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Research News

What's bugging brood parasites?

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Brown-headed cowbirds (*Molothrus ater*) might reduce populations of the songbird species they parasitize, including endangered species. Data are therefore needed on the frequency with which cowbirds use different species of foster parents. Hahn *et al.* propose a clever new approach by which the identity of foster parents can be inferred from host-specific lice the cowbirds acquire as nestlings. We discuss the feasibility of this method and underlying assumptions.

'Tell me what company thou keepest,
and I'll tell thee what thou art.' –
Cervantes

Brown-headed cowbirds (*Molothrus ater*) are obligate brood parasites, which lay their eggs in the nests of other species of birds. Nestling cowbirds reduce the reproductive success of their hosts because cowbird nestlings outcompete host nestlings for food. Their negative impact on host species has been implicated in the decline of endangered species, such as the Kirtland's warbler (*Dendroica kirtlandii*)¹. Monitoring the influence of cowbirds, which parasitize a variety of passerine species, requires reliable data regarding which host species are used by cowbirds. Obtaining such data is difficult because it requires considerable time and money, and enough personnel who are capable of finding large numbers of nests. Indeed, the time taken to understand the extent to which cowbirds affect other species could be significantly reduced if a strategy facilitating identification of cowbird hosts could be found.

A new paper by Hahn *et al.*² describes such a potential shortcut. They propose an approach in which host-specific chewing lice (Phthiraptera) are used as natural markers to identify the foster parents of cowbirds. As such, their study is the first in-depth assessment of infestations of

chewing lice on cowbirds. Chewing lice are relatively host-specific 'permanent' ectoparasites that pass their entire life cycle on the body of the host. They move onto new hosts mainly during periods of direct contact between host individuals, such as between parent birds and their offspring in the nest³. Assuming that cowbird nestlings get lice from their foster parents, it should be possible to identify the foster species simply by determining which species of lice fledgling cowbirds have.

To test the feasibility of this idea, Hahn *et al.*² trapped and fumigated 244 recently fledged cowbirds. Lice were removed from the cowbirds and identified. Next, lice were collected from 320 birds representing most of the possible foster species at the study site ($n = 30$). Lice from cowbirds were compared with those from potential foster species to see how many cowbirds could be linked to a particular host species. Although interesting, the results were not quite as satisfying as one might have hoped. Only 44 (18%) of the fledgling cowbirds and 45 (14%) of their potential fosters yielded lice. Of the cowbirds yielding lice, only 11 (4.5%) could be assigned unambiguously to a single foster species.

Several factors contributed to the low proportion of cowbirds that could be matched with foster species. The most obvious problem was that so few birds had lice. This low prevalence contrasts with an earlier study of cowbirds in which lice were recovered from 71 of 155 (46%) of the birds sampled⁴. Hahn *et al.*'s low returns reflect their sampling of lice from live birds; the earlier studies had sampled dead birds. Lice were removed by exposing live birds to ethyl acetate fumes in a glass fumigation chamber, while keeping the head of the bird outside the chamber. Unfortunately, in addition to missing lice on the head, up to two-thirds of the lice on the body of the bird can also be missed by this method⁵.

Another problem discussed by Hahn *et al.*² was that several of the lice they collected were not specific for any one particular host. The worst offender by far, was *Menacanthus eurysternus*, a louse known from more than 150 species of passerines⁶. Conversely, eight species of lice collected from cowbirds were not found on any species of host², although several of these lice were already known to parasitize some of the sampled foster species⁶. It is possible that some of the eight species of lice recovered only from cowbirds are host-specific parasites of cowbirds, although further sampling is needed to confirm this specificity.

The existence of cowbird-specific lice would raise an interesting paradox about lice and other vertically transmitted parasites of brood parasites. Because lice depend largely on direct contact between hosts for transmission, and because no contact occurs between brood-parasitic nestlings and their biological parents, how would young brood parasites acquire their own specific lice? Two possibilities exist: (1) lice from adult brood parasites are deposited in the nest and move onto the young after they hatch; and (2) lice are transmitted from adult to juvenile cowbirds once they leave the nest. The first possibility is unlikely because without association with a host, the survival of lice is severely limited. If cowbird-specific lice exist, therefore, they must presumably transfer during periods of contact between juvenile and adult cowbirds.

This conundrum is the subject of two recent papers concerning another renowned group of brood parasites, the Old World cuckoos. Cuckoos are a much older group of brood parasites than are cowbirds^{7,8}; a fact which is reflected by the existence of two genera of cuckoo-specific lice (*Cuculoecus* and *Cuculicola*). The transmission paradox described above is

even more applicable in the case of cuckoo lice. On the basis of careful field work, Brooke and Nakamura⁹ concluded that the Common cuckoo (*Cuculus canorus*) must acquire its host-specific lice sometime between leaving the nest in summer and returning from migration the following spring. None of the 21 cuckoo nestlings they examined had cuckoo lice. Nor were any cuckoo lice found in 19 nests containing cuckoo eggs that had yet to hatch. However, cuckoos making their first return to the breeding grounds from the wintering grounds had as many lice as did older birds. The authors therefore suggest that the most likely transmission route for cuckoo lice is from adult to juvenile birds during feeding aggregations on the wintering grounds.

Studies of Diederik cuckoos (*Chrysococcyx caprius*) in Africa¹⁰ are consistent with the findings for Common cuckoos. No nestling cuckoos harbored cuckoo lice ($n = 14$), again suggesting that the cuckoos must acquire their lice after leaving the nest. Diederik cuckoos also carry lice from foster parents¹⁰, thus contradicting the conventional wisdom that foster lice do not occur on brood parasites, such as cuckoos^{3,11}. Two genera of foster lice were present on adult cuckoos, although the low abundance of these lice would not favor their long-term establishment.

As with the cuckoo studies, Hahn *et al.*'s results² initially appear to contradict the conventional wisdom that foster lice do not occur on brood parasites¹¹. The authors recovered nearly as many species of lice from cowbird fledglings ($n = 11$) as they did from all 30 foster species combined ($n = 13$). These results show that foster lice can transfer to cowbirds and survive on them, at least for a time. However, transfer is merely the first step in colonization of a new host; the parasites must also establish a viable breeding population on that host. Hahn *et al.*² recovered populations of only five species of lice from adult cowbirds, which is about the number of lice expected for a bird of this body size and sampling effort¹². Therefore, as with the papers describing the cuckoo research, Hahn *et al.*'s² results suggest that foster lice are not able to establish long-term breeding populations on cowbirds.

The issue of host body size is directly relevant to the paper of Hahn *et al.*² Of the 11 cowbirds on which lice could be

matched to those on a particular foster species, six were assigned to Red-winged blackbirds (*Agelaius phoeniceus*) and five to Wood thrushes (*Hylocichla mustelina*). Of the 18 cowbirds on which lice could be matched to those on one of two foster species, all involved either Red-winged blackbirds or Wood thrushes. The apparent high rate of fostering by these two species is probably an artefact of their similarity in body size to cowbirds¹³. Similarly, foster lice found on cuckoos are from foster species of similar body size to cuckoos¹⁰.

Recent experiments show that the survival of lice on 'foreign' hosts is dictated by feather barb size, which is itself correlated with body size. Lice transferred to foreign hosts can survive only if the foreign host is quite similar in size to the usual host¹⁴. It is conceivable that lice on Red-winged blackbirds and Wood thrushes survive longer on cowbirds than do lice from other foster species. This would increase the probability of finding lice from these two species on cowbirds, which would, in turn, increase the relative rate at which these species are identified as foster parents.

Body size might also be relevant for another reason. Large-bodied species of birds have more individual lice than do small-bodied species¹⁵. This probably explains why louse prevalence was higher for Red-winged blackbirds (42% infested) and Wood thrushes (43%) than for any other species in Hahn *et al.*'s² study. Therefore, cowbirds reared by blackbirds and thrushes, as opposed to those reared by other species of birds in the study, were probably more likely to acquire foster lice in the first place. This could have further biased the method used by Hahn *et al.* towards detecting blackbird and thrush foster parents.

The paper by Hahn *et al.*² is the result of a productive collaboration by workers in different fields, and the authors deserve credit for pioneering an interesting shortcut by which cowbird hosts can be identified. Their method of measuring specificity through large-scale sampling, is a rigorous approach recently championed by others¹⁴. This method might have potential under certain conditions, especially after some of its inherent assumptions have received further scrutiny. Perhaps the most important take home message of their paper is to remind us that even simple

approaches can be far more complicated than they at first appear.

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