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Abandonment by Little Eagles *Hieraaetus morphnoides* of a nest infested with beetles

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Abstract. A pair of Little Eagles *Hieraaetus morphnoides* in the Australian Capital Territory was recorded (on closed-circuit camera) feeding and mating on a nest and had added a layer of green pine sprigs in preparation for egg-laying. Many beetles, likely a species of Dermestidae, were recorded in the nest during the time that the birds were there. The Eagles abandoned the nest and moved to another 1.7 km away, where they laid a clutch. It is possible that the beetle infestation was the cause of abandonment.

Introduction

Eagles, like many raptor species, are well known to build and use multiple nests within their territories (Gordon 1955; Brown & Amadon 1968); for example, Golden Eagles *Aquila chrysaetos* have an average of 6.9 nests per territory in Idaho, United States of America (Kochert & Steenhof 2012) and up to 17 eyries in Scotland (Rae 2012). The use of alternative nests by Little Eagles *Hieraaetus morphnoides* is less well studied: they have been found to use one to three in New England, New South Wales (Debus 1984) and one to five nests per territory in the Australian Capital Territory (unpubl. data; this study).

Reasons suggested for alternative nest use include: nests can advertise a territory (Newton 1979; Jiménez-Franco *et al*. 2014), frustration nests can be built after failure of breeding attempts (Newton 1979; Gargett 1990), competition avoidance by nest-site choice (Newton 1979; Friedemann *et al*. 2017), and cleansing and reduction of nest ectoparasites (Gordon 1955; Wimberger 1984). These four hypotheses were examined for alternative nest use by Bonelli's Eagle *Aquila fasciata* and the most plausible explanation was found to be avoidance of nest ectoparasites (Ontiveros *et al.* 2008).

Invertebrates are common in birds' nests, including those of raptors, where they can help decompose carrion, excreta, pellets, and other organic matter (Philips & Dindal 1977). However, birds' breeding success can be reduced by ectoparasites, such as Blowfly (Calliphoridae) larvae, which suck the nestlings' blood (Richner *et al*. 1993), and the larvae of dermestid beetles can cause skin lesions and feather damage (Snyder *et al*. 1984). Fresh green plant material is added by raptors to their nests at various stages of nesting (Brown & Amadon 1968) and the addition of greenery is mostly done by raptors that re-use nests, such as eagles (Wimberger 1984; Watson 1997). The exact function of the addition of greenery to birds' nests is unclear (Mainwaring *et al*. 2014) but deterrence of invertebrates is a favoured hypothesis (Baumann & Morgan 2015). Fresh greenery can contain high levels of aromatic compounds such as monoterpenes and isoprene (Batish *et al.* 2008); peppermint *Eucalyptus* sp. leaves are often chosen by Wedge-tailed Eagles *A. audax* in Tasmania, even if the trees are not nearby (Nick Mooney pers. comm.). These compounds are known to disrupt olfaction in insects (Wimberger 1984). In Common Starlings *Sturnus vulgaris*, post-fledging survival was higher among nestlings raised in nests with more green material (Gwinner *et al*. 2000). Insect ectoparasites found in Bonelli's Eagle nests included abundant beetles (Dermestidae) and flies (Diptera) (Ontiveros *et al.* 2008), and that study described how the use of alternative nests and the presence of greenery are effective mechanisms for avoiding dipteran ectoparasites, but not dermestid beetles.

In this study, we describe how a pair of Little Eagles occupied and prepared a previously used nest for breeding, then abandoned it in favour of another, possibly in reaction to an infestation of the nest by beetles.

Observations

The first Little Eagle nest was positioned ~18 m above ground within a Monterey Pine *Pinus radiata*, in a shelter belt of the pines, planted along the perimeter of an old farm homestead on the outskirts of Canberra, ACT. In July 2017, a closed-circuit television camera was set up in advance of the Little Eagles returning to a nest, in which a chick had been successfully reared the previous breeding season. The camera was attached to branches ~2.0 m from the nest. The footage was monitored live, broadcast online and recorded. A second camera was set at the nearest known other Little Eagle nest, 2.7 km from the first nest, where a neighbouring pair was seen in 2016, although no eggs were known to have been laid, and this nest was little more than a flimsy platform in 2017. That camera was also closed-circuit and recorded continuously, but it was not monitored live. It was also set to record from late July, before any birds were attending the nests.

Other records of the birds were made by observers who watched over the nesting areas and visited the nest sites to check on the birds' breeding status.

Footage from the recorded video showed that a pair of Little Eagles was originally seen at the first nest on 6 September 2017. Both birds were identifiable by distinctive damage (breakage) to their primary feathers. The pair was seen intermittently at the nest between 6 and 19 September, during which they added branches, including fresh green

pine sprigs, to the nest. On 7 September, the male brought food (a young European Rabbit *Oryctolagus cuniculus*) to the female, which consumed the food on the nest and on a nearby branch. The pair was recorded mating on the nest on 6 and 11 September. No eggs were laid and the birds were last recorded there on camera on 19 September. A single Eagle was observed flying over the second nest site previously (23 August) and the same pair was recorded on camera at that nest on 24 August. The female was seen flying over that nest again on 13 September, 29 October and 23 December. No material was seen to be added to that nest. After the birds were no longer being recorded at the first nest, adjacent areas were watched with binoculars and telescope from a vantage point and the pair was found at a previously unknown third nest. This nest was 1.7 km from the first nest, and 1.3 km from the second nest. The Eagles were first seen flying over the new nest area from the vantage point 1.4 km away on 1 October. They must have been attending that nest before that as they had already added leafy branches and laid an egg (or eggs) on or soon after 2 October, when the female was first observed sitting on the nest. The female was seen incubating on the nest on 11 October and 1 November, but the breeding attempt failed for an unknown reason and the birds left the nest, sometime before 24 November, when the pair was last seen flying over the nest area.

Small numbers of beetles were recorded crawling out of the first nest on 16, 19, 20, 22 and 23 September. On 11 October 2017, a larger number of beetles was recorded crawling over the nest and its supporting branches (video link: https://www.dropbox.com/s/tiydj02idrcghzr/Little%20Eagle%20nest%20with%20beetles.mp4?dl=0). The abundance of the beetles can be more easily seen by viewing the video in fast forward setting. The peak activity was in the twilight period, between 1946 and 2023 h, when a minimum of 59 beetles was counted leaving the nest and dispersing along branches and flying away. Sunset in the area on that day was at 1915 h (Geoscience Australia 2017). The beetles could not be counted fully as they crawled in and out of view while they remained in the nest; however, as another indication of their abundance, 11 individual beetles can be identified in the frame in the 15 seconds between 20.02.50 and 20.03.05 h. The insects were clearly beetles as they can be seen opening their elytra before flying, e.g. at 20.03.40 h. They were dark and long–oval shaped, and ~5–8 mm long, and were most likely dermestids.

One or more Pied Currawongs *Strepera graculina* were recorded, by the camera, visiting the first nest on 25 September and 11 October. These could have been recordings of the same bird, or of different birds, as they were unmarked and so unidentifiable. They were seen to peck at something inside the nest, beneath the pine needles, possibly larval or adult beetles. The Eagles were not seen to peck at anything in the nest, nor show any unusual preening behaviour that might have indicated the presence of parasites. Nor was there any feather damage on the Eagles that could have been caused by dermestids.

Discussion

The sequence of events before and after the abandonment of the nest by the pair of Little Eagles described in this study fits the possibility that an infestation of beetles caused the birds to switch nests. The combined strategies of adding fresh pine sprigs to the nest then moving to an alternative nest are those previously described as the best actions for birds to avoid nest parasites (Ontiveros *et al.* 2008).

Parasite levels are likely to be highest in nests where young have been successfully reared in the previous season (Newton 1979), as in this case. Dermestid larvae are nest saprovores and, when in low numbers, their presence is important as they help clean the nest (Philips & Dindal 1977). Hence, the relationship between Dermestidae and host birds is mostly passive protocooperation (Dindal 1975): the birds provide food and shelter to the beetle larvae, which in turn eat animal matter in the nest such as eagle food remains, pellets and moulted feathers. However, when dermestid larvae are numerous, they can directly impact on birds by feeding on them and create open wounds (Snyder *et al*. 1984; Samour & Naldo 2003) and even kill nestlings (Rothschild & Clay 1952). In one instance, Brown Falcon *Falco berigora* chicks and the adult female, with severe feather damage, were seen in a nest that contained many dermestids, but the birds were in otherwise good condition (Nick Mooney pers. comm.).

Dermestidae is a family of the Coleoptera, often referred to as skin, hide or carpet beetles. Most genera of Dermestidae scavenge on desiccated animal material, such as skin, hair and feathers (Zhantiev 2009). The Larder Beetle *Dermestes lardarius* is a typical species found in raptor nests; females lay their eggs (usually >100) in the nests in spring. 2017 was a warm dry year in the study area (Bureau of Meteorology 2018) and dermestids are more active in such conditions (Charabidze *et al*. 2014). Their life cycle takes 2–3 months and second-generation larvae can bore into wood to pupate over winter. The adults that emerge in spring have round–oval bodies of diameter 7–9 mm, and they fly only in twilight or at night (Peacock 1993). The adult beetles evident in the video footage fit this description and it is likely that they were emerging adults of this or a similar dermestid species.

The addition of resin-rich pine greenery to the Little Eagle nest might not have had any effect on the number of dermestid larvae. Although the presence of pine material in Bonelli's Eagle nests has been found to be negatively correlated with the number of flies (Diptera) in the nests and positively with breeding success (Ontiveros *et al.* 2008), that study did not find any effect of pine sprigs on dermestids. Nor did other studies on Wood Storks *Mycteria americana* (Rodgers *et al*. 1988) and Common Starlings (Fauth *et al*. 1991). If the Little Eagles had assessed the larvae as a risk to them or any subsequent chicks, but the addition of pine sprigs did not reduce the infestation, the abandonment of the nest, and subsequent laying of eggs in another, would fit as their next action in avoidance of such risk.

It is not possible to give a precise reason for this instance of nest abandonment by Little Eagles. However, we present this record as an example of a raptor species that added fresh green foliage to a re-used old nest, which was probably infested by dermestid larvae. Then, when this did not have any apparent effect on the infestation, the birds subsequently moved to use an alternative nest. Although the results are inconclusive, nest parasites are poorly known in Australia (e.g. Hindwood 1951) and we hope that this report will stimulate further research.

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