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Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

COMMUNICATION

FOOD COMPOSITION OF INDIAN EAGLE OWL *BUBO BENGALENSIS* FRANKLIN (AVES: STRIGIFORMES: STRIGIDAE) FROM TIRUCHIRAPPALLI DISTRICT, TAMIL NADU, INDIA

Tamilselvan Siva, Periyasamy Neelanarayanan & Vaidyula Vasudeva Rao

26 March 2019 | Vol. 11 | No. 5 | Pages: 13545–13551

DOI: 10.11609/jott.4416.11.5.13545-13551



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FOOD COMPOSITION OF INDIAN EAGLE OWL *BUBO BENGALENSIS* FRANKLIN (AVES: STRIGIFORMES: STRIGIDAE) FROM TIRUCHIRAPPALLI DISTRICT, TAMIL NADU, INDIA

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ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

PLATINUM
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Abstract: The diet of the Indian Eagle Owl was studied from April to September 2017 in Tiruchirappalli District, Tamil Nadu, India. Analysis of 1082 regurgitated pellets yielded 2077 prey items; the mean prey items/ pellet was 1.91. The diet constituted 65.1% of rodent prey and the remaining 34.83% of other groups of both vertebrate and invertebrate animals. The mean percentage of prey composition was 31.15% *Millardia meltada* Soft-furred Field Rat, 12.95% *Bandicota bengalensis* Lesser Bandicoot Rat, 10.25% *Mus booduga* Indian Field Mouse, and 10.24% of other rodent species. Of the 34.83% of non-rodent prey, the owls ingested insects (Rhynchoceros beetles, 9.58%), Arachnida (Solifugae or Sun spider, *Galeodes* sp., 9.58%), reptiles (*Calotes* sp., 3.7%), amphibians (3.56%), shrews (*Suncus murinus*, 2.84%), and others (5.57%). The Indian Eagle Owls consumed more than one prey per day and chiefly foraged in agricultural crop fields and consumed both small mammals and insects of agricultural importance under crop ecosystems.

Keywords: Amphibians, arachnid, *Bandicota bengalensis*, insects, *Millardia meltada*, pellet analysis, prey composition, reptiles, rodents, shrew.

DOI: <https://doi.org/10.11609/jott.4416.11.5.13545-13551> | **ZooBank:** urn:lsid:zoobank.org:pub:E75E53D9-1F48-467F-B89F-8CE84D8BC0E8

Editor: Reuven Yosef, Ben Gurion University of the Negev, Eilat, Israel.

Date of publication: 26 March 2019 (online & print)

Manuscript details: #4416 | Received 18 July 2018 | Final received 08 February 2019 | Finally accepted 02 March 2019

Citation: Siva, T., P. Neelananarayanan & V.V. Rao (2019). Food composition of Indian Eagle Owl *Bubo Bengalensis* Franklin (Aves: Strigiformes: Strigidae) from Tiruchirappalli District, Tamil Nadu, India. *Journal of Threatened Taxa* 11(5): 13545–13551. <https://doi.org/10.11609/jott.4416.11.5.13545-13551>

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Funding: Indian Council of Agricultural Research (ICAR) – A Voluntary Research Centre on “All India Network Project on Vertebrate Pest Management” (AINP on VPM) – “Agricultural Ornithology” (Period: November 2014- March 2017).

Competing interests: The authors declare no competing interests.

Author details: T. SIVA, research scholar who works on owls for his PhD programme. DR. P. NEELANARAYANAN, PhD is an Associate Professor of Zoology and Guides research work on owls. DR. V. VASUDEVA RAO, PhD is a Professor and Co-Coordinator of “All India Network Project on Vertebrate Pest Management” (AINP on VPM).

Author contribution: TS collected and analysed Data. PNN and VVR prepared the article.

Acknowledgements: The financial assistance rendered by ICAR, New Delhi, for carrying out this research work is gratefully acknowledged. We are highly indebted to the Principal and the Management of Nehru Memorial College (Autonomous) for their help and encouragement. We thank Mr. N. Saravanan, Mr. G. Lakshmanan and Mr. T. Mohanraj, UG students of Zoology department of Nehru Memorial College, for their help during many of our field trips.



INTRODUCTION

Owls are nocturnal birds and there are 241 (BirdLife International 2017) living species in the world. The Indian Eagle Owl *Bubo bengalensis* is one of the nocturnal raptors distributed only in the Indian subcontinent. Owls have evolved with many adaptations to occupy the top of the food chain in the ecological niche. Owls feed mainly on field rats, mice, shrews, bats, birds, reptiles, frogs, crabs, scorpions, and insects. The Indian Eagle Owls are terrestrial nesters of rocky hillocks of hill slopes, earth cuttings and bushes. Their hunting grounds consist of agricultural crop fields, water bodies, hills and rural habitats. Regurgitated pellets of owls have undigested body parts of prey like bones, fur of vertebrate and exoskeleton of invertebrate animals. These undigested food materials are oval in shape and greenish black or grey coloured and dropped in the nesting and roosting/perching sites of owls. Regurgitated pellets are analyzed to understand and document the prey composition of Indian Eagle Owls and to find out the variations in their food habits over a period of time. Earlier studies have been carried out on Indian Eagle Owls such as information on the long call (Ramanujam 2003); methods of analyzing rodent prey (Ramanujam 2004); auditory and visual communicatory traits (Ramanujam 2007), morphometric development of young Indian Eagle Owl (Penteriani et al. 2005; Ramanujam & Murugavel 2009; Pande & Dahanukar 2011a); breeding biology, nesting habitat, and diet (Ramanujam 2006; Pande et al. 2011; Pande & Dahanukar 2011b); spread-winged

agonistic displays (Ramanujam 2010); the time budget and behavioural traits of young and adult (Ramanujam 2015); and a comparative study on the diet (Ramanujam & Singh 2017). In India, prey spectrum of this species have been studied and reported from Tamil Nadu – Puducherry (ravines and gullies habitats) in southern India (Ramanujam 2006, 2015) and Maharashtra (Pande et al. 2011; Pande & Dahanukar 2011b) in central India. It is understood from the review of literature that there is limited published information on the diet composition of Indian Eagle Owls from Tamil Nadu and hence the present study.

MATERIALS AND METHODS

The Study Area

The present study was carried out in Musiri Taluk of Tiruchirappalli District, Tamil Nadu. The area consists of many hillocks, interspersed with villages and agricultural fields (Image 1). In the past, studies by Nagarajan et al. (1993), Taylor (1994) and Santhanakrishnan (1995) suggested use of indirect signs such as regurgitated pellets, milky white droppings and prey remains of Barn Owls for the identification of roosting/nesting sites. The same indirect signs were utilized in the present study for the identification of Indian Eagle Owls' nesting/roosting sites. Information given by the local residents was also useful in locating the roosting/nesting sites of Indian Eagle Owls. It is apparent from the survey that the hillocks are the prime nesting and roosting/



Image 1. A typical roosting habitat of Indian Eagle Owls in Thuraiyur Puthupatti hillock and adjoining agricultural crop fields.

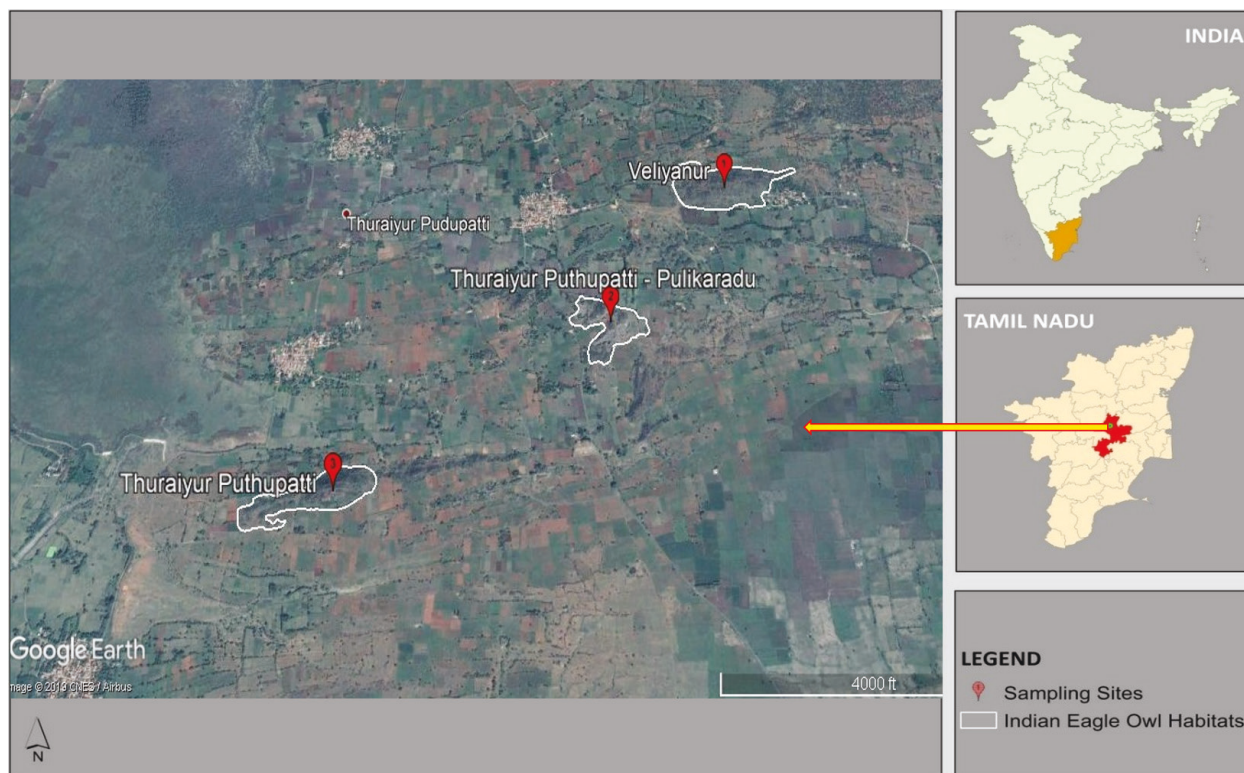


Figure 1. Location of the identified Indian Eagle Owl's roosting sites in the chosen study area.

perching habitats of Indian Eagle Owls (Image 2). The pellets of Indian Eagle Owls were collected from hillocks near three villages - Veliyanur (11.049°N & 78.586°E), Thuraiyur-Puthupatti-Pulikaradu (11.043°N & 78.580°E) and Thuraiyur-Puthupatti (11.037°N & 78.568°E) (Fig. 1) between April and September 2017. In total, 1082 pellets were collected during the study period.

Pellet Analysis

The pellets (Images 3 & 4) were collected once a month, and bagged in separate polybags, labelled and brought to the laboratory for analysis. Before analysis, the pellets were kept in an oven at 70°C for 24h to kill the associated invertebrate parasites (Neelananarayanan et al. 1995; Santhanakrishnan 1995). The pellets were then placed in separate washing cups, containing 8% NaOH (by weight) sodium hydroxide solution, and then analysed (Neelananarayanan et al. 1998). Fur and other debris were dissolved in the 8% NaOH solution leaving only the osteous and chitinous remains of vertebrates and invertebrates, respectively. The solution was then carefully decanted by using a filter and the osteous remains were collected, oven dried at 60°C, labelled, bagged and preserved for prey species identification.

Vertebrate prey items were identified on the basis

of lower jaws, skull, limb bones and pectoral and pelvic girdles (Neelananarayanan et al. 1998; Talmale & Pradhan 2009). We determined the number of prey individuals consumed per pellet based upon the number of skulls, lower jaws, or fore and hind limb bones found in each pellet. One set of lower jaws (left and right) (Image 5) or one skull or one pair of fore and hind limb bones were counted as remains of one prey item. In the absence of mandibles, other bones like skulls, limb bones, pectoral and pelvic girdles and synsacra (in the case of birds) were useful, especially for identifying and quantifying the mammalian, avian and amphibian prey (Neelananarayanan 2007). Insect prey items were identified up to order level on the basis of undigested pieces such as chitinous exoskeleton, heads, wings, legs, and stings (Images 6 & 7). A hand lens or low power binocular microscope was employed to identify insect exoskeleton (Marti 1987; Neelananarayanan 2007). In order to know the contribution of each prey species in the Indian Eagle Owl's diet, they were converted into proportions and presented in tables. The mean prey items per pellet were calculated as follows:

$$\text{Mean prey items/pellet} = \frac{\text{Total no. of prey items observed in a month}}{\text{Total no. of pellets collected in a month}}$$



Image 2. A pair of Indian Eagle Owl observed in the Thuraiyur Puthupatti-Pulikaradu hillock.

RESULTS AND DISCUSSION

Analysis of 1082 regurgitated pellets yielded 2077 prey items (Table 1). The analyzed pellets revealed—small mammals such as *Bandicota bengalensis*, *B. indica*, *Funambulus palmarum*, *Millardia meltada*, *Mus booduga*, *Rattus rattus*, *Suncus murinus* & *Tatera indica*, and bats; amphibians; reptiles; birds; and invertebrates such as Rhinoceros beetle *Oryctes rhinoceros*, *Galeodes indicus*, Scorpion—the constituents of the diet of Indian Eagle Owls. Of these 2077 prey items, rodents constituted 1353 of the prey and the remaining 724 of other prey species like *S. murinus*, amphibians, reptiles, birds, bats, Rhinoceros beetle, among others.

Earlier, Pande & Dahanukar (2011b) and Pande et al. (2011) reported *B. bengalensis*, *B. indica*, *M. meltada*, *R. rattus*, *T. indica*, *M. musculus* and *Golunda ellioti* as the major constituents of the Indian Eagle Owls' diet in terms of frequency, proportion and biomass. Besides these they also reported Rhinoceros beetles, long-horned beetles, grass hoppers, mantids, snakes, scorpions formed the diet of Indian Eagle Owl. The diet of the Indian Eagle Owl in and around Puducherry and a part of Tamil Nadu comprised of prey such as *S. murinus*, *T. indica*, Chiroptera, *F. palmarum*, *R. rattus*, *M. meltada*, *B. indica*, *B. bengalensis*, *Mus* spp., *Lepus*

nigricollis, Aves, *Varanus bengalensis*, *Amphiesma stolata*, Anura, *Paratelphusa* sp., *Heterometrus swammerdami*, *Scolopendra morsitans*, Orthoptera, Coleoptera (Ramanujam 2006; Ramanujam & Singh 2017). The results of these studies corroborate the findings of the present study. It is obvious from the results of the present investigation that these owls hunt both commensal and field rodent pests and insect pests (particularly Rhinoceros beetle) from agricultural crop fields around their nesting/roosting habitats.

The Rhinoceros beetle is found on Coconut palms, occurring throughout the country and many regions of the world. Detection can be difficult due to the beetles' nocturnal activity within the trees. In the present study, rhinoceros beetle accounted for 9.58% of the Indian Eagle Owl's diet. In Maharashtra, 11.9% of this beetle was recorded in the owl diet (Pande & Dahanukar 2011b). *Galeodes indicus* was found to be 9.58% of the diet in this study, however, Pande & Dahanukar (2011b) reported it at 0.2%. The presence of the diurnal Three-striped Palm Squirrel *F. palmarum* in the diet may be due to the owls hunting behaviour during day time. Bats are also potential prey of owls, not surprising considering that both these animal groups are nocturnal (Marks et al. 1999). The other prey species groups like birds, reptiles including *Calotes* sp., amphibians, and scorpion

Table 1. Prey composition (month-wise) of Indian Eagle Owls revealed from pellet analysis.

Month and Year		April 2017	May 2017	June 2017	July 2017	August 2017	September 2017	Total	Percentage	Proportion of rodents, insects & other prey	Proportion of major prey groups (pest & non-pest)
Prey species/ total number of pellets		158	177	191	207	167	182	1082			
Bandicota bengalensis		46	42	47	38	53	43	269	12.95	65.1	74.68
Millardia meltada		93	108	126	111	89	120	647	31.15		
Mus booduga		18	27	36	53	36	43	213	10.25		
Tatera indica		2	5	4	11	7	9	38	1.82		
Rattus rattus		0	0	1	1	0	0	2	0.096		
Bandicota indica		0	2	1	6	0	2	11	0.52		
Funambulus palmarum		0	1	0	2	1	1	5	0.24		
Unidentified Rodents		28	21	31	38	21	29	168	8.08		
Rhinoceros beetle		23	51	42	34	17	32	199	9.58	9.58	25.25
Galeodes indicus		36	47	44	23	17	32	199	9.58		
Scorpion		2	1	4	2	5	2	16	0.77		
Amphibians		17	10	4	16	22	5	74	3.56		
Reptiles	Calotes sp.	12	7	9	21	18	10	77	3.7		
	Others	7	2	6	12	14	8	49	2.35		
Birds		3	5	9	17	8	5	47	2.26		
Suncus murinus		4	11	6	17	9	12	59	2.84		
Bats		0	1	2	0	1	0	4	0.19		
Grand Total		291	341	372	402	318	353	2077	100	100	100



Image 3. A pellet of Indian Eagle Owl observed in its roosting site.

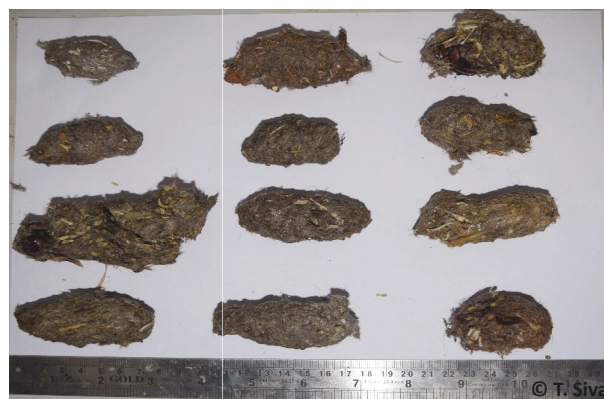


Image 4. Different sizes of Indian Eagle Owls' pellets collected during the present study.

were rarely hunted by owls.

In the present study, a maximum of 1.94 prey items/pellet was observed during June and July 2017 while a minimum of 1.84 prey items/pellet was observed during April 2017 (Table 2). The results of the present study indicate that the Indian Eagle Owls consumed more than one prey per day.

CONCLUSION

In conclusion, the results of the present study reveal that the Indian Eagle Owls are hunters of both rodent and insect pests. Steps should be initiated to protect and conserve Indian Eagle Owls in their natural habitats to increase their population and make use of their services in managing the pest populations in cropping ecosystems.



Image 5. The lower jaws or mandibles of rodents, an insectivore and *Calotes* sp.



Image 6. Entire exoskeleton of Rhinoceros Beetle observed in the pellets.



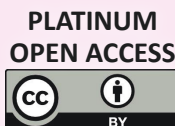
Image 7. Chelicerae of *Galeodes indicus* observed in the Indian Eagle Owl pellets.

Table 2. Mean prey items/ pellet observed during the study period.

	Month & year	Total number of pellets collected	Total number of prey items enumerated	Mean prey items/ pellet
1	April 2017	158	291	1.84
2	May 2017	177	341	1.92
3	June 2017	191	372	1.94
4	July 2017	207	402	1.94
5	August 2017	167	318	1.90
6	September 2017	182	353	1.93
	Total	1082	2077	1.91

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

March 2019 | Vol. 11 | No. 5 | Pages: 13511–13630

Date of Publication: 26 March 2019 (Online & Print)

DOI: 10.11609/jott.2019.11.5.13511-13630

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