophorum* (0.05), Rain tree (0.25) and Khijado (0.45), *Spathodea* and Mahudo (0.37). The index for tree species like Almond -0.28 and neem -0.11 indicates that owlets had a selectivity index nearing zero for these trees and the bird utilized the tree species in proportion to their availability. The index of tree species like Umber (0.54) and Pipal (0.53) which neared + 1 shows that these tree species were utilized in much greater proportion than they were available. There were seventeen different tree species available within 50 m radius of surrounding area of the roost tree. Amongst them, there were 20 Ashok (7.16) and 14 Mango (5.01) trees available but non was utilised by owlets for roosting purpose which clearly indicated that owlets showed negative preference for these two tree species. Avoidance of these two tree species was perhaps due to the absence of cavities in tree species which were not old enough to form cavities. Spotted Owlet selected only old and mature trees for roosting purpose. The highest utilization of *Peltophorum* (48.74 %) and Neem (15.05%) might be due to their higher availability in the study area and it may not be a preference.

Fig: 4.1 Per cent relative abundance of different roosting tree species of Spotted Owlet



4.1.2 Characteristics of roost tree, roost and surrounding trees of Spotted Owlet

A total forty two roosting trees of Spotted Owlet were located during study period and a total of 34 trees within 5 m radius of the roost trees were marked and studied.

The characteristics of roost tree and surrounding trees are given in Table 4.2. The data revealed that the mean roost tree height was 12.90 ± 1.93 and it ranged from 8.35 to 16.1 m whereas the mean bole height was 3.04 ± 1.03 which ranged from 1.35 to 5.95 m. The mean CBH of roost tree was 2.63 ± 0.83 m and ranged from 1.3 to 5.1 m. The mean roost height of the perching site was found to be 6.95 ± 1.57 which ranged from 4 to 10

m, while the minimum roost height ranged from 3.3 to 9.6 m and maximum roost height ranged from 4.3 to 10.5 m. The mean distance of water from roost tree was 13.10 ± 6.42 m which ranged from 2.4 to 29 m whereas the mean distance of light from roost tree was 13.63 ± 7.36 m which ranged from 0.5 to 31 m.

Table: 4.2 Characteristics of roost tree, roost and surrounding trees for Spotted Owllet

| Characteristics | n | Min | Max | Mean \pm S. D. | S. E. | C. V. % |
|-----------------------------------|----|------|------|-------------------|-------|---------|
| Tree | | | | | | |
| Roost tree height (m) | 42 | 8.35 | 16.1 | 12.90 ± 1.93 | 0.29 | 14.96 |
| Bole height (m) | 42 | 1.35 | 5.95 | 3.04 ± 1.03 | 0.15 | 33.97 |
| CBH of roost tree (m) | 42 | 1.3 | 5.1 | 2.63 ± 0.83 | 0.12 | 31.84 |
| Roost | | | | | | |
| Roost height (m) | 42 | 4 | 10 | 6.95 ± 1.57 | 0.24 | 22.64 |
| Minimum roost height (m) | 42 | 3.3 | 9.6 | 6.25 ± 1.51 | 0.23 | 24.16 |
| Maximum roost height (m) | 42 | 4.3 | 10.5 | 7.57 ± 1.59 | 0.24 | 21.04 |
| Distance to Water (m) | 42 | 2.4 | 29 | 13.10 ± 6.42 | 0.99 | 48.37 |
| Distance to Light (m) | 42 | 0.5 | 31 | 13.63 ± 7.36 | 1.13 | 54.06 |
| Number of owl roosted | 42 | 1 | 6 | 2.70 ± 1.04 | 0.16 | 38.92 |
| Inter-owl distance (cm) | 42 | 5 | 60 | 23.33 ± 25.03 | 3.72 | 100.01 |
| Distance to next owl roost (m) | 42 | 7.8 | 330 | 126.2 ± 95.05 | 14.66 | 75.30 |
| Distance from nest (m) | 42 | 0.4 | 7 | 1.25 ± 1.04 | 0.22 | 115.8 |
| Detectibility rank (0-4) | 42 | 4 | 0 | 2.73 ± 1.56 | 0.24 | 57.07 |
| Possible human disturbances (0-4) | 42 | 2 | 0 | 0.35 ± 0.57 | 0.08 | 161.5 |
| Surrounding trees | | | | | | |
| Tree height (m) | 34 | 5.4 | 15.6 | 10.59 ± 2.59 | 0.44 | 24.50 |
| CBH (m) | 34 | 0.4 | 3.1 | 1.87 ± 0.69 | 0.11 | 37.19 |
| Number of Cavities | 34 | 3 | 1 | 1.4 ± 0.70 | 0.12 | 49.94 |

The mean tree height of surrounding areas was 10.59 ± 2.59 m and which ranged from 5.4 to 15.6 m and which was smaller as compared to the mean height of the roost tree. The mean CBH of surrounding trees was 1.87 ± 0.69 m and ranged from 0.4 to 3.1 m.

The mean number of owls roosted was 2.7 and their number ranged from 1 to 6. This indicates that at least one non-breeding owl remains with a breeding pair. Mean inter-owl distance was 23.33 ± 25.03 cm. Mean distance of next owl roost ranged from

7.8 to 300 m and the distance from the nest ranged from 0.4 to 7 m. In some cases, both the birds flew from the nest cavity. Obviously, the second bird might roost in the cavity along with its incubating mate. Most of the time, one bird guarded nest by sitting at 1 to 7 m distance either on the same tree or near by tree. Mean value of detectibility rank was 2.73 ± 1.56 while in case of possible human disturbances 0.35 ± 0.57 . In some occasions the owls roosting in the cavities were also observed. The owls roosting on tree branches were easily detectible from ground by human eyes. Canopy cover was not sufficient enough to conceal the owlets due to regular tree pruning activity. As a result, the owlets were frequently disturbed by House Crow (*Corvus splendens*), Common Myna (*Acridotheres tristis*) and Five-striped Squirrel (*Finnambulus pinnantii*). Human beings did not disturb the owlets directly though detected easily from the ground. However, they caused a serious damage to the roosting sites as well as nests by assorting to tree felling and pruning activity. These disturbances were so serious that the owlets were forced to shift their roosting sites. Roost site characteristics for *Athene brama indica* have not been reported earlier in the literature. However, According to Kumar (1985) from Hyderabad, the mean roost height of perching site for *Athene brama brama* was found to be 8.91 ± 2.68 m and ranged from 5.4 to 20.40 m. Hayward and Garton (1984) studied the roost habitat selection by three small forest owls at Idaho and reported that mean roost height of Boreal, Saw-whet and Screech Owl were 6.9 ± 0.60 m, 4.2 ± 0.64 m, 4.60 ± 1.46 m respectively. Barrows and Barrows (1978) studied roost characteristics and thermoregulation in Spotted Owlet (*Strix occidentalis*) at California and reported that the height of the roost above the ground ranged from 1.8 m to 7.5 m. Ganey *et al.* (2000)

studied the roost sites of Mexican Spotted Owls (*Strix occidentalis lucida*) at Arizona and reported that mean roost tree height was 15.2 m.

4.1.3 Comparison of roost site characteristics between residential and agricultural area

The roosting sites of the residential area (26) and agricultural area (16) used by owl during the study period were compared and the results are presented in Table 4.5.

The comparison of roost site characteristics of Spotted Owllet between residential and agricultural areas (Table 4.3) revealed that average tree height of residential area was higher (13.34 ± 1.45 m) as compared to the tree height (12.28 ± 2.43 m) of agriculture area but this difference was not significant when compared with “t” test

Table: 4.3 Comparison of residential and agricultural habitat of Spotted Owllet

| Characteristics | Residential Habitat | | Agricultural Habitat | | Cal T | Result |
|--|---------------------|------------------|----------------------|------------------|--------|--------|
| | n | Mean \pm S. D. | n | Mean \pm S. D. | | |
| Tree | | | | | | |
| Roost tree height (m) | 26 | 13.34 \pm 1.45 | 16 | 12.28 \pm 2.43 | 0.11 | NS |
| Bole height (m) | 26 | 2.71 \pm 0.71 | 16 | 3.58 \pm 1.25 | 0.18 | NS |
| CBH of roost tree (m) | 26 | 2.55 \pm 0.69 | 16 | 2.77 \pm 1.04 | 0.04 | NS |
| Roost | | | | | | |
| Roost height (m) | 26 | 7.25 \pm 1.60 | 16 | 6.47 \pm 1.44 | 0.07 | NS |
| Minimum roost height (m) | 26 | 6.6 \pm 1.51 | 16 | 5.69 \pm 1.36 | 0.09 | NS |
| Maximum roost height (m) | 26 | 7.87 \pm 1.52 | 16 | 7.08 \pm 1.63 | 0.08 | NS |
| Distance to Water (m) | 26 | 13.08 \pm 7.34 | 16 | 13.12 \pm 5.73 | 0.0007 | NS |
| Distance to Light (m) | 26 | 12.57 \pm 6.52 | 16 | 14.85 \pm 9.17 | 0.05 | NS |
| Table T at 40 d.f. = 2.021 P = 0.05 | | | | | | |

($t = 0.11$, $df = 40$, $P > 0.05$). CBH and Bole height of roost tree in agricultural area was higher (3.58 ± 1.25 and 2.77 ± 1.04 m) as compared to the residential area (2.71 ± 0.71 and 2.55 ± 0.69 m). Roost height, maximum and minimum roost height of residential area was higher (7.25 ± 1.60 m, 6.6 ± 1.51 m and 7.87 ± 1.52 m) as compared to the agriculture area (6.47 ± 1.44 m, 5.69 ± 1.36 m and 7.08 ± 1.63 m). However there were no significant

differences in the roosting tree and roost site characteristics of Spotted Owllet between residential and agricultural area. Similarity in roost site characteristics of Spotted Owllet in residential and agricultural area might be due to similar tree species present in the study area.

4.1.4 Comparison of roost site characteristics of breeding and non-breeding Spotted Owllets

Thirty two roosting sites were of breeding birds while ten roosting sites were of non-breeding birds during the study period. Summary of the results obtained are presented under.

The comparison of roost site characteristics between breeding and non-breeding Spotted Owllet are presented in Table 4.4 and revealed that roost height, minimum and maximum roost height, distance to water and light in non-breeding Spotted Owllet was higher as compared to breeding Spotted Owllet. There were no significant differences in the roost site characteristics between breeding and non-breeding Spotted Owllet. The non-significant difference between breeding and non-breeding pair might be due to the similar tree species present in the study area, leading to non-choice condition.

4.4 Comparison of breeding and non-breeding sites of Spotted Owllet

| Characteristics | Breeding site | | Non breeding site | | Cal T | Result |
|--|---------------|--------------|-------------------|--------------|-------|--------|
| | n | Mean ± S. D. | N | Mean ± S. D. | | |
| Tree | | | | | | |
| Roost tree height (m) | 32 | 12.83 ± 2.21 | 10 | 13.55 ± 1.22 | 0.59 | NS |
| Bole height (m) | 32 | 3.15 ± 1.11 | 10 | 2.72 ± 0.68 | 0.29 | NS |
| CBH of roost tree (m) | 32 | 2.63 ± 0.89 | 10 | 2.64 ± 0.68 | 0.30 | NS |
| Roost | | | | | | |
| Roost height (m) | 32 | 6.95 ± 1.69 | 10 | 6.97 ± 1.21 | 0.42 | NS |
| Minimum roost height (m) | 32 | 6.25 ± 1.60 | 10 | 6.27 ± 1.26 | 0.40 | NS |
| Maximum roost height (m) | 32 | 7.54 ± 1.73 | 10 | 7.69 ± 1.12 | 0.44 | NS |
| Distance to Water (m) | 32 | 12.26 ± 5.98 | 10 | 16.6 ± 7.01 | 0.10 | NS |
| Distance to Light (m) | 32 | 13.54 ± 7.23 | 10 | 13.91 ± 8.21 | 0.19 | NS |
| Table T at 40 d.f. = 2.021 P = 0.05 | | | | | | |

4.1.5 Comparison of characteristics of tree species used for roosting by the Spotted Owllet

The nine different tree species were used by the Spotted Owllet for the roosting purpose during the study period and the results obtained are presented in the following heads.

Table 4.5 revealed that the mean tree height of nine different tree species was 11.94 m and the bole height was 3.35 m. The mean CBH of roost tree was 2.81 m whereas the mean roost height was 6.49 m and the mean minimum roost height and maximum roost height was 5.71m and 7.08 m, respectively.

There were nine different tree species used by the Spotted Owllet among them the Spathodea had highest tree height (15.80), roost height (8.6) and maximum roost height (9.2) as compared to others such as Peltophorum, Rain tree, Almond, Umber, Samdo, Pipal, Neem and Mahudo whereas the bole height of Khijado (5.25) was higher as compared to others.

Table: 4.5 Roost site characteristics of different tree species of Spotted Owllet

| Characte ristics | Peltop horum (23)* | Rain tree (5) | Almo nd (1) | Umber (1) | Sam do (2) | Spat odea (1) | Pipal (3) | Neem (5) | Mahudo (1) | Average (42) |
|------------------------------|--------------------------|---------------------|-------------------|--------------|------------------|---------------------|--------------|-------------|---------------|-----------------|
| Tree height (m) | 13.36 | 13.2 | 8.7 | 11.3 | 10.97 | 15.8 | 12.97 | 12.7 2 | 8.4 | 11.94 |
| Bole height (m) | 2.67 | 3.48 | 2 | 2.5 | 5.25 | 3.75 | 3.43 | 3.26 | 3.8 | 3.35 |
| CBH of tree (m) | 2.44 | 2.37 | 1.4 | 3.7 | 3.5 | 2.8 | 4.73 | 2.32 | 2 | 2.81 |
| Roost height (m) | 7.30 | 7 | 6.3 | 6.4 | 5.5 | 8.6 | 6.47 | 6.67 | 4.2 | 6.49 |
| Min. roost height (m) | 6.60 | 6.46 | 5.35 | 5.5 | 4.6 | 7.4 | 5.63 | 6.09 | 3.8 | 5.71 |
| Max. roost height (m) | 7.93 | 7.46 | 6.9 | 7.2 | 6.1 | 9.2 | 7.02 | 7.47 | 4.4 | 7.08 |

* Figures in parenthesis is sample size

The roost height was minimum in Mahudo (4.2) as compared to others. As seen in this study Kumar (1985) from Hyderabad also reported that the height of the roosting site differed from tree to tree and also reported that Spotted Owlet seems to prefer the 6.75 to 10.75 m height range, on 66.2% occasions the birds were observed to roost on this height range hence the optimal height for the roosting in this area may be 9 m.

4.1.6 Number of owls roosted during breeding and non-breeding season

The roosting behaviour of Spotted Owlet was monitored from January 2007 to May 2008. The study was conducted over one and half year, though the data gathering was largely confined from January to May 2008. The mean number of owls roosted during the non-breeding season was 3.79 whereas the mean number of owls roosted during breeding season was 2.7. During breeding season, number of roosting birds at breeding site was 2.63 birds and at non-breeding sites the number of roosting bird was 2.83.

During the non-breeding season the number of owls roosted was higher as compared to the breeding season. The values suggest that during non-breeding season, entire family might be roosting together on a same tree branch. During the breeding season, the adults might be getting engaged in breeding activity but previous years young ones (sub-adult) might be hanging around. We could not determine whether extra bird around breeding pair was helping them.

4.2 DIET COMPOSITION OF SPOTTED OWLET

The nest and roosting sites of Spotted Owlet were identified to collect the regurgitated pellets from the ground. The diet composition of the Spotted Owlet was studied by analysis of the material found in the pellets and the prey remains collected from the nest cavity and its vicinity. The pellets found just below the roosting site were considered to be that of adults only. The prey remains found within the cavity or just below the cavity were analyzed separately. These prey remains might have been brought by the parents to feed the young ones and hence analysed separately as 'Prey remains in nest cavity'.

223 pellets of Spotted Owlet were collected from three different localities of University campus as shown in Table 4.6.

Table: 4.6 Number of Spotted Owl pellets collected from three locations of Anand Agricultural University

| No. | Locality | No. of pellets examined |
|-----|--------------------------|-------------------------|
| 1. | Veterinary campus, Anand | 77 |
| 2. | Horticulture farm, Anand | 75 |
| 3. | E. C. F. P. farm, Anand | 71 |
| | Total | 223 |

4.2.1 Diet composition of Spotted Owlet at Veterinary campus

A total of 77 pellets were examined from veterinary campus. A summary of the prey items recovered is presented in Table 4.7. Amongst the prey items, numerically insects were most dominant food item (96.55%) eaten by the owlet as compared to the vertebrates (3.45%). Amongst the insects, Orthoptera (54.28%) and Coleoptera (36.35%) were most preferred orders followed by Dermaptera (4.61%), Hymenoptera (0.99%) and

unidentified insects (0.33%). Mole cricket *Gryllotalpa africana* was the only species of Orthoptera having 54.28% relative abundance.

Table: 4.7 Diet composition of Spotted Owlet at Veterinary campus (n = 77)

| Prey taxa | No. of items | Rel. abundance (%) | Fre. occurrence (fi) | Rel. occurrence (% O) | Fre. occurrence (%F) |
|---------------------------------|--------------|--------------------|----------------------|-----------------------|----------------------|
| Insects | 587 | 96.55 | | | 91.32 |
| Orthoptera | | | | | |
| <i>Gryllotalpa africana</i> | 330 | 54.28 | 72 | 93.51 | 32.88 |
| Coleoptera | | | | | |
| <i>Agriotes</i> sp | 63 | 10.36 | 31 | 40.26 | 14.16 |
| <i>Maladera</i> sp. | 50 | 8.22 | 12 | 15.58 | 5.48 |
| <i>Allecula</i> sp. | 41 | 6.74 | 21 | 27.27 | 9.59 |
| <i>Scarite Indus</i> | 18 | 2.96 | 16 | 20.78 | 7.31 |
| <i>Pentodon bispinifrons</i> | 17 | 2.80 | 10 | 12.99 | 4.57 |
| <i>Schizonycha ruficollis</i> | 16 | 2.63 | 9 | 11.69 | 4.11 |
| <i>Spyrathus</i> sp. | 7 | 1.15 | 7 | 9.09 | 3.20 |
| <i>Adoretus</i> sp. | 5 | 0.82 | 3 | 3.90 | 1.37 |
| <i>Onthophagus bonasus</i> | 2 | 0.33 | 2 | 2.60 | 0.91 |
| <i>Holotrichia serrata</i> | 1 | 0.16 | 1 | 1.30 | 0.46 |
| <i>Myllabris postolata</i> | 1 | 0.16 | 1 | 1.30 | 0.46 |
| Dermaptera | | | | | |
| <i>Labidura reparaia</i> | 28 | 4.61 | 11 | 14.29 | 5.02 |
| Hymenoptera | | | | | |
| Wasp | 6 | 0.99 | 2 | 2.60 | 0.91 |
| Unidentified insects | 2 | 0.33 | 2 | 2.60 | 0.91 |
| Vertebrate | 24 | 3.45 | | | 8.68 |
| Mammals | 21 | 2.96 | | | 7.31 |
| Rats and Mice | | | | | |
| Rodentia | 17 | 2.51 | 15 | 19.48 | 6.86 |
| <i>Mus booduga</i> | 1 | 0.16 | 1 | 1.30 | 0.46 |
| <i>Mus</i> sp. | 7 | 1.15 | 5 | 6.49 | 2.28 |
| <i>Mus musculus</i> | 4 | 0.38 | 4 | 5.19 | 1.83 |
| <i>Rattus</i> sp. | 1 | 0.16 | 1 | 1.30 | 0.46 |
| Unidentified Rodentia | 4 | 0.66 | 4 | 5.19 | 1.83 |
| Bats | | | | | |
| Chiroptera | 1 | 0.16 | 1 | 1.30 | 0.46 |
| Unidentified Vertebrates | 3 | 0.49 | 3 | 3.90 | 1.37 |
| Total | 608 | 100 | | | 100 |

Amongst the Coleopterans, Click beetle *Agriotes* sp. (10.36%) and *Maladera* sp. (8.22%) were dominant components of diet. Vertebrates contributed only 3.45% of the diet, with the dominance of rodents. Relative occurrence (%O) of the insects was dominated by Orthoptera (93.51%) followed by Coleoptera (70.12%) in which followed by *Agriotes* sp. (40.26%), *Allecula* sp. (27.27%), *Scarite indus* (20.78%), *Maladera* sp. (15.58%), *Pentodon bispinifrons* (12.99%) etc. were predominant. This group was followed by Dermaptera (14.29%), Hymenoptera (2.60%), and unidentified insects (2.60%). Amongst vertebrates, Rodentia were predominant (19.48%) followed by unidentified vertebrates (3.90%) and Chiroptera (1.30%) (Table 4.7 and 4.8).

Per cent relative frequencies of occurrence (%F) indicate that insects (91.32%) occupy most preferred position which mainly constitutes Orthoptera, Coleoptera, Dermaptera, Hymenoptera and Unidentified insects whereas mammals occupied 7.31% and Unidentified vertebrate 1.37%.

4.2.2 Importance of various animal taxa in diet composition at Veterinary campus

Analysis of seventy seven pellets of Spotted Owlet collected from the roosting sites of the owl at Veterinary campus is shown up to order level and presented in Table 4.8 and Fig. 4.2. The relative abundance of insects belonging to various orders were as follows: Orthoptera 54.28%, Coleoptera 36.35%, Dermaptera 4.61%, Hymenoptera 0.99%, Unidentified insects 0.33%; whereas in mammals, Rodentia contributed 2.80%, Chiroptera (0.16%) and Unidentified vertebrates (0.49%).

The relative occurrence (%O) of insect orders like Orthoptera (93.50%), Coleoptera (70.12%), was very high as compared to Dermaptera (14.28%), Hymenoptera

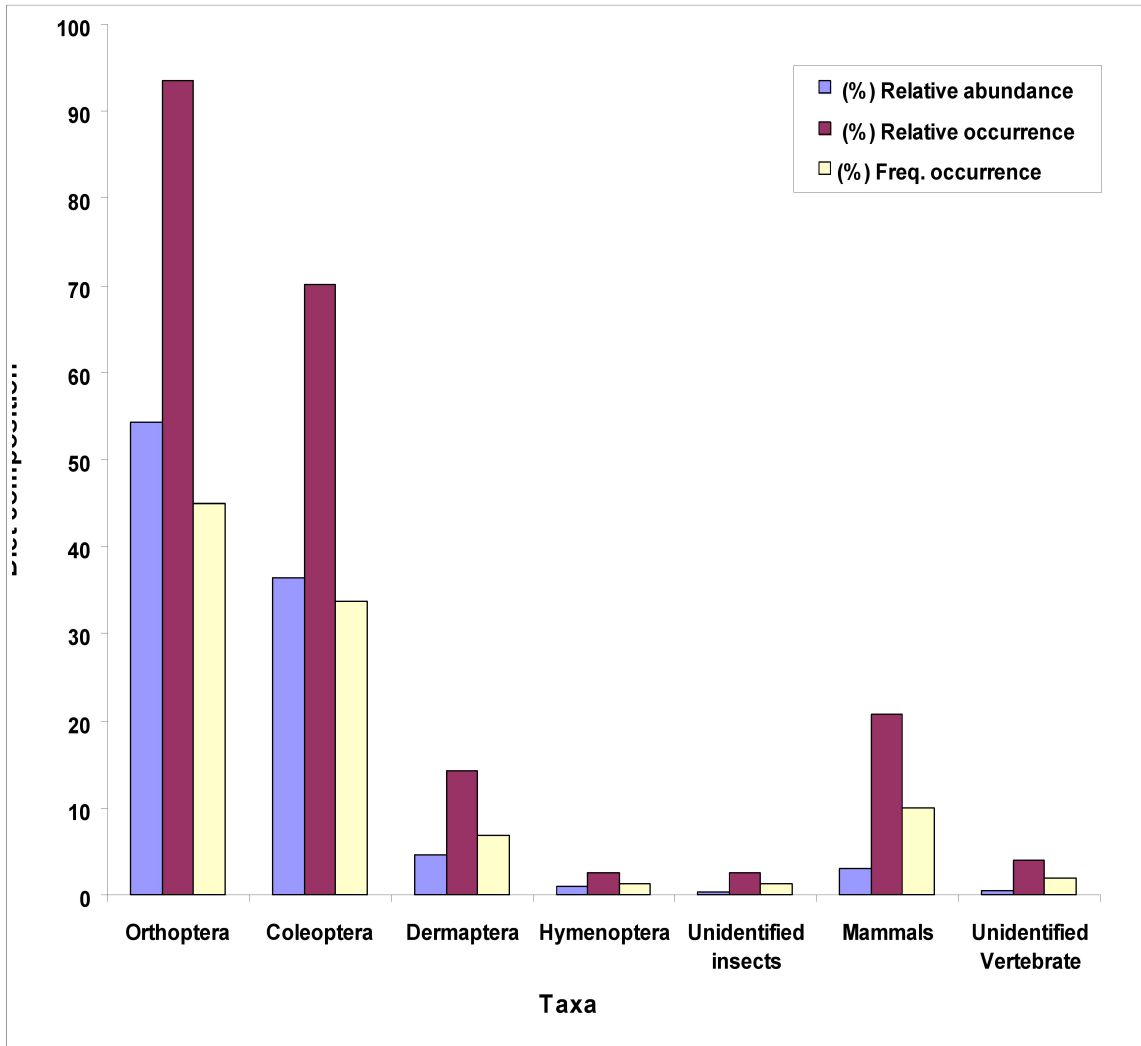
(2.59%) and unidentified insects (2.59%). In mammals Rodentia contributed 19.48%, Chiroptera 1.30% and Unidentified vertebrate 3.90% to the pellets.

Table: 4.8 Significance of different animal taxa in diet compositions of Spotted Owlet at Veterinary campus (n = 77)

| Order | No. of items | Rel. abundance (%) | Freq. of occurrence (fi) | Rel. occurrence (%O) | Freq. occurrence (%F) |
|--------------------------|---------------------|---------------------------|---------------------------------|-----------------------------|------------------------------|
| Insects | | | | | |
| Orthoptera | 330 | 54.28 | 72 | 93.5 | 45.00 |
| Coleoptera | 221 | 36.35 | 54 | 70.12 | 33.75 |
| Dermaptera | 28 | 4.61 | 11 | 14.28 | 6.87 |
| Hymenoptera | 6 | 0.99 | 2 | 2.59 | 1.25 |
| Unidentified insects | 2 | 0.33 | 2 | 2.59 | 1.25 |
| Mammals | | | | | |
| Rodentia | 17 | 2.80 | 15 | 19.48 | 9.38 |
| Chiroptera | 1 | 0.16 | 1 | 1.30 | 0.63 |
| Unidentified Vertebrates | 3 | 0.49 | 3 | 3.90 | 1.88 |
| Total | 608 | 100 | | | 100 |

The *per cent* relative frequency of occurrence (%F) indicate that Orthoptera (45.00%) occupied most preferred position followed by Coleoptera (33.75%), Dermaptera (6.87%), Hymenoptera (1.25%) and unidentified insects (1.25%), whereas the *per cent* relative frequency of mammals was fairly high. Amongst them, Rodentia (9.38%) was most predominant taxa followed by Chiroptera (0.63%) while that of unidentified vertebrates (1.88%) was quite low.

Fig. 4.2 Diet composition of Spotted Owlet at Veterinary campus (n = 77)



4.2.3 Diet composition of Spotted Owlet at Horticulture farm

75 pellets collected from Horticulture farm were examined and the summary of prey items identified is presented in Table 4.9.

Numerical analysis showed that the relative abundance of insects (97.44%) occupied most preferred position whereas small mammals (1.41%) and unidentified vertebrates (1.14%) were negligible. In case of insects, Coleoptera was most preferred

Table: 4.9 Diet composition of Spotted Owlet at Horticulture farm (n = 75)

| Prey taxa | No. of items | Rel. abundance (%) | Fre. occurrence (fi) | Rel. occurrence (% O) | Fre. occurrence (%F) |
|---------------------------------|--------------|--------------------|----------------------|-----------------------|----------------------|
| Insects | 685 | 97.44 | | | 93.13 |
| Orthoptera | | | | | |
| <i>Gryllotalpa africana</i> | 235 | 33.43 | 63 | 84.00 | 24.05 |
| Coleoptera | | | | | |
| <i>Agriotes</i> sp | 115 | 11.36 | 38 | 50.67 | 14.50 |
| <i>Maladera</i> sp. | 47 | 6.69 | 14 | 18.67 | 5.34 |
| <i>Allecula</i> sp. | 67 | 9.53 | 31 | 41.33 | 11.83 |
| <i>Scarite Indus</i> | 9 | 1.28 | 9 | 12.00 | 3.44 |
| <i>Pentodon bispinifrons</i> | 26 | 3.70 | 16 | 21.33 | 6.11 |
| <i>Schizonycha ruficollis</i> | 21 | 2.99 | 11 | 14.67 | 4.20 |
| <i>Spyrathus</i> sp. | 22 | 3.13 | 11 | 14.67 | 4.20 |
| <i>Adoretus</i> sp. | 1 | 0.14 | 1 | 1.33 | 0.38 |
| <i>Onthophagus bonasus</i> | 5 | 0.71 | 5 | 6.67 | 1.91 |
| <i>Anomela bengalensis</i> | 4 | 0.57 | 1 | 1.33 | 0.38 |
| <i>Myllocerus discolour</i> | 1 | 0.14 | 1 | 1.33 | 0.38 |
| Dermaptera | | | | | |
| <i>Labidura reparaia</i> | 122 | 17.35 | 34 | 45.33 | 12.48 |
| Hymenoptera | | | | | |
| Wasp | 1 | 0.14 | 1 | 1.33 | 0.38 |
| Unidentified insects | 9 | 1.28 | 9 | 10.67 | 3.05 |
| Vertebrate | 18 | 2.55 | | | 6.87 |
| Mammals | 10 | 1.41 | | 12.00 | 3.43 |
| Rats and Mice | | | | | |
| Rodentia | 9 | 1.28 | 8 | 10.67 | 3.05 |
| <i>Mus booduga</i> | 6 | 0.85 | 5 | 6.67 | 1.91 |
| <i>Mus</i> sp. | 2 | 0.28 | 2 | 2.67 | 0.76 |
| <i>Mus musculus</i> | 1 | 0.14 | 1 | 1.33 | 0.38 |
| Shrew | | | | | |
| <i>Suncus murinus</i> | 1 | 0.14 | 1 | 1.33 | 0.38 |
| Unidentified Vertebrates | 8 | 1.14 | 8 | 12.00 | 3.44 |
| Total | 703 | 100 | | | 100 |

order which mainly constituted *Agriotes* sp. (11.36%), *Maladera* sp. (6.69%), *Pentodon bispinifrons* (3.70%), etc. Orthoptera (33.43%) and Dermaptera (17.35%) had high relative abundance value whereas unidentified insects (1.28%) and Hymenoptera (0.14%) had very low relative abundance.

Amongst the insects, Orthoptera (84%), had highest relative occurrence (%O) followed by Coleoptera 82.67% amongst them *Agriotes* sp. (50.67%), *Allecula* sp. (41.33%), *Pentodon bispinifrons* (21.33%) and *Maladera* sp. (18.67%), Dermaptera (45.33%), unidentified insects (10.67%) and Hymenoptera (1.33%). At least 11 species of Coleopterans were consumed by the owlet. Both mammals and unidentified vertebrates occurred in 12.00% samples (Table 4.10).

Value of Relative frequency (%F) indicate that insects (93.13%) occupied most preferred position which mainly constitutes Orthoptera, Coleoptera, Dermaptera, Unidentified insects and Hymenoptera; whereas mammals had 3.43% and unidentified vertebrates had 3.44% relative frequency (%F) values. Amongst the species %F value was highest of *Gryllotalpa africana* (24.05%) followed by *Agriotes* sp. (14.50%), *Labidura reparaia* (12.48%) and *Allecula* sp. (11.83%). Other insects and vertebrate species had very a low relative frequency (%F) value.

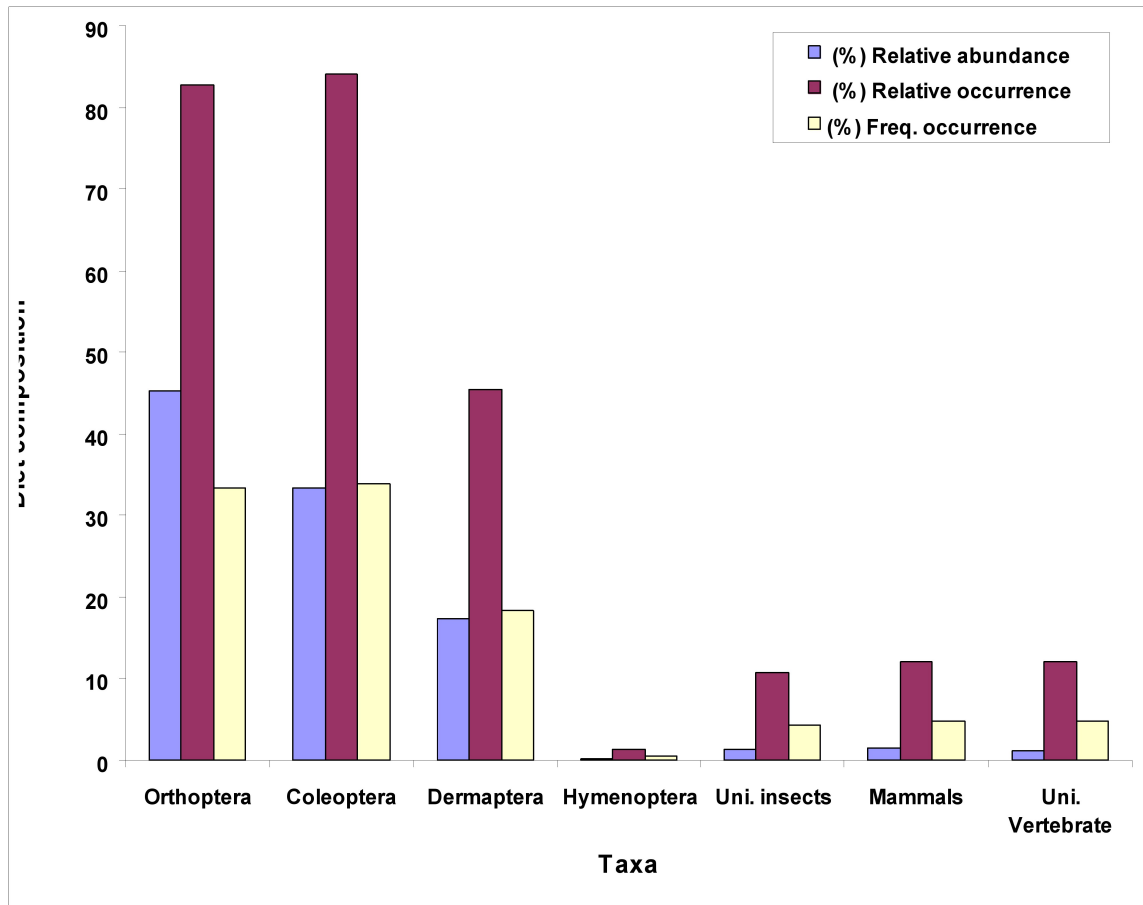
4.2.4 Importance of various animal taxa in diet composition at Horticulture farm

Table 4.10 and Fig. 4.3 shows that amongst the prey items, insects were the most dominant food item eaten by owlet as compared to the others. Data presented in Table 4.10 show that the value of relative abundance (%) was highest for Coleoptera followed by Orthoptera, Dermaptera, unidentified vertebrates, mammals, unidentified insects and Hymenoptera. The frequency of occurrence, relative occurrence and relative frequency was highest for Orthoptera followed by Coleoptera. Other insect orders and vertebrates had very low significance in the diet of owlets.

Table: 4.10 Significance of different animal taxa in diet compositions of Spotted Owlet at Horticulture farm (n = 75)

| Order | No. of items | Rel. abundance (%) | Fre. occurrence (fi) | Relative occurrence (%O) | Fre. occurrence (%F) |
|------------------|--------------|--------------------|----------------------|--------------------------|----------------------|
| Insects | | | | | |
| Orthoptera | 235 | 33.43 | 63 | 84 | 33.87 |
| Coleoptera | 318 | 45.23 | 62 | 82.67 | 33.33 |
| Dermaptera | 122 | 17.35 | 34 | 45.33 | 18.28 |
| Hymenoptera | 1 | 0.14 | 1 | 1.33 | 0.54 |
| Uni. insects | 9 | 1.28 | 9 | 12 | 4.3 |
| Mammals | | | | | |
| Rodentia | 9 | 1.28 | 8 | 10.67 | 4.30 |
| Insectivora | 1 | 0.14 | 1 | 1.33 | 0.54 |
| Uni. vertebrates | 8 | 1.14 | 8 | 10.67 | 4.30 |
| Total | 703 | 100 | | | 100 |

Fig. 4.3 Significance of different animal taxa in diet compositions of Spotted Owlet at Horticulture farm



4.2.5 Diet composition of Spotted Owlet at E. C. F. P. farm

A total of 71 pellets were collected and examined from ECFP farm. The results summarized in Table 4.11 show that insects (95.44%) formed major component of the

Table: 4.11 Diet composition of Spotted Owlet at E. C. F. P farm (n = 71)

| Prey taxa | No. of items | Rel. abundance (%) | Fre. occurrence (fi) | Rel. occurrence (% O) | Fre. occurrence (%F) |
|---------------------------------|--------------|--------------------|----------------------|-----------------------|----------------------|
| Insects | 502 | 95.44 | | | 88.44 |
| Orthoptera | | | | | |
| <i>Gryllotalpa africana</i> | 198 | 37.64 | 58 | 81.69 | 29.29 |
| Coleoptera | | | | | |
| <i>Agriotes</i> sp | 60 | 11.41 | 19 | 26.76 | 9.55 |
| <i>Maladera</i> sp. | 10 | 1.90 | 5 | 7.04 | 2.51 |
| <i>Allecula</i> sp. | 9 | 1.71 | 6 | 8.45 | 3.02 |
| <i>Scarite indus</i> | 12 | 2.28 | 8 | 11.27 | 4.02 |
| <i>Pentodon bispinifrons</i> | 25 | 4.75 | 16 | 22.54 | 8.04 |
| <i>Schizonycha ruficollis</i> | 19 | 3.61 | 10 | 14.08 | 5.03 |
| <i>Spyrathus</i> sp. | 1 | 0.19 | 1 | 1.41 | 0.50 |
| <i>Adoretus</i> sp. | 1 | 0.19 | 1 | 1.41 | 0.50 |
| <i>Onthophagus bonasus</i> | 5 | 0.95 | 3 | 4.23 | 1.51 |
| <i>Holotrichia serrata</i> | 3 | 0.57 | 2 | 2.82 | 1.00 |
| Dermaptera | | | | | |
| <i>Labidura reparaia</i> | 150 | 8.52 | 38 | 53.52 | 19.19 |
| Hymenoptera | | | | | |
| Wasp | 1 | 0.19 | 1 | 1.41 | 0.50 |
| Unidentified insects | 8 | 1.52 | 8 | 11.27 | 4.04 |
| Vertebrate | 24 | 4.56 | | | 11.56 |
| Mammals | 16 | 3.04 | | | 7.54 |
| Rats and Mice | | | | | |
| Rodentia | 13 | 2.47 | 12 | 16.90 | 6.03 |
| <i>Mus booduga</i> | 5 | 0.95 | 4 | 5.63 | 2.01 |
| <i>Mus</i> sp. | 4 | 0.76 | 4 | 5.63 | 2.01 |
| <i>Mus musculus</i> | 2 | 0.38 | 2 | 2.82 | 1.01 |
| <i>Rattus</i> sp. | 1 | 0.19 | 1 | 1.41 | 0.50 |
| Unidentified Rodentia | 1 | 0.19 | 1 | 1.41 | 0.50 |
| Shrew | | | | | |
| <i>Suncus murinus</i> | 1 | 0.19 | 1 | 1.41 | 0.50 |
| Bats | | | | | |
| Chiroptera | 2 | 0.38 | 2 | 2.82 | 1.01 |
| Unidentified Vertebrates | 8 | 1.52 | 8 | 11.27 | 4.02 |
| Total | 526 | 100 | | | 100 |

diet whereas small mammals (3.04%) and unidentified vertebrate (1.52%) formed a minor component. Amongst the species, relative abundance of only *Gryllotalpa africana* (37.64%), *Agriotes* sp. (11.41%) and *Labidura reparaia* (8.52%) were dominant.

Relative occurrence (%O) of insects was very high which was mainly attributed to Orthoptera (81.69%), Coleoptera (59.15%) and Dermaptera (53.52), while mammals comprised of *Mus booduga* (5.63%), *Mus musculus* (2.82%) but the unidentified vertebrates (11.27%) occurred at relatively low frequency (Table 4.12).

Relative frequency (%F) indicated that insects (88.44%) occupied the most preferred position which mainly consisted of Coleoptera, Orthoptera, Dermaptera, unidentified insects and Hymenoptera. Small mammals (7.54%) and unidentified vertebrate (4.02%) had a low relative frequency.

4.2.6 Importance of various animal taxa in diet composition at E. C. F. P farm

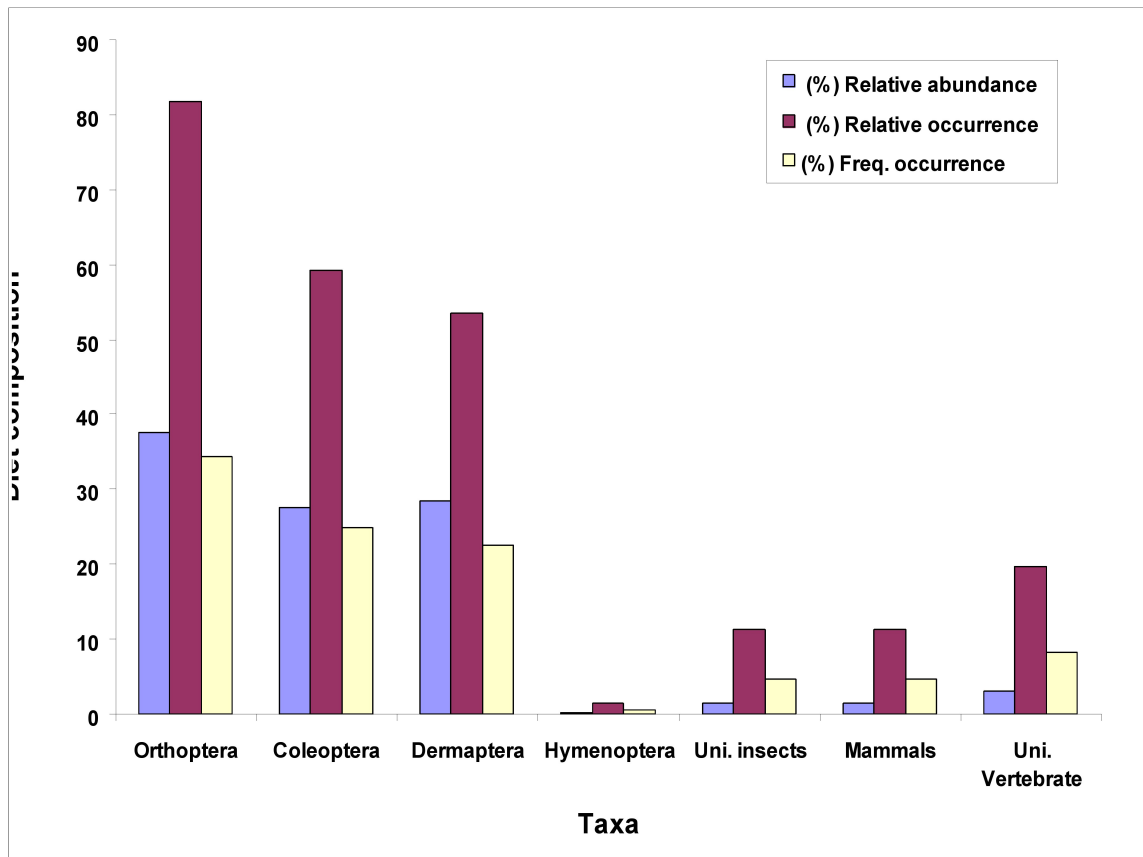
Results presented in Table 4.12 and Fig. 4.4 show that the value of relative abundance, relative occurrence and relative frequency was highest for Orthoptera

Table: 4.12 Significance of different animal taxa in diet compositions of Spotted Owlet at E. C. F. P. farm

| Order | No. of items | RA (%) | Fre. occurrence (fi) | Rel. occurrence (%O) | Freq. occurrence (%F) |
|------------------|--------------|------------|----------------------|----------------------|-----------------------|
| Insects | | | | | |
| Orthoptera | 198 | 37.64 | 58 | 81.69 | 34.31 |
| Coleoptera | 145 | 27.57 | 42 | 59.15 | 24.8 |
| Dermaptera | 150 | 28.52 | 38 | 53.52 | 22.48 |
| Hymenoptera | 1 | 0.19 | 1 | 1.4 | 0.59 |
| Uni. insects | 8 | 1.52 | 8 | 11.26 | 4.73 |
| Mammals | | | | | |
| Rodentia | 13 | 2.47 | 12 | 16.90 | 7.10 |
| Chiroptera | 2 | 0.38 | 1 | 1.41 | 0.59 |
| Insectivora | 1 | 0.19 | 1 | 1.41 | 0.59 |
| Uni. vertebrates | 8 | 1.52 | 8 | 11.26 | 4.73 |
| Total | 526 | 100 | | | 100 |

followed by Coleoptera, Dermaptera, unidentified vertebrates, mammals, unidentified insects and Hymenoptera in the descending order.

Fig. 4.4 Significance of different animal taxa in diet compositions of Spotted Owlet at E. C. F. P. farm



4.2.7 Pooled results of overall diet composition at Anand

223 pellets examined from all the three locations of the University campus are presented in Table 4.13. Amongst the prey items, insects (96.57%) were most dominant food item eaten by owlet as compared to the micro mammals (2.40%) and unidentified vertebrates (1.03%). The relative abundance of insects (96.57%) was highest which mainly constituted Orthoptera (41.54%), Coleoptera (37.23%), and Dermaptera (16.33%); while small mammals (2.40%) and unidentified vertebrate (1.03%) had very

Table: 4.13 Diet compositions of Spotted Owlet at all three locations (n = 223)

| Prey taxa | No. of items | Rel. abundance (%) | Fre. occurrence (fi) | Rel. occurrence (% O) | Fre. occurrence (%F) |
|-------------------------------|---------------------|---------------------------|-----------------------------|------------------------------|-----------------------------|
| Insects | 1774 | 96.57 | | | 91.46 |
| Orthoptera | | | | | |
| <i>Gryllotalpa africana</i> | 763 | 41.54 | 193 | 86.55 | 28.42 |
| Coleoptera | | | | | |
| <i>Agriotes</i> sp | 238 | 12.96 | 88 | 39.46 | 12.96 |
| <i>Maladera</i> sp. | 107 | 5.82 | 31 | 13.90 | 4.57 |
| <i>Allecula</i> sp. | 117 | 6.37 | 58 | 26.01 | 8.54 |
| <i>Scarite Indus</i> | 39 | 2.12 | 33 | 14.80 | 4.86 |
| <i>Pentodon bispinifrons</i> | 68 | 3.70 | 42 | 18.33 | 6.19 |
| <i>Schizonycha ruficollis</i> | 56 | 3.05 | 30 | 13.45 | 4.42 |
| <i>Spyrathus</i> sp. | 30 | 1.63 | 19 | 8.52 | 2.80 |
| <i>Adoretus</i> sp. | 7 | 0.38 | 5 | 2.24 | 0.74 |
| <i>Onthophagus bonasus</i> | 12 | 0.65 | 11 | 4.93 | 1.62 |
| <i>Holotrichia serrata</i> | 4 | 0.22 | 3 | 1.35 | 0.41 |
| <i>Anomela bengalensis</i> | 4 | 0.22 | 1 | 0.45 | 0.15 |
| <i>Myllabris postulata</i> | 1 | 0.05 | 1 | 1.45 | 0.15 |
| <i>Myllocerus discolour</i> | 1 | 0.05 | 1 | 1.45 | 0.15 |
| Dermaptera | | | | | |
| <i>Labidura reparaia</i> | 300 | 16.33 | 83 | 37.22 | 12.22 |
| Hymenoptera | | | | | |
| Wasp | 8 | 0.44 | 4 | 1.79 | 0.59 |
| Unidentified insects | 19 | 1.03 | 18 | 8.07 | 2.65 |
| Vertebrate | 63 | 3.52 | | | 8.54 |
| Mammals | 44 | 2.40 | | 17.49 | 5.74 |
| Rats and Mice | | | | | |
| Rodentia | 39 | 2.12 | 35 | 15.70 | 5.15 |
| <i>Mus booduga</i> | 12 | 0.65 | 10 | 4.48 | 1.47 |
| <i>Mus</i> sp. | 13 | 0.71 | 11 | 4.93 | 1.62 |
| <i>Mus musculus</i> | 7 | 0.38 | 7 | 3.14 | 1.03 |
| <i>Rattus</i> sp. | 2 | 0.11 | 2 | 0.90 | 0.29 |
| Unidentified Rodentia | 5 | 0.27 | 5 | 2.24 | 0.74 |
| Shrew | | | | | |
| <i>Suncus murinus</i> | 2 | 0.11 | 2 | 0.90 | 0.29 |
| Bats | | | | | |
| Chiroptera | 3 | 0.16 | 2 | 0.90 | 0.29 |
| Unidentified Vertebrates | 19 | 1.03 | 19 | 8.52 | 2.80 |
| Total | 1837 | 100 | | | 100 |

low relative abundance. Amongst individual prey items, relative abundance of *Gryllotalpa africana* (41.54%) was highest followed by *Labidura reparaia* (16.33%) and *Agriotes* sp. (12.96%). Only these three insect species contributed 70.83% of the owlet's diet. Though the owlet consumed total 13 species of Coleoptera, except Click beetle (*Agriotes* sp.), other species constituted very small proportion of its diet (Table 4.13 and 4.14).

The relative occurrence of insects mainly consisted of Orthoptera (86.55%), followed by Coleoptera (70.85%). Amongst the Coleopterans, *Agriotes* sp. (39.46%), *Allecula* sp. (26.01%), *Scarite indus* (14.20%), *Maladera* sp. (13.90%), *Pentodon bispinifrons* (18.33%) had substantial relative occurrence, followed by Dermaptera (37.22%), unidentified insects (8.07%) and Hymenoptera (1.79%). Mammals (17.49%) and unidentified vertebrate (8.52%) appeared at higher frequency in the pellets (Table 4.13 and 4.14).

Relative frequency of insects (91.46%) was also very high which mainly constituted Orthoptera, Coleoptera and Dermaptera. Though mammals (5.74%) and unidentified vertebrates (2.80%) had low relative frequency.

4.2.8 Diet composition of different taxa at all three locations (n = 223)

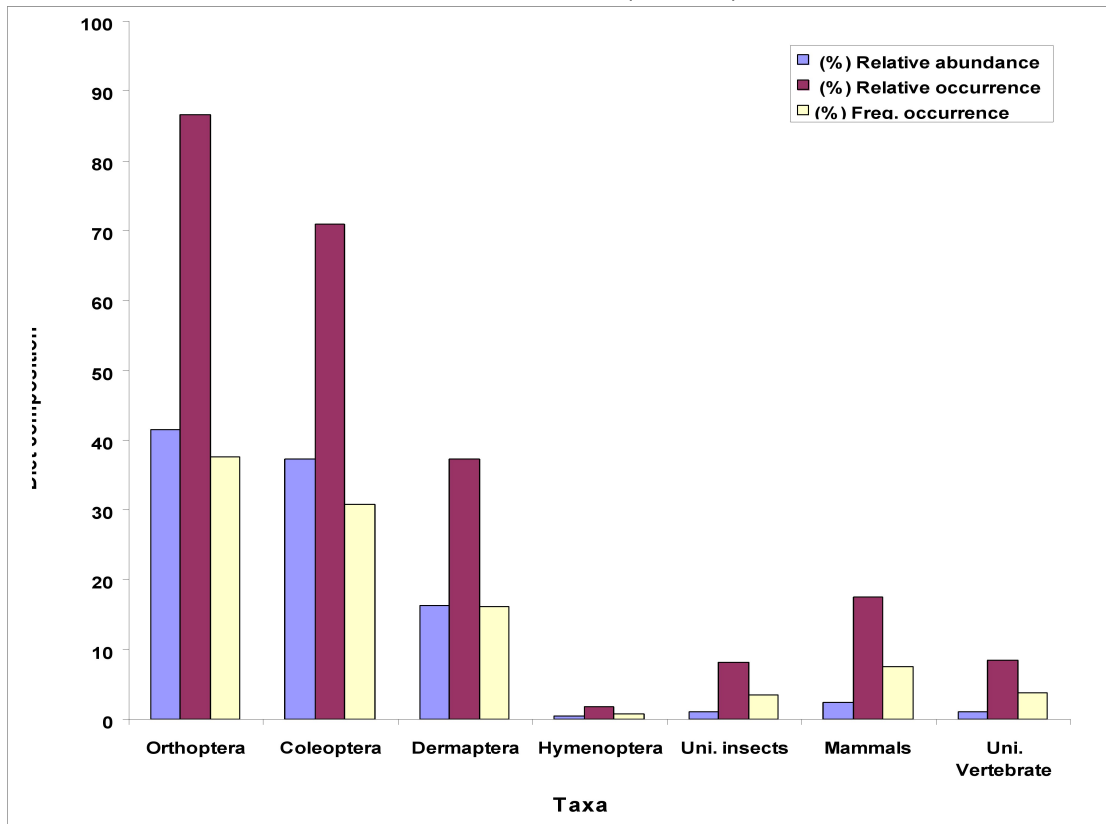
Pooled analysis of 223 pellets of Spotted Owlet collected from three locations at Anand, are presented in Table 4.14 and Fig. 4.5 shows that the value of relative abundance, frequency of occurrence, relative occurrence and relative frequency of all the parameters show that only few taxa were important in the diet of Spotted Owlet in descending order; Orthoptera, Coleoptera, Dermaptera and micro mammals. Unidentified

vertebrates, unidentified insects and Hymenoptera constituted very little to the diet of Spotted Owlet.

Table: 4.14 Significance of different animal taxa in diet compositions of Spotted Owlet at all three locations (n = 223)

| Order | No. of items | RA (%) | Frequency of occurrence (fi) | Relative occu. (%O) | Freq. occu. (%F) |
|-----------------|--------------|---------------|------------------------------|---------------------|------------------|
| Insects | | | | | |
| Orthoptera | 763 | 41.54 | 193 | 86.55 | 37.55 |
| Coleoptera | 684 | 37.23 | 158 | 70.85 | 30.74 |
| Dermaptera | 300 | 16.33 | 83 | 37.22 | 16.15 |
| Hymenoptera | 8 | 0.44 | 4 | 1.79 | 0.78 |
| Uni. insects | 19 | 1.03 | 18 | 8.07 | 3.5 |
| Mammals | | | | | |
| Rodentia | 39 | 2.12 | 35 | 15.70 | 6.81 |
| Chiroptera | 3 | 0.16 | 2 | 0.90 | 0.39 |
| Insectivora | 2 | 0.11 | 2 | 0.90 | 0.39 |
| Uni.vertebrates | 19 | 1.03 | 19 | 8.52 | 3.70 |
| Total | 1837 | 100.00 | | | 100 |

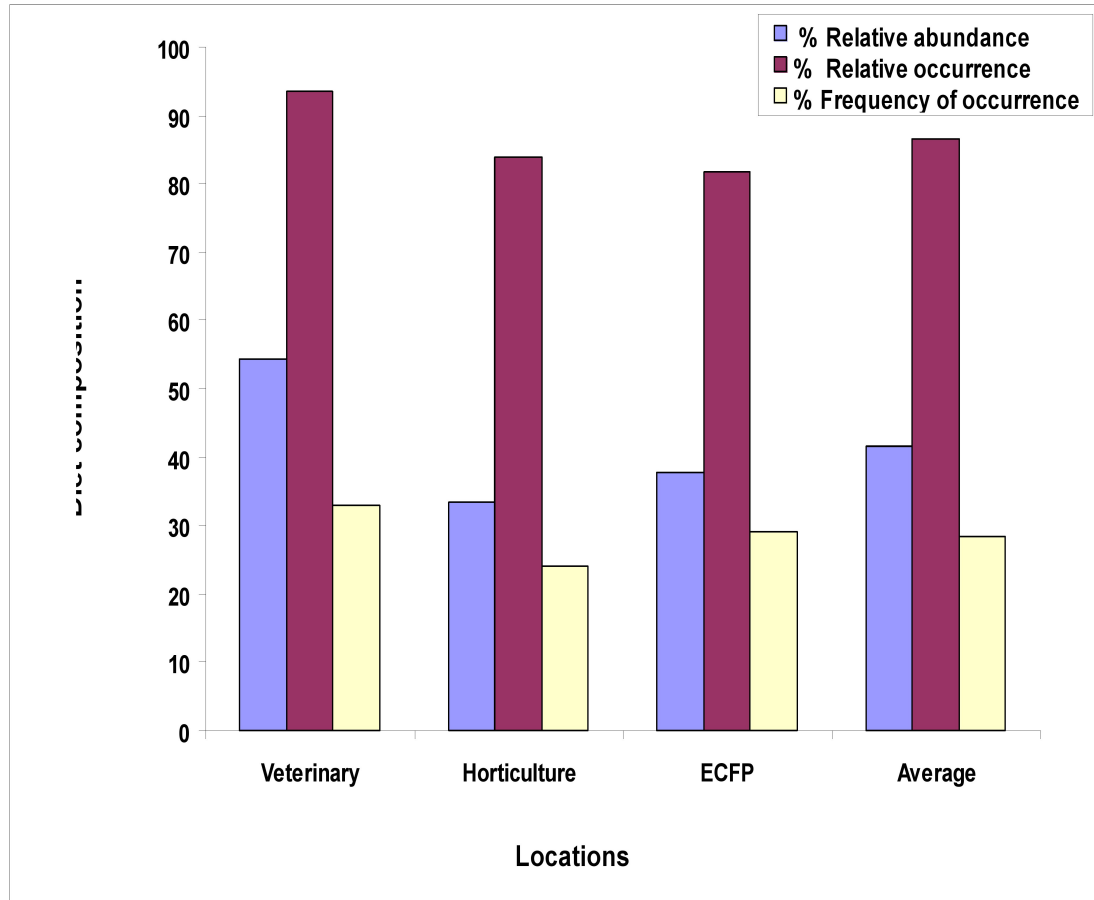
Fig. 4.5 Significance of different animal taxa in diet compositions of Spotted Owlet at all three locations (n = 223)



4.2.9 Importance of five major taxa in the diet

Numerically only five taxa were important in the diet of Spotted Owllet. A comparison of relative abundance, relative occurrence and % frequency of each taxa amongst 3 locations of the campus is discussed below.

Fig. 4.6 *Gryllotalpa africana* in the diet of Spotted Owllet at three different locations

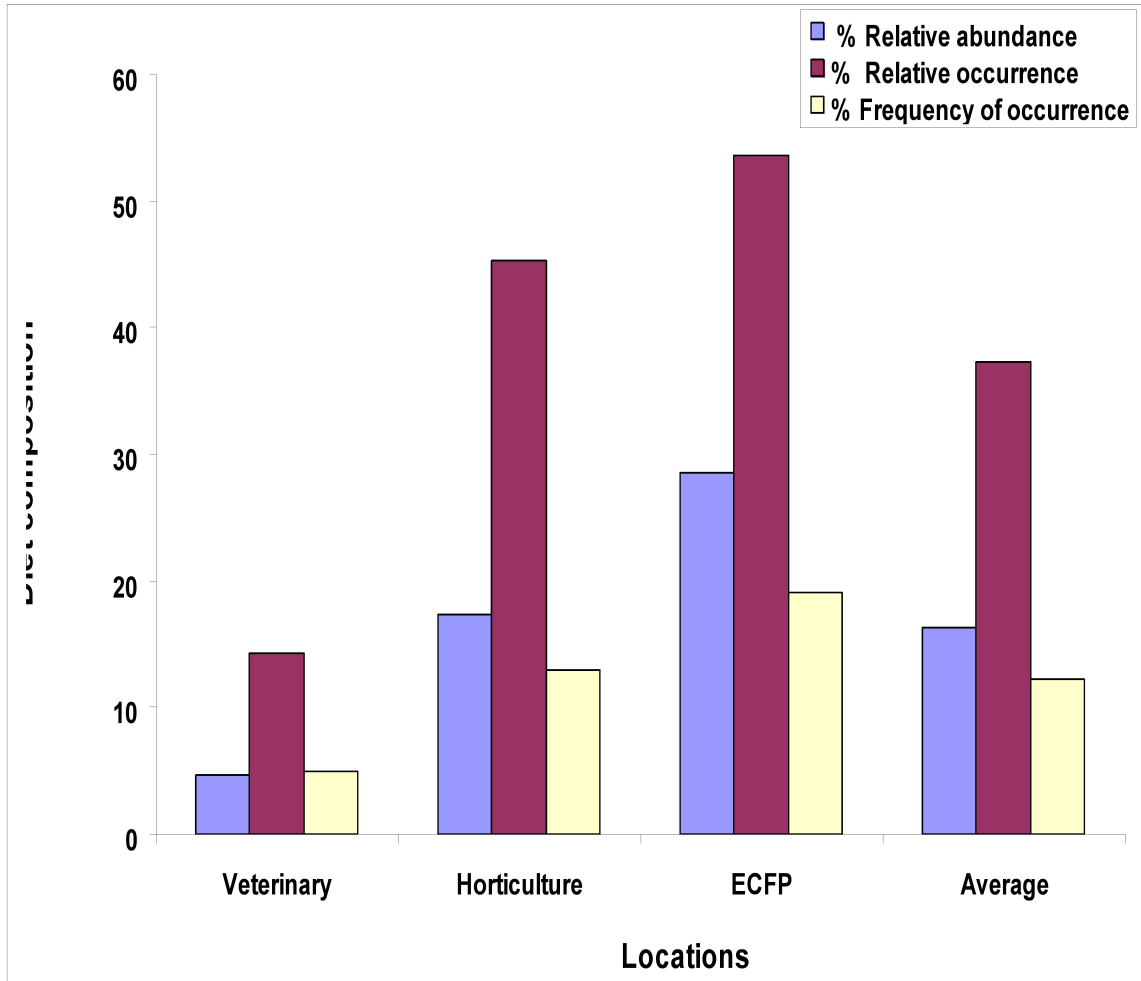


The mole cricket (*Gryllotalpa africana*) was the most important prey item in the diet of Spotted Owllet. Numbers of mole cricket found in the diet of Spotted Owllet at three locations were significantly different (Chi square - 36.79 at df12, $P < 0.01$) (Table 4.15).

Fig. 4.6 shows that the relative abundance (%) of mole cricket (*Gryllotalpa africana*) was highest in Veterinary campus followed by ECFP farm and Horticulture

farm, while the relative occurrence (%O) was higher at Veterinary campus followed by Horticulture and ECFP farm. On the basis of frequency of occurrence (fi) mole cricket was highest at Veterinary campus followed by ECFP and Horticulture farm.

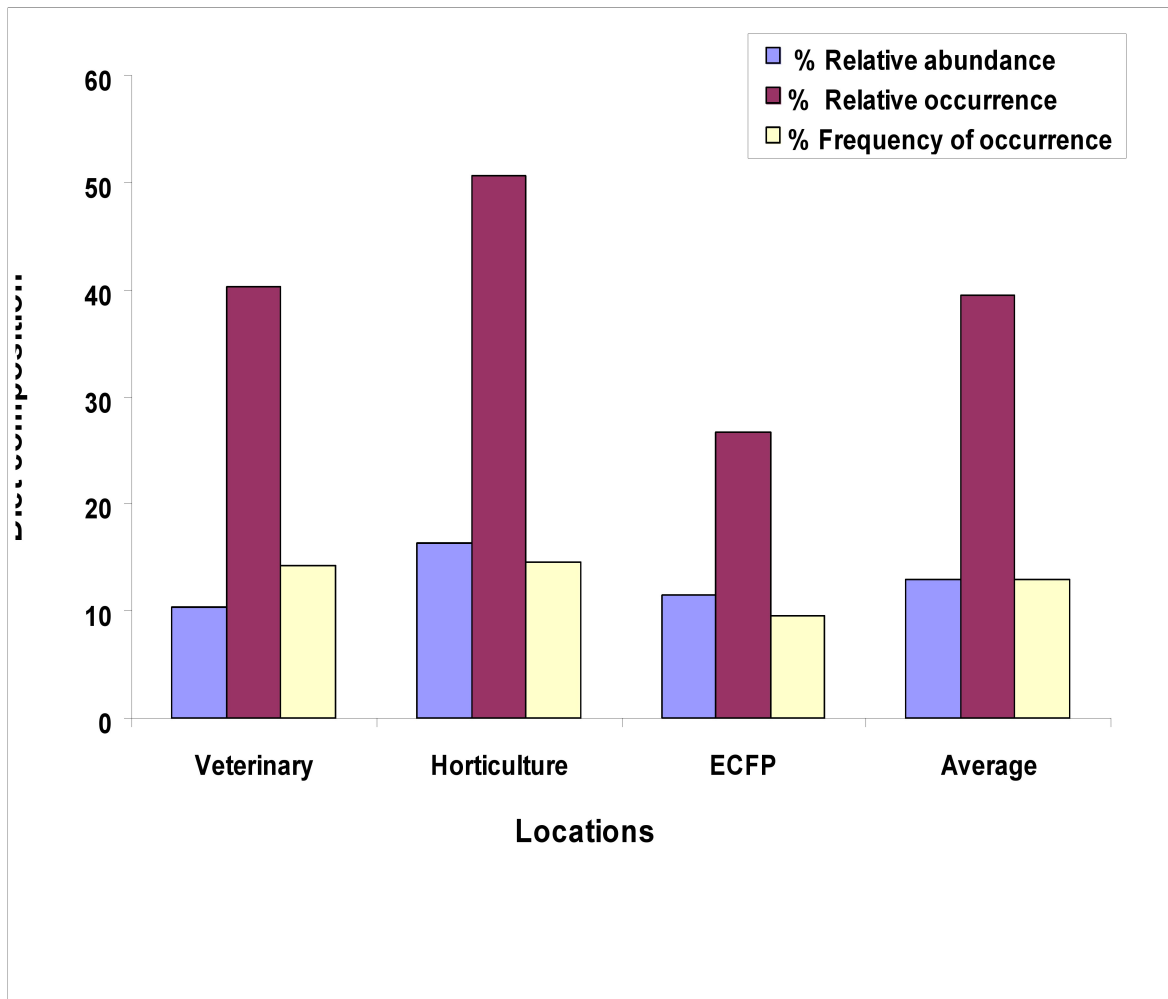
Fig. 4.7 *Labidura repara* in the diet of Spotted Owllet at three different locations



The earwig (*Labidura repara*) was second important insect prey in the diet of Spotted Owllet. Numbers of earwig found in the diet of Spotted Owllet at three locations were significantly different (Chi square - 99.46 at df12, $P < 0.01$) (Table 4.15).

Fig. 4.7 shows that relative abundance (%) of earwig (*Labidura repara*) was highest at ECFP farm followed by Horticulture farm and Veterinary campus. Relative occurrence (%O) and frequency of occurrence (fi) also followed the similar pattern.

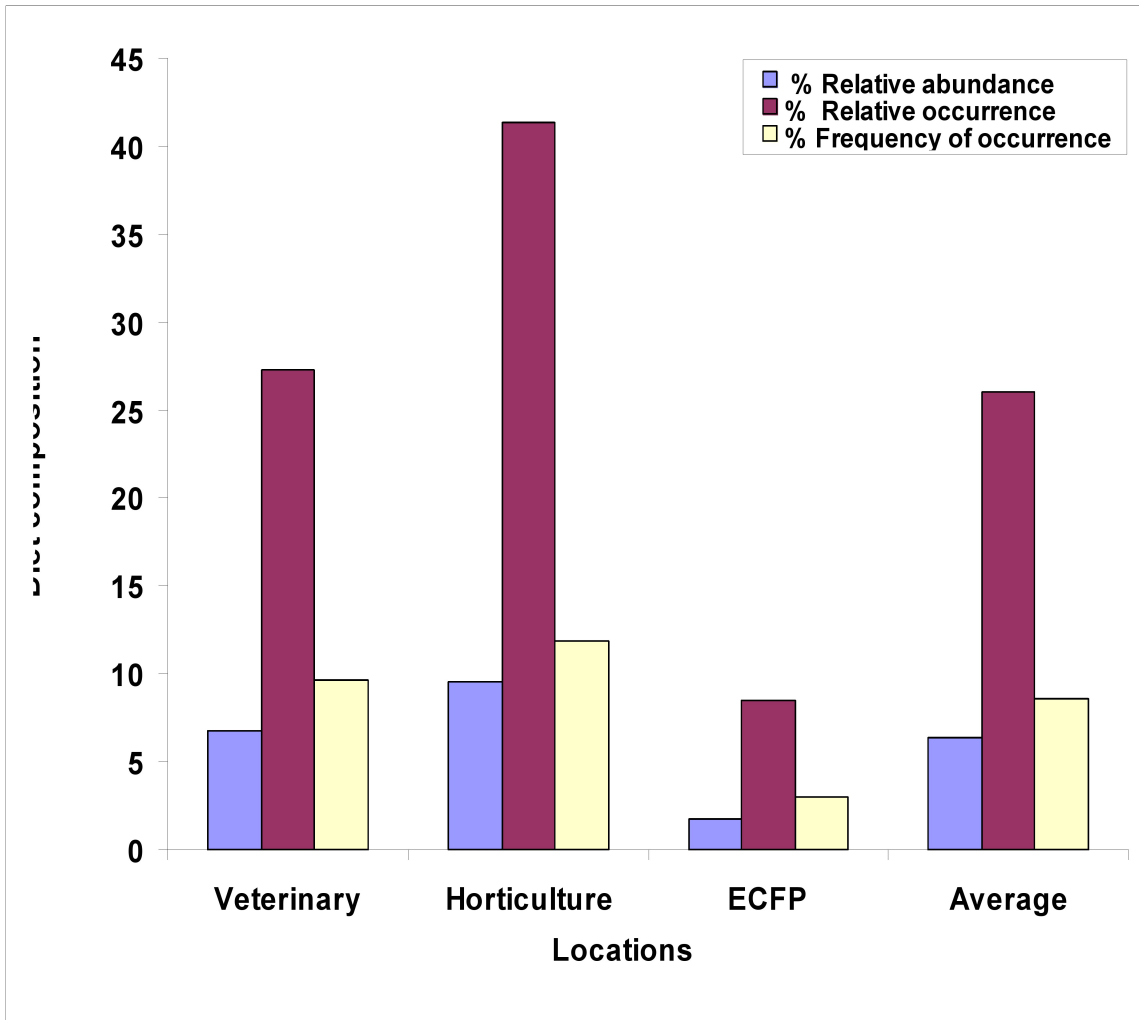
Fig. 4.8 *Agriotes* sp. in the diet of Spotted Owllet at three different locations



Numbers of Click beetle found in the diet of Spotted Owllet at three locations were significantly different (Chi square - 10.4 at df12, $P < 0.01$) (Table 4.15).

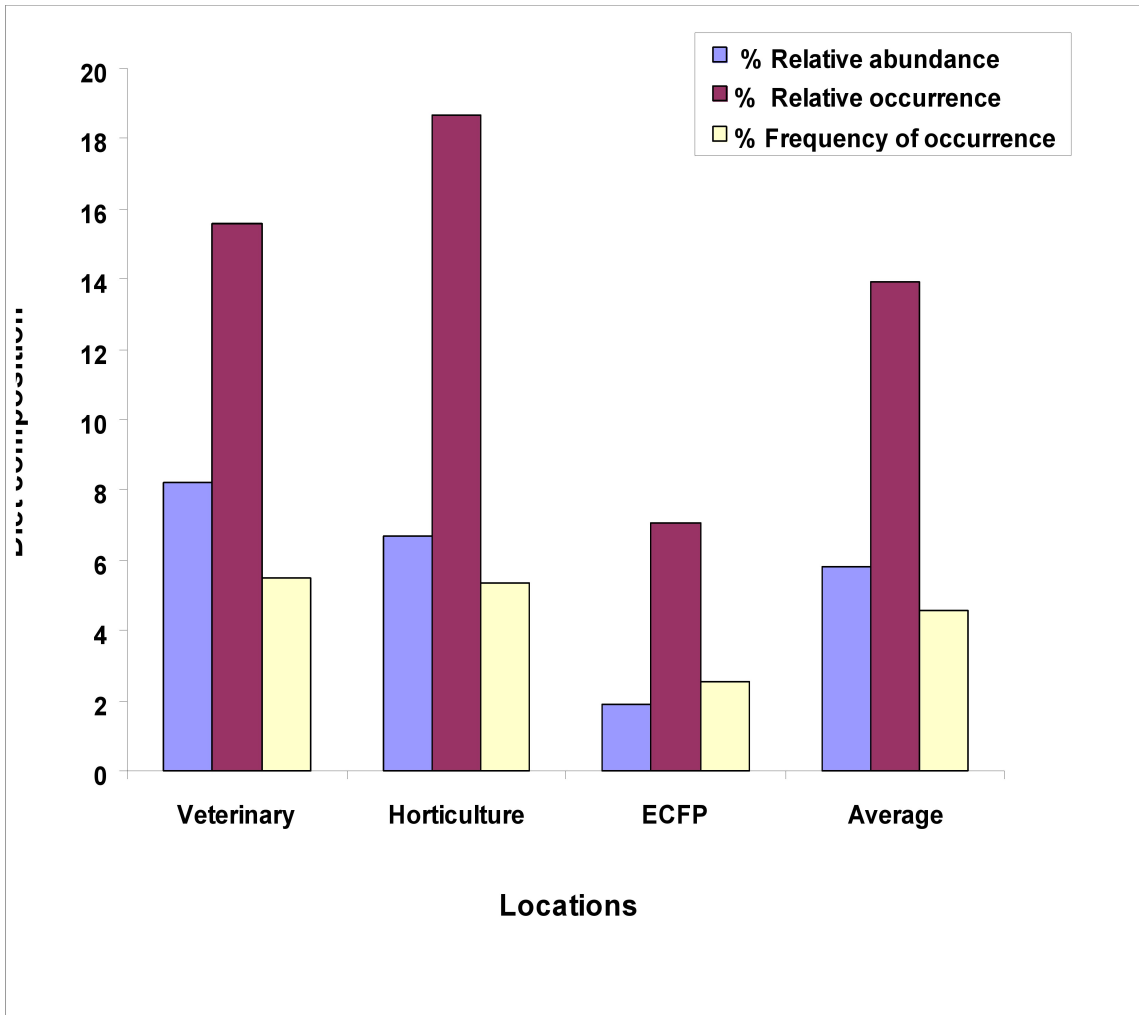
Fig. 4.8 shows that relative abundance (%) of Click beetle (*Agriotes* sp.) was higher at Horticulture farm followed by ECFP farm and Veterinary campus, whereas relative occurrence (%O) was higher at Horticulture farm followed by Veterinary campus and ECFP farm. Highest frequency of occurrence of Click beetle was at Horticulture farm followed by Veterinary campus and ECFP farm.

Fig. 4.9 *Allecula* sp. in the diet of Spotted Owllet at three different locations



Numbers of the *Allecula* sp. found in the diet of Spotted Owllet at three locations were significantly different (Chi square - 29.07 at df12, $P < 0.01$) (Table 4.15). Fig. 4.9 shows that relative abundance (%) and relative occurrence (%O) of *Allecula* sp. was higher at Horticulture farm followed by Veterinary campus and ECFP farm. Frequency of occurrence (fi) of *Allecula* sp. was highest at Horticulture farm followed by Veterinary campus and ECFP farm.

Fig. 4.10 *Maladera* sp. in the diet of Spotted Owllet at three different locations



Numbers of *Maladera* sp. found in the diet of Spotted Owllet at three locations were significantly different (Chi square - 20.79 at df12, $P < 0.01$) (Table 4.15).

Fig. 4.10 shows that relative abundance (%) of *Maladera* sp. was highest in Veterinary campus followed by Horticulture farm and ECFP farm, whereas relative occurrence (%O) was higher at Horticulture farm followed by Veterinary campus and ECFP farm. On the basis of frequency of occurrence (fi) the highest frequency was at Veterinary campus followed by Horticulture farm and ECFP farm.

Table: 4.15 The Chi-square test of frequency (number) of various prey items of Spotted Owlet at three different locations

| Location | Prey items | | | | | | | Chi-square value |
|--------------------------|--------------------|------------------|---------------------|---------------------|---------------------|-------------|--------------|--|
| | <i>G. africana</i> | <i>L.reparia</i> | <i>Agriotes</i> sp. | <i>Allecula</i> sp. | <i>Maladera</i> sp. | Others | Mammals | |
| Veterinary campus | 23.76 | 51.18 | 3.15 | 0.133 | 6.007 | 0.66 | 0.001 | 201.01 df = 2 P<0.01 |
| Horticulture farm | 11.12 | 0.45 | 6.28 | 11.03 | 0.89 | 0.14 | 1.54 | |
| E.C.F.P. farm | 1.91 | 47.83 | 0.97 | 17.91 | 13.9 | 0.19 | 1.96 | |
| Sum | 36.79 | 99.46 | 10.4 | 29.073 | 20.797 | 0.99 | 3.501 | |

The results of Table 4.15 shows that number of major prey items such as *Gryllotalpa africana*, *Labidura reparaia*, *Agriotes* sp., *Allecula* sp. and *Maladera* sp. were significantly different at three different locations; however other prey items and mammals were not significantly different.

Fig. 4.11 Weekly frequency of occurrence (fi) of major prey items in the diet of Spotted Owlet (Pooled data)

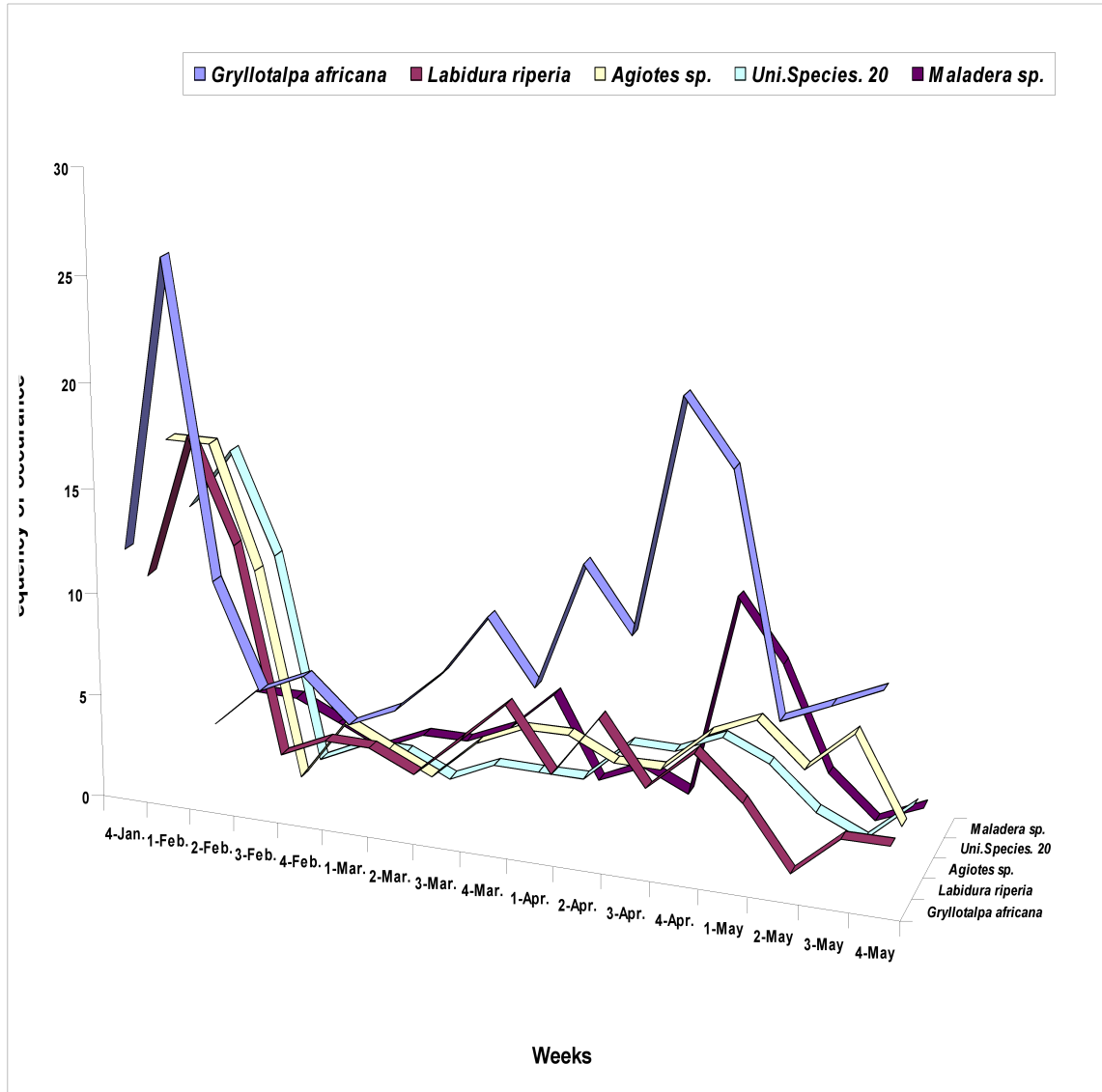


Fig. 4.11 shows week wise frequency of occurrence (fi) of major prey items. Among them, the highest frequency of *Gryllotalpa africana*, *Labidura reperia*, *Agriotes* sp. and *Allecula* sp. were in 1st week of February. Their frequency gradually decreased up to 4th week of April whereas the frequency of *Maladera* sp. was higher in 4th week of April and then gradually decreased.

Appendages of potential insect parts were photographed and it was used as a key to identify prey species from the pellet remains. Such an identification key is prepared for the first time.

Earlier studies carried out in India have reported insects as food were identified up to order level but in the present study we have identified them up to species level. A few species are being reported for the first time as a part of the diet of Spotted Owlet in India and given in Table 4.16.

Table: 4.16 New report of the dietary component of Spotted Owlet in India

| No. | Prey items | Order/ Family |
|-----|-------------------------------|---------------|
| 1. | <i>Gryllotalpa africana</i> | Orthoptera |
| 2. | <i>Agriotes sp.</i> | Elateridae |
| 3. | <i>Maladera sp.</i> | Melolonthinae |
| 4. | <i>Scarite indus</i> | Carabidae |
| 5. | <i>Pentodon bispinifrons</i> | Scarabaeinae |
| 6. | <i>Schizonycha ruficollis</i> | Melolonthinae |
| 7. | <i>Adoretus sp.</i> | Rutelinae |
| 8. | <i>Onthophagus bonasus</i> | Scarabaeinae |
| 9. | <i>Anomela bengalensis</i> | Rutelinae |
| 10. | <i>Allecula sp.</i> | Tenebrinidae |
| 11. | <i>Spyrathus sp.</i> | Tenebrinidae |
| 12. | <i>Labidura reparaia</i> | Dermaptera |
| 13. | <i>Mus booduga</i> | Muridae |
| 14 | <i>Suncus murinus</i> | Soricidae |
| 15 | <i>Bufo melanosticus</i> | Bufo |

4.2.10 Discussion

Predators often take more of some species of prey than the others and have an important effect on prey number and community structures. Body size of both predator and prey is an obvious factor that determines prey selection. Investigation on owl predation has shown that certain prey species are more likely to be eaten than others (Marti, 1974; Kolter, 1985).

The results of the present study show that *per cent* relative abundance of insects (96.57%) occupied most preferred position followed by small mammals (2.40%) while the major share of *per cent* relative frequency of occurrence was represented by insects (91.46%) and small mammals (5.74%) in the owls pellets collected during study period.

The data shows that Spotted Owlet of the present study area mainly depended on insects and small mammals. Of the former, the insect orders like Orthoptera, Coleoptera, and Dermaptera were the main sources of nutrients whereas the *Mus musculus*, *Mus booduga*, *Suncus murinus* were the most dominant amongst the latter. Thus, it is indicated that owlet mainly depends for its food on insects and small mammals. The role of Spotted Owlet in inhibiting rats and mice population is disputed, but it is thought to be mainly an insectivore species (Roberts, 1991).

It is well known that Spotted Owlet mainly depend on insects and to some extent on small mammals, particularly, rodents for their food. Jain and Advani (1981) reported that about (60%) of their food was composed of various types of insects like Hemiptera, Hymenoptera, and Coleoptera. Kumar (1985) reported that the mole cricket topped the list (29%) followed by grasshoppers (20.7%) field cricket (17.2%), field mouse (10.0%), amphibians (1.2%), etc. Mario and Boris (2004) gave the prey composition of Spotted

Owlet from Pond cherry. They reported that the basic food consisted of beetles (22.19%) and Hymenopterans (21.06%). Shah *et al.* (2004) reported that *per cent* relative frequency of occurrence of insects (47%) occupy the most preferred position followed by small mammals, birds, plant tissues and reptiles.

Heavy dependence of Spotted Owlet on the insects is perhaps because of their easy availability and universal presence. However, the raptor has to put in a lot more effort to gather small bits of biomass to fulfil its nutritional need. Heavy dependence of Spotted Owlet on insects for their food has been recorded by number of authors (Ali and Ripley, 1983; Akhtar, 1984; Maqbool, 1985; Beg *et al.*, 1990; Tariq *et al.*, 2003). The present findings are in accordance with earlier workers. Earlier studies carried out in India and Pakistan has reported insects as main food but the insects were identified up to order level only. In the present study, we have identified both insects and small mammals up to species level, because many of the insects consumed are also ‘pests’ of agricultural crops and therefore, the identification of insects to the species level is very important. Patel (1998) reported that the proportion of *Holotrichia serrata* was greater (83.58 to 85.57%) when samples were analysed from Anand indicating dominance of *Holotrichia serrata* whereas in present study the *Holotrichia serrata* occurred only in 1.35 % samples this is might be perhaps due to the cropping pattern was changed.

Undoubtedly, insects are the major constituents of the diet of Spotted Owlet. But sometimes they may exhibit opportunistic behaviour with respect to the selection of prey.

The results of present studies indicate that the presence of small mammals and unidentified vertebrates contribute a little amount of the total owl pellets. Amongst the small mammals, the best utilized prey item was the field mouse (*Mus booduga*). Shah and

Beg (2001) studied the food habits of the Spotted Owllet (*Athene brama*) inhabiting the croplands near Faisalabad, Pakistan. The major constituents of the pellets of the owl were 12 species of small mammals.

Mushtaq-ul-Hassan *et al.* (2003) reported that the most dominant prey item of the owl from Sheikhpua study area were the insects (63.68%) followed by small mammals, whereas the most dominant food item eaten by the owl at Faisalabad Pakistan were small mammals (47.36%) followed by insects (41.70%). This is perhaps due to the fact that a large quantity of biomass can be secured in a single attempt compared to the insects where a large numbers of attempts are needed to procure the same amount of food. The unidentified vertebrates were found in (2.80%) of the total pellets of the owl. This is perhaps due to some of vertebrates like reptiles and in amphibians like frogs are poisonous which may mimic the palatable ones.

The results of the Anand Agricultural University study area show that the insects and small mammals were the staples diet of the owl. The insect fauna in the diet of the campus owl is much richer, because it frequently forages around street lamps posts which attract a wide variety of insects in large numbers.

4.2.11 Prey remains in the nest cavity of Spotted Owllet

Thirteen nests were checked throughout the breeding season during 2008 for prey remains in the cavity, but only few nests had these prey remains. In the prey remains collected from the nest and its vicinity, some body parts of insects and vertebrates were collected. Some insects were identified by their body parts i.e. head region, limbs, etc.

The prey items comprising the food of Spotted Owllet are listed in Table 4.17.

Table: 4.17 Prey remains in the nest cavity

| No. | Prey items | Order/ Family |
|-----|------------------------------|---------------|
| 1. | <i>Onthophagus bonasus</i> | Scarabaeinae |
| 2. | <i>Anomela bengalensis</i> | Rutelinae |
| 3. | <i>Pentodon bispinifrons</i> | Scarabaeinae |
| 4. | Grasshopper | Orthoptera |
| 5. | Field cricket | Orthoptera |
| 6. | Cockroach | Dictyoptera |
| 7. | <i>Gryllotalpa africana</i> | Orthoptera |
| 8. | <i>Agriotes</i> sp. | Elateridae |
| 9. | <i>Bufo melanosticus</i> | Bufonidae |
| 10. | Bat | Chiroptera |
| 11. | Lizard | Lacertilia |
| 12. | <i>Suncus</i> sp. | Soricidae |
| 13. | <i>Suncus murinus</i> | Soricidae |

During the entire study one head capsule of *Onthophagus bonasus*, three fore legs, four hind leg and two elytra of *Anomela bengalensis* while fifteen elytra, nine fore leg and seven hind legs of *Pentodon bispinifrons* were collect from the nests. One hind leg of Grasshopper and field cricket was also present in nest cavity whereas several body parts of Cockroach were collected from the nest and its vicinity.

Two mandibles of mole cricket (*Gryllotalpa africana*) and one elytra of Click beetle (*Agriotes* sp.) were also found in the nest cavity. A toad (*Bufo melanosticus*) was actually colleted below the nest cavity and its body was intact. The most surprising item in the diet of Spotted Owlet was a bat. One specimen of bat was collected from the nest. It comprised of one fore limb along with the petagium and two hind limbs. The head was missing. Also one skeleton of lizard was found below the nest cavity.

Jadhav and Parasharya (2003) studied the nesting behaviour of Spotted Owlet at Anand and reported that Marbled Toad *Bufo stomaticus* and Cockroach *Periplanata americana* were found in the diet of the young ones. Kumar (1985) reported that important invertebrate food consumed by owlets were members from Gryllotalpidae,

Gryllidae, Acrididae, Scolopendridae and Blattidae. Several other invertebrate taxa were consumed in significant amounts. Scorpionidae and Arinae contributed significant amounts in the nestling diets. Lizards contributed very less amounts, blind snakes were significantly used.

V. SUMMARY AND CONCLUSION

Studies on “Roost site characteristics and food habits of Spotted Owllet *Athene brama* Temminck” were carried out at Anand Agricultural University and its surrounding areas from January to May, 2008 are summarised and concluded here.

5.1 Roost site characteristics of Spotted Owllet

Fourty two roosting sites of Spotted Owllet were studied during study period which shows that out of seventeen species of trees available only nine tree species were used by the owllet for roosting. The data revealed that nearly half (54.76%) of roosts were located exclusively in *Peltophorum* tree. Both Rain tree and Neem occupied 11.90% each while the other tree species with substantial number of roosts were Pipal (7.14%) and Khijado (4.76%). The selectivity index of tree species was as follows: *Peltophorum* (0.05), Rain tree (0.25), Khijado (0.45) *Spathodea* (0.37) and Mahudo (0.37). This indicates that owllets had a selectivity index nearing zero for these trees utilized them in proportion to their availability. The index of tree species like Umber (0.54) and Pipal (0.53) which neared + 1 shows that these tree species were utilized in much greater proportion than their availability.

A total 34 trees were found within 5 m radius of surrounding areas of roost tree. The mean roost tree height was 12.90 ± 1.93 and it ranged from 8.35 to 16.1 m whereas the mean roost height of the perching site was found to be 6.95 ± 1.57 which ranged from 4 to 10 m, while the minimum roost height ranged from 3.3 to 9.6 m and maximum roost height ranged from 4.3 to 10.5 m. The mean distance of water from roost tree was 13.10 ± 6.42 m ranged from 2.4 to 29 m whereas the mean distance of light from roost tree was

13.63 ± 7.36 m which ranged from 0.5 to 31 m. Mean value of detectibility rank was 2.73 ± 1.56 while in case of possible human disturbances 0.35 ± 0.57. The Spotted Owllet used old (based on CBH value) and tallest trees for roosting which were also close to the ensured food source (distance to light source). The mean number of owl roosted together was 2.7 and their number ranged from 1 to 6. This indicates that at least one non breeding owl remains with a breeding pair.

The roosting sites of the residential area (26) and agricultural area (16) used by owllet during study period were compared and revealed that there were no significant difference in the roosting tree and roost site characteristics of Spotted Owllet between residential and agricultural area. There were no significant differences in the roost site characteristics between breeding (n = 32 sites) and non-breeding (n = 10 sites) Spotted Owllet.

Tree height and roost height were function of the tree species used for roosting by Spotted Owllet. The tree species *Spathodea* had highest tree height (13.36), roost height (8.6) and maximum roost height (9.2) as compared to others.

The mean number of owls roosted during the non-breeding season was 3.79 whereas the mean number of owls roosted during breeding season was 2.7 among them the breeding bird was 2.63 and non breeding bird was 2.83. During the non breeding season the number of owls roosted was higher as compared to the breeding season. The values suggest that during non-breeding season, entire family might be roosting together on a same tree branch. During breeding season, at least one young one of previous breed might be sticking around their parents.

Present study on roost site conclude that the Spotted Owlet chose old and mature growth trees for roosting purpose and protection from predators and shelter from the climatic factors.

5.2 Diet composition of Spotted Owlet

223 pellets of Spotted Owlet were examined from all three locations of Anand University campus, among them 77 pellets were from Veterinary campus, 75 pellets were from Horticulture farm and 71 pellets were from E. C. F. P. Farm.

The Spotted Owlet *Athene brama* heavily depended on insects and small mammals for its food. The relative abundance of insects (96.57%) occupied most preferred position which mainly constitutes Orthoptera (41.54%), Coleoptera (37.23%), Dermaptera (16.33) etc. Among Coleoptera *Agriotes* sp. contributed (12.96%), *Maladera* sp (5.82%), *Schizonycha ruficollis* (3.05%), *Scarite indus* (2.12%), *Onthophagus bonasus* (0.65 %) while small mammals (2.40%) which mainly constitute *Mus booduga* (0.65%), *Mus musculus* (0.38%), and unidentified vertebrate (1.03%).

The relative occurrence of insects mainly consisted of Orthoptera (86.55%) which was highest as compared to Coleoptera (70.85%), Dermaptera (37.22%), unidentified insects (8.07) and Hymenoptera (1.79%) while mammals occurred in 17.49% and unidentified vertebrate in 8.52% samples. Relative frequency of insect (91.46%) was also very high which mainly constituted Coleoptera, Orthoptera and Dermaptera. Though small mammals (5.74%) and unidentified vertebrates (2.80%) had very low relative frequency. The number of major prey items such as *Gryllotalpa africana*, *Labidura repara*, *Agriotes* sp., *Allecula* sp. and *Maladera* sp. were

significantly different at three locations however; other prey items and mammals were not significantly different.

Total 17 species of insect pests were identified in present study. Among them 7 species of insect pests such as *Maladera* sp., *Schizonycha ruficollis*, *Adoretus* sp., *Holotrichia serrata*, *Anomela bengalensis*, *Myllabris postulata*, *Labidura repara* can cause serious damage to the crops and ultimately reduce the production of agricultural crops.

Present research indicates that the Spotted Owlet exclusively feed on the insects and small mammals which have economic importance in agriculture. The Spotted Owlet can keep a check on the population of various insect pests by eating them.

We should take a step to conserve such a useful bird. The successful conservation of Spotted Owlet species that inhabit in the agro ecosystems can synergistically minimize the losses inflicted by insects and rodents to the farm crops in India. Studies on roost site characters and feeding behaviour suggested that some large trees should be maintained in the agro ecosystem to provide roost site to the Spotted Owlet and its feeding potential to control insect pest (Particularly Coleopterans and Orthoptera) can be exploited by attracting insects / rodents to the light trap / street light. Thus these two studies should help us to gain maximum advantage of Spotted Owlet in insect pest management.

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