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Eco-resilience: Herons use of anthropogenic nesting materials

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Abstract

The susceptibility of birds to plastic pollution is well established. The incorporation of macroplastic debris as nesting materials into seabird nests has been extensively studied. Incidental sighting of plastic strands hanging from heronry nests paved the way for this study, which revealed extensive use of macroplastic debris as nesting material by Little Egrets *Egretta garzetta* and Indian Pond Herons *Ardeola grayii* in an urban heronry adjacent to a derelict fishing gear strewn fishing harbour. Immediate consequences in the form of entanglement death are evident. Inclusion of macroplastic debris as nesting material by tree-nesting waterbirds is reported for the first time from India.

Introduction

Durability and resistance to degradation, the important properties which make plastic so useful to humans, also make it almost impossible for nature to break them down completely. Plastic pollution is a transboundary threat to biodiversity, impacting terrestrial and marine ecosystems due to slow degradation and unsustainable production and disposal (Patra & Chatterjee 2024). When plastic waste and wildlife come into contact, it may be extremely harmful to both individuals and communities. Ingestion, entanglement, and plastic utilisation (plastic as a nesting material, biota transit vector and refuge/shelter) are the most frequent encounters (Blettler & Mitchell 2021).

It is common knowledge that birds are particularly vulnerable to plastic pollution (Acampora et al. 2017). Nevertheless, there is currently scant data indicating the frequency of plastic nest incorporation for different bird species and populations, and even fewer studies have been conducted to determine the origin of this debris (Tavares et al. 2016, Thompson et al. 2020).

The percentage of plastic-containing nests has been proposed as a valuable indicator of environmental plastic pollution (Tavares et al. 2016, Jagiello et al. 2019, O'Hanlon et al. 2019). However, this may be somewhat weakened by the selection of particular debris types or colours (Verlis et al. 2014). At the local level, there are wide variations in the prevalence of plastic in bird nests (Witteveen et al. 2017, Grant et al. 2018), since most nesting materials are gathered in proximity to the nest location. Primarily, the probability of plastic being utilised during nest building is contingent upon the availability of natural nesting material in addition to the quantity of plastic waste in the immediate proximity of the nest (Witteveen et al. 2017).

The present study intends to ascertain the percentage of nests that include plastic waste and evaluate the immediate impact of the same on the inhabitants of those nests and gain an insight into the species of heronry birds that use plastic nesting material in the study areas.

Methods

Heronry nesting survey in Kollam district has been carried out since 2019, as part of the Kerala State Heronry Nesting Survey, where details of nesting species, nesting trees and location of nests were photographed and recorded, along with the observations of the

survey team. Kollam district (8.99° 00' N 76.87° E) is the 43rd most populated agglomeration in India (Census of India 2011); it has no discernible distinction between its urban and rural areas in terms of population density (Sarlin et al. 2022). In the Kerala State Heronry Nesting Survey during 2021, 1,798 nests at 22 sites in 581 trees were reported in the Kollam district; there were five species of nesting birds and 31 species of trees used for nesting.

While doing preliminary survey for 2022 nesting, we observed strands of plastic hanging from some nests of Little Egret *Egretta garzetta* and Indian Pond Herons *Ardeola grayii* at Vaddy (8.8816° N, 76.5744° E), Kollam, Kerala, India. This triggered a thorough search for detection of plastic debris used as nesting material. The Vaddy heronry in Kollam is scattered throughout a 2.1 km × 200 m corridor on the coast of Arabian Sea, it is home to several trees bearing over 500 Little Egret and Indian Pond Heron nests, a bustling fishing harbour, a four-lane coastal highway, and a densely populated human community.

Photographs of the nests with presence of macroplastic debris were taken; the nesting species were recorded and a count of nests was made. Images were taken, using a Nikon D500 and Sigma 150–600 telelens, 2.5–6.5 m below each nest, varying the height to ensure that the entire 'apron' of nesting material around each nest was recorded (Figure 2). The comprehensive survey was conducted from 8–10 June 2022. For the study, only inhabited nests and nests being actively constructed nests by heronry birds were taken into account. Asynchronous breeding occurred because some birds were building nests, while others were incubating eggs, caring for hatchlings, feeding nestlings, fledglings or juveniles. No plastic was collected from nests, because disturbing breeding birds is prohibited by The Wildlife (Protection) Act, 1972 of India, and it was anyway deemed unethical because it might have compromised the breeding attempt. To rate the amount, kind and colour of macroplastic trash in each nest, the photos were analysed. When counting plastic articles, the identities of unquestionably plastic bits were the only ones recorded. There is likely to have been more plastic in the nests than what we recorded because only the part of the nest that was visible from below was photographed. It was beyond of our scope to quantify the plastics in the nests in their entirety.

Results

A total of 342 heronry nests were surveyed at the Vaddy heronry; 270 of the nests (78.9%) showed the presence of macroplastic debris. 12 nests (3.5%) were excluded from the study because of the nature of the probable plastic debris could not be ascertained. The amount of macroplastic nesting material varied considerably among nests: white -coloured parcel straps, fishing lines, ropes, insulated cables and nets were the predominant plastic items in the nests. 62% of the macroplastic waste consisted of white and transparent materials and 28% of blue/green items (combined since many ropes were turquoise and difficult to determine blue or green). Fishing lines were categorised into white and blue as most of the lines were blue, white or transparent. Only the debris incorporated as nesting material or those that were hanging from the nests were included in the study (Figures 1 and 2). Caution was exercised to keep the disturbance to the breeding populations to the minimum.

The most widely present plastic items incorporated into the nests (83.7%) were white parcel straps that might have arrived at the harbour holding bales of new nets together and other fishing gear. Derelict fishing gear (fishing line in 63.7% nests and ropes in 22.2%) were the next most prevalent items. The worn and broken nature of several of the ropes indicated they had been on the coast for an extended amount of time. The plastic debris found in the nests could have been picked up from the adjacent dumping areas, where birds were observed scavenging. Some nests had insulated wires (2.6%) and drinking straws (1.1%). The most astonishing macroplastic inclusion in the nest was a pair of cloth hangers found in the nest of a Little Egret (Figure 1).

Discussion

The amount of artificial or man-made material found in nests is closely correlated with the level of urbanisation. Higher levels of urbanisation cause birds to integrate more anthropogenic debris into their nests (Reynolds et al. 2019). This is because different birds may choose to use readily available materials for their nests, depending on their behavioural preferences and the location of their nests (Britt & Deeming 2011). The "availability hypothesis," which is based on the

Figure 1: Heronry nests incorporating macroplastic debris. A pair of cloths hangers is visible in the nest of a Little Egret *Egretta garzetta*, highlighting the extent of plastic waste usage in nesting materials.

Figure 2: Heronry nests containing macroplastic debris. A dead Little Egret *Egretta garzetta* is seen hanging from one of the nests, possibly entangled in the plastic material, illustrating the harmful effects of

observation that nest composition varies depending on local availability of nesting materials (Wimberger 1984), including those that are anthropogenic (Jagiello et al. 2018), suggests that birds merely choose the materials that are abundant, with no adaptive value of such changes. Fishing lines, mainly blue, white or transparent, that were occasionally found in the nests, likely originated from nearby fish markets or discarded artisanal gear. Though less frequent than other plastics, their presence poses serious risks. This study documented entanglement-related deaths, underscoring the direct threat fishing debris poses to birds and the growing overlap between human waste and urban wetland nesting habitats.

These wetland birds usually build nests using twigs, leaves or other natural materials procured from their surroundings. It may not be the paucity of natural nesting materials that is motivating the incorporation of plastic garbage in the nests, since these birds are known to reuse nesting materials from abandoned nests and even steal from other nests. The birds in the urban heronry appear to opportunistically incorporate plastic materials into their nests, reflecting the abundance of such materials in their surroundings rather than an adaptive response or preference for synthetic nesting materials.

Birds may intentionally gather manmade debris to build nests, or they may do so unintentionally since certain maritime debris resembles appropriate natural nesting material (Sergio et al. 2011). Another factor influencing the amount of plastic used in nests is the availability of marine trash and natural nesting materials at the size over which nest material is gathered. Brown Boobies *Sula leucogaster* were found to include plastic into their nests more frequently at breeding areas where there was less natural foliage available for them to build their nests (Lavers et al. 2013).

Extensive literature search has not yielded any reports on studies on the use or presence of macroplastic nesting materials by tree nesting heronry birds.

Conclusion

At the heronry, the sources of the plastic debris were the fishing harbour and the dumping area which were strewn with large quantities of abandoned fishing gear, packing straps, etc. White and clear plastic items, especially threadlike debris, dominated heronry nests and the adjacent beach debris. To the best of our knowledge, this is the first report of use macroplastic trash as building materials by tree nesting heronry birds. The findings are indicative of the pollution levels in the coastal zone where the herons forage and gather materials for their nests. Our result show, that 79% of heronry bird nests in the study area contained plastic debris. This points to the level of plastic debris encounters, which in turn, are indicative of extent the plastic pollution in the areas adjoining the heronry.

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