Tropical Life Sciences Research, 27(2), 127–134, 2016

SHORT COMMUNICATION

Usage of Nest Materials by House Sparrow (*Passer domesticus*) Along an Urban to Rural Gradient in Coimbatore, India

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Published date: 17 August 2016
To cite this article: Dhanya Radhamany, Karumampoyil Sakthidas Anoop Das, Parappurath Abdul Azeez, Longying Wen and Leelambika Krishnan Sreekala. (2016). Usage of nest materials by house sparrow (*Passer domesticus*) along an urban to rural gradient in Coimbatore, India. *Tropical Life Sciences Research* 27(2): 127–134. doi: 10.21315/tlsr2016.27.2.10
To link to this article: http://dx.doi.org/10.21315/tlsr2016.27.2.10

Abstrak: Burung ciak rumah (*Passer domesticus*) merupakan spesies burung yang tersebar luas di seluruh dunia. Spesies ini mempunyai perhubungan yang dekat dengan manusia, maka ia bersarang atas struktur-struktur buatan manusia. Di sini, kami menerangkan tentang bahan-bahan yang digunakan oleh burung ciak rumah untuk membina sarang sepanjang gradien kawasan bandar ke luar bandar. Untuk kajian ini, kami telah memilih jalan Coimbatore ke Anaikatty (State Highway-164), satu jalan lebuh raya 27 km panjang, yang melalui satu kawasan bandar ke luar bandar di Coimbatore. Daripada 30 sarang yang diperhatikan, 15 merupakan dari kawasan luar bandar, 8 daripada kawasan subbandar, dan 7 dari kawasan bandar. Sarang-sarang tersebut mempunyai 2 lapisan jelas, iaitu lapisan struktural dan lapisan dalaman. Dalam kajian ini, kami telah mengenal pasti 11 spesies tumbuhan, 2 jenis bahan haiwan, dan 6 jenis bahan antropogenik, termasuk kepingan plastik dan tali halus. Bilangan bahan antropogenik berbeza mengikut gradien kawasan. Penggunaan bahan antropogenik tinggi di kawasan bandar ($p<0.05$) manakala tidak ada perbezaan nyata di kawasan-kawasan subbandar ($p>0.05$). Satu pengurangan beransur penggunaan bahan tumbuhan mengarah ke kawasan bandar telah dikenal pasti ($p<0.05$). Kajian ini telah menunjukkan perhubungan antara penggunaan bahan untuk membina sarang sepanjang gradien kawasan bandar ke luar bandar, untuk burung yang berkaitan rapat dengan manusia.

Kata kunci: Burung Ciak Rumah, Bahan Sarang, Gradien Bandar ke Luar Bandar

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Abstract: The house sparrow (*Passer domesticus*) is a widely distributed bird species found throughout the world. Being a species which has close association with humans, they chiefly nest on man-made structures. Here we describe the materials used by the house sparrow for making nests along an urban to rural gradient. For the current study, we selected the Coimbatore to Anaikatty road (State Highway-164), a 27 km inter-state highway, which traverses along an urban core to rural outstretch of Coimbatore. Of the 30 nests observed, 15 nests were from the rural, 8 were from the suburban, and 7 were from the urban areas. The nests had two distinct layers, specifically the structural layer and the inner lining. In the current study, we identified 11 plant species, 2 types of animal matter, and 6 types of anthropogenic matter, including plastic pieces and fine rope. The amount of anthropogenic materials in the nest formation varied along the gradients. The usage of anthropogenic materials was high in urban areas ($p<0.05$) whereas it did not differ at the sub-urban regions ($p>0.05$). A gradual decrease in the usage of plant matter towards the urban area was noticed ($p<0.05$). This study explicitly documents the links between nest material usage along an urban to rural gradient, in a human associated bird.

Keywords: House Sparrow, Nest Material, Urban to Rural Gradient

House sparrows are closely associated with human dominated landscapes (Summers-Smith 1988). The decline of the species is being recorded from different parts of the world (Hole *et al.* 2002; Royal Society for the Protection of Birds [RSPB] 2003; Vincent 2005; Anderson 2006; Dhanya 2012). One of the reasons predicted to be the cause for their decline is lack of nesting sites. House sparrows generally build single or semi-colonial nests. Nest building is most intense during January to May (Vincent 2005). This multi-brooded species is widely distributed in cities and are known to build open-cup nests which may be reused during the same season as well as in successive breeding seasons (Cavitt *et al.* 1999; Friesen *et al.* 1999). The species mainly nests in holes and crevices of man-made structures and nest-boxes (Summers-Smith 1988). House sparrows use a broad range of materials for nest building, including feathers, grass inflorescences, stalks and roots of plants, barks, threads, strings, and pieces of paper and wool (Indykiewicz 1990). The present study was conducted to examine the materials used for making the nest, the occurrence, and the types along an urban to rural population of house sparrows (*Passer domesticus*, "sparrow" hereafter), a species that breeds in urban, suburban, and rural landscapes.

The study area, Coimbatore (11°0′45″N 76°58′17″E), is the third largest city in Tamil Nadu, India (Fig. 1). The city is well-known for textile mills, small scale engineering works and in recent years as an educational hub. For the current study, we selected the Coimbatore to Anaikatty road (State Highway-164), a 27 km inter-state highway, which traverses along an urban core to rural outstretch of Coimbatore.

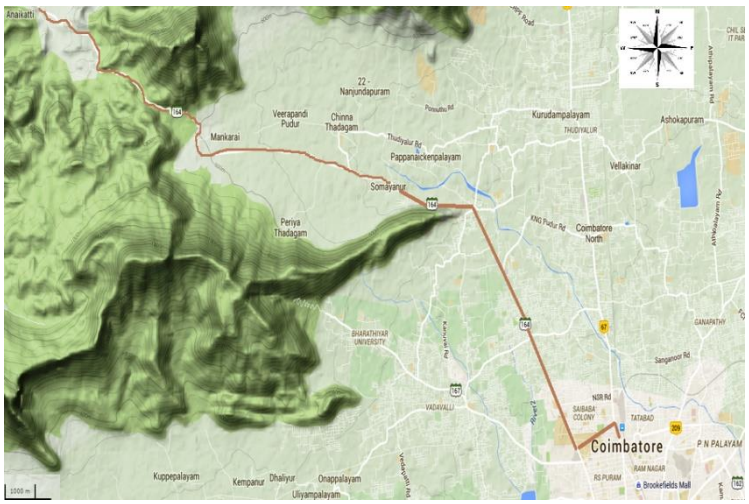

Figure 1: Study area.
Source: Google Earth (2015).

The sampling points were selected along an urban to rural gradient to ensure a wide range of variation in key ecological variables (Pennington & Blair 2012) during the reproductive season of 2006–2008. The nests were located by intensive search in built up areas along the urban gradient. The nest locations were identified using the behavioural cues of parent birds such as vocalisation and bird activities (birds flew off from nests, carrying nest materials, bringing food to the nestlings, and calls) as described by Martin and Geupel (1993), Reale and Blair (2005), and Peach *et al.* (2008). Since nest site fidelity and nest reuse were observed in many cases, immediately after the chicks fledged, nests of sparrows were carefully examined and individually labelled in the field for further monitoring. We examined each nest, which was accessed by an aluminium ladder, and assessed the nature and quantity of materials it was made of, and quantified the number of components it contained. Most of the plant materials used was identified up to the species level using the standard field guide and field keys pertinent to the study area (Henry *et al.* 1984).

A total of 30 nests were examined to identify the nest materials. Of these, 15 nests were from the rural, 8 were from the suburbs, and 7 were from the urban areas. The nests were cup shaped and loosely built. The nest materials were classified as plant matter, animal matter, anthropogenic matter, and unidentified (materials which were dried and converted to powder form, thus could not be identified). The nests had two distinct layers, specifically, the structural layer and the inner lining. The structural layer formed the base of the nest and constituted predominantly of plant matters. The lining is the thin layer which was in direct contact with the eggs and the nestling. This layer is made of fine and soft materials such as paper pieces, cotton, and fine jute. In total, the sparrows used whole/parts of grass species of which three were identified and one unidentified, one sedge, three herbs, one shrub, and two tree species

excluding an unidentified matter. In some situations, anthropogenic nest materials could be a beneficial resource, enabling nest construction in places where natural materials are limited. Riper (1977) observed the use of sheep wool as a binding material in the structural layer of nests of Hawaiian birds. In the current study, we identified 11 plant species from the structural layer of the nests (Table 1). Whole or parts of the flower, leaf, stem or the dried herbs itself formed the building material of the structural layer. Similarly, in the lining material we determined two plant species, i.e., *Azadirachta indica* (fine parts of flowers and leaves) and one unidentified grass species (Table 1). Similarly, two types of animal matters, i.e., fine feather and human hair, six types of anthropogenic materials including plastic pieces and fine rope were also recorded. Parts of leaf, flower, and stem which were powdered were also found in the lining.

Table 1: Constituents of house sparrow nest layers.

No.	Species/materials	Parts used	Nest layer
	Plant matter		
1	*Aerva lanata*[h]	Flowers/stem	Structural
2	*Azadirachta indica*[t]	Leaf/flowers/fine stem	Structural/lining
3	*Boerhavia* sp.[h]	Leaves/whole plant	Structural
4	*Cynodon dactylon*[g]	Whole plant	Structural
5	*Cyperus* sp.[se]	Leaves/whole plant	Structural
6	*Dactyloctenium aegyptium*[g]	Stem/whole plant	Structural
7	*Eleusine indica*[g]	Leaves/whole plant	Structural
8	Grass sp.	Leaves	Structural/lining
9	*Moringa oleifera*[t]	Leaves/fine stem	Structural
10	*Parthenium hysterophorus*[h]	Stem/flowers/inflorescence	Structural
11	*Musa paradisiaca*[h]	Thread/leaf	Structural
	Anthropogenic matter		
1	Paper	Small piece	Lining
2	Plastic	Small paper piece/fine rope	Structural/lining
3	Cotton thread	Small piece	Lining
4	Coir	Fine piece	Lining
5	Cotton	Rope/fine	Lining
6	Jute	Fine	Lining
	Animal matter		
1	Chicken feather	Fine part	Lining
2	Hair	Hair	Lining
1	Unidentified	Parts of leaf, flower, stem etc.	Lining

Note: [g] = grass, [se] = sedge, [h] = herb, [s] = shrub, [t] = tree.

A gradual decrease in the usage of plant matter towards the urban area was reported. Nests from the rural area were comprised of about 90% plant matter followed by 10% materials from anthropogenic matter (Table 2). The amount of anthropogenic materials in the nest varied with the gradients. The usage of anthropogenic materials was high in urban areas, (p<0.05) whereas it did not differ much with sub-urban regions (p>0.05). A gradual decrease in usage of plant matter towards the urban area was reported (p<0.05).

Table 2: Constituents of house sparrow nest layers along an urban to rural gradient.

Nest material	Rural (%)	Suburban (%)	Urban (%)
Plant matter	89.80	82.94	77.10
Animal matter	–	0.78	1.20
Anthropogenic matter	10.20	11.96	21.69
Unidentified	–	4.31	–

A total of 11 plant species were recorded in the nests from the rural area, 7 from suburban areas, and 5 species from urban areas. The constituents of nest layers in percentage have been given in Table 3. Compared to the other gradients, for nests from urban regions, plant matter was recorded the least and anthropogenic matter i.e., small pieces of paper, plastic wrapper, fine pieces of jute, and plastic rope etc. were high. This observation is different compared to a study conducted by Townsend and Baker (2014), in which they have reported the usage of anthropogenic matter in higher loads from the nests observed from agricultural areas in the case of the American crow, *Corvus brachyrhynchos*.

Table 3: Constituents of house sparrow nest layers.

Nest material	Mean	Standard Deviation
Plant matter	10.46	17.2
Animal matter	0.08	0.59
Anthropogenic matter	1.65	2.91
Unidentified	0.13	1.18

Behavioural plasticity can be considered as a potential mechanism for avian invasion as the species would readily recognise and utilise unfamiliar resources to colonise new areas (Webster & Lefebvre 2001). Fitzgerald and Martin (2005) observed high behavioural plasticity in sparrows. Hence, these species may readily identify and utilise unfamiliar resources available in the area for nest construction. In the current case, behavioural plasticity/flexibility in selecting nest materials can be considered as a mechanism to identify unfamiliar resources, which can evolve as part of establishing populations in new areas. The composition of the nest materials may vary according to the local availability of materials (Wimberger 1984). Anthropogenic nest materials could have benefits too, for example, Suarez-Rodriguez *et al.* (2013) reported the usage of cigarette butts as nesting materials of sparrows for pest control, which was also reported in the present study. In the current study, we observed that sparrows used leaves

and stems of *A. indica,* a plant with anti-microbial properties, to probably repel arthropods in the nests, which may serve as ecto-parasites. Dhandhukia and Patel (2012) reported the occurrence of *A. indica,* from the nests of the common myna (*Acridotheres tristis*). The secondary metabolites present in the plant materials may help to kill/deter avian ectoparasites (Wimberger 1984; Mennerat *et al.* 2009). Several studies revealed that the presence of ectoparasites may adversely affect nestling growth mainly due to the loss of blood (Wimberger 1984; Newton 2002). The major ectoparasites responsible for bird mortality are dipterans, fleas, ticks, and mites (Wimberger 1984).

Many studies have revealed that the parasitic load was closely related to the presence of old nest materials in nest boxes (Møller 1992; Lehmann 1993; Weddle 2000; Marzal *et al.* 2005). Parasites generally gain resources from their hosts and this deteriorate the fitness of their hosts. Hence, old nest materials have a significant effect on the reproductive success and nestling growth as it affects both adults and chicks (Møller 1992). Many of the studies revealed that the loss of genetic diversity in urban sparrows could be a reason for the decline in the bird's population (Vangestel *et al.* 2011) and causing the birds to be more prone to parasitic infections (Hedrick *et al.* 2000; Hawley *et al.* 2005). Much of the causality that has been reported is due to the presence of anthropogenic materials in the nests. In the case of the American crow, plastic twines in nest materials have entangled on fledglings and deaths were reported (Townsend & Barker 2014). Ospreys were reported to have causalities because of plastic twines in nest materials (Blem *et al*. 2002) whereas in doves, fishing lines in nest materials have contributed to the causality (Parker & Blomme 2007). As observed in the present study, the use of animal matter (chicken feather and human hair), especially in the nest lining, may increase the presence of parasites in the nests. Presence of such material could be a potential threat for the survival of chicks and the reproductive capacity of the adult. This can be a potential reason for the decline in the urban sparrow population.

In conclusion, the amount of anthropogenic materials in the nest varied along the gradient. A gradual decrease in the usage of plant matter towards the urban area was reported. Eleven species of plants, two types of animal matter, and six types of anthropogenic materials were identified from the nests. In the study, the presence of old nest materials have been observed widely. The present observation envisages the need to explore the relation of old nest materials and the parasitic load, which in turn may help to resolve the severity of population decline of the studied species.

ACKNOWLEDGEMENT

This paper is benefitted from the discussions with Dr. Ranjini J. and Dr. Murugesh M. from Sálim Ali Centre for Ornithology and Natural History, Dr. C. K. Nistar, Dr. K. M. Ismail, and O. P. Abdurahiman from the Department of Zoology, MES Mampad College. Funding for the study were provided by the Department of Science and Technology, Government of India (Rajat Jayanti Award 2008) and UNEP- Eco Peace Leadership Award, South Korea (2009). We thank Leshan

Normal University, P. R. China and the University Grants Commission, for the ongoing support.

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