Putative function of green lining in black sparrowhawk nests: mite-repellent role?

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We investigated whether the fresh green plant material with which black sparrowhawks (*Accipiter melanoleucus*) line their nests functions to repel insect pests and ectoparasites. When insect pest levels were elevated by means of securing an attractant (decaying meat) to the nest periphery, significantly more, and only highly volatile, *Eucalyptus* leaves were brought to the nest by the adult birds. At another black sparrowhawk nest, an outbreak of the haematophagous mite, *Ornithonyssus bursa*, was recorded one month after the birds had stopped lining the nest selectively with leaves containing high concentrations of phenolic lipids. This outbreak happened when the young had already fledged and were probably less susceptible to infestation than nestlings. The selective use of nest-lining material may serve to prevent chemically the transfer of mites from adults to the nest, and thus reduce infestation of nestlings. We discuss hypotheses and suggest future study directions for understanding the relationship between mites, their hosts, and the selective use of volatile plant chemicals.

Several hypotheses have been advanced to explain why some birds use green plant material to line their nests. These hypotheses include controlling nest moisture, retarding heat loss, advertising nest occupancy, and providing camouflage.1,2 A further postulate is that aromatic green nest material serves a chemical function to repel ectoparasites (such as mites) that reduce nestling growth and survival, particularly in cases where nests are re-used in successive years (ectoparasite repulsion hypothesis).3–9 Raptors face an additional problem in that the meat they provide for nestlings may attract unwanted flies, and the green table-cloth of leaves may have the physical function of covering the meat or preventing it from falling between the sticks of the nest (table-cloth hypothesis).10 The black sparrowhawk (*Accipiter melanoleucus*) is one of the common African raptors that re-uses and lines nests with green material during the breeding season.11,12 We have investigated the ectoparasite repulsion and table-cloth hypotheses with respect to this raptor and discuss some of the questions raised by this study.

Two in-use black sparrowhawk nests located in the Kenneth Steinbank Nature Reserve (29°54'S, 30°56'E), KwaZulu-Natal, South Africa, were observed in this study. The nests were 1.3 km apart and the birds' nesting behaviour was monitored from an 8.5-m-high scaffold supporting a hide erected 24 m from the nests.

To test the sanitation hypothesis, an experiment was carried out during the six-week attentive nesting period, that is, the five incubation weeks and the first brooding week, in which the black sparrowhawk female was present on the nest for most of the time.13 During each weekly visit to nest 1, the nest was observed on two successive days, once as a treatment and once as a control (the order was randomized). The treatment consisted of climbing to the nest and pegging a 7-cm³, three-day-old, partially rotten ox heart to the nest rim. During each treatment, the same peg was used and the meat was cased in chicken-wire mesh to prevent the birds from consuming it. Six control (292 ± 13 min, mean ± s.d.) and six treatment observations (241 ± 68 min) were made. Flies were collected once from a piece of rotten meat placed 30 m from the nest.

When presented with rotting ox heart, the breeding birds brought in green leafy sprays in five out of six treatments (83%), significantly more than the one in six controls (17%; Fisher exact test, *P* < 0.05). During exposure to the meat, breeders also brought green leafy sprays at a higher rate (0.34 ± 0.21 leafy sprays per hour) than the control (0.04 ± 0.09 leafy sprays per hour; *Z* = –2.02, *P* < 0.05). Eight green sprays were delivered to the nest during the treatment and in all cases the twig was placed next to the rotten meat. During the treatment the female spent, on average, 4.7 ± 1.7% (mean ±

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No mites were recorded at nest 1 but at nest 2 (week 12), the week the nestlings fledged, we note that the black sparrowhawks stopped lining the second nest with fresh leaves. Apart from transferring from one indigenous tree known for its high concentrations of volatile chemicals,14 at nest 2, the black sparrowhawks chemically disinfected the aromatic nest-lining material by the mites apparently find it difficult to disperse from prey to predator, especially when the latter is a bird-eater.9,15

The black sparrowhawks therefore timed the lining of the nest to coincide with the vulnerable period when the nestlings were small. The five-week period between halting the lining of the nest with fresh leaves and the mite outbreak (Table 1) coincided with O. bursa’s generation time of about one month.9 We therefore concluded that the selective use of fresh aromatic nest-lining material by the sparrowhawks chemically disinfected the nest and prevented a build-up of mites on the vulnerable young nestlings.

Furthermore, the fresh nest-lining materials appeared to inhibit the movement of mites between birds. The parasites were present in the nest in four of the eight weeks when fresh material was not being conveyed to the nest, and were not present in all six weeks when fresh leafy material was being provided (Table 1). The virtual absence of adult and deutonymph mites in the nest material indicated that they generally remained on the adult birds and that the early juvenile stages (protonymphs) left adult birds to pursue fledglings via the intermediary of the nest.17

The adult mites are blood feeders whereas nymphal stages are primarily nest bound and visit the host only to feed.9 Additional information about the mite’s life cycle on adult birds throughout the breeding period would enable more definite conclusions to be reached regarding the inhibiting effects of fresh plant lining. Mites apparently find it difficult to leave an incubating and brooding adult black sparrowhawk sitting on a carpet of fresh leaves. Apart from transferring from adult to offspring, and between birds mating and roosting together, the mites, which are not host specific, are also able to disperse from prey to predator, especially when the latter is a bird-eater.9

This study raised various questions. First, although birds are generally...
thought to have poorly developed olfactory senses, recent research has suggested otherwise.\textsuperscript{18,19} Do black sparrowhawks therefore locate the aromatic plants near their nests by means of smell? Given the great number of indigenous plants found in South African forests, for inexperienced breeders establishing a new territory it would be an inefficient strategy to search for aromatic plants through trail and error. One should also consider that the breeders at nest 1 may have responded to the foul smell of the rotten meat, rather than the irritation caused by the flies. Note that the female spent more time trying to remove the rotten meat than shaking her head. Second, to what size can an \textit{Ornithomyssus} population grow in a raptor’s nest? A large black sparrowhawk nest was composed of 3947 sticks (1447 sticks >20 cm in length) with a combined length of 835 m (W.R. Tarboton, \textit{in litt.}). At the highest density recorded in this study (25.7 mites/13 cm), this nest would have yielded 166 000 mites, of which 50 000 can cause a 6% daily blood loss in an adult domestic chicken.\textsuperscript{20}

Third, to what extent does \textit{Ornithomyssus} affect the fitness of the nestlings? Although blood-feeding mites on young birds are known to slow their growth and even to kill them, other studies have found no, or even a positive, relationship between fledging survival and the number of mites in the nest.\textsuperscript{7} Fourth, how sensitive are the mites to the aromatic foliage? Furthermore, to what extent is the reproductive strategy of the mites (which display extremely high fecundity) related to their parasitic mode of life, and, in turn, to the short period available to colonize nestlings. Although the nesting cycle of the black sparrowhawk is long enough to allow the mite populations to reach levels detrimental to the birds,\textsuperscript{21} the growth of the mite population is initially severely limited by the presence of fresh nest lining.

Finally, do raptor species that use fresh leafy sprays and nest over a wide geographic range select higher volumes of plant material, and leaves with higher volatile components, when nesting in hot, humid climates than in cool, dry climates?

This study has raised more questions than answers and we hope this note will encourage others to delve deeper into the mysteries of the life cycle of the haematophagous mite, the employment of fungigants by their avian hosts, and the effect of nest parasites on the survival of nestling birds.

We thank the National Research Foundation for a bursary (to W.A.P.) and the KwaZulu-Natal Ornithological Trust for funding the project. KwaZulu-Natal Wildlife provided a permit to work in sensitive ecological areas, and Formscar kindly donated the scaffolding for the hide. E.A. Ueckermann identified the mites and D. Barraclough the flies.


In Brief...

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The August 2002 issue of the National Research Foundation’s newsletter, \textit{news@NRF}, is now available on the NRF website at http://www.nrf.ac.za. Also available is the annual magazine \textit{Research Files}, which showcases research conducted by NRF grantees as well as that performed at the national facilities managed by the foundation. The web version of the magazine is available at http://www.nrf.ac.za/publications/researchfiles/

The \textit{Mail & Guardian} newspaper and the Foundation for Education, Science and Technology have joined forces to present South Africa’s first photographic competition aimed specifically at illustrating and communicating the nature and impact of science to a broad audience. The competition is open to professional and amateur photographers. The judges will be looking for stunning original images from all aspects of science, engineering and medicine. There are three entry categories to choose from, with cash prizes of R45 000 at stake. The closing date for entries is Monday, 30 September 2002. For more information, visit the competition website at http://www.fest.org.za/sciencelens

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