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# Ectoparasites and other invertebrates in the nests of the Hair-crested Drongo (*Dicrurus hottentottus*)

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**Abstract** Ectoparasites and other invertebrates are known to play a role in bird behavior and in evolutionary adaptations such as preening and foraging strategies. We conducted an exploratory study by macro- and microscopically evaluating the nests of Hair-crested Drongos (*Dicrurus hottentottus*) at Dongzhai National Nature Reserve, Henan Province, China in 2011 to determine if there was a presence of invertebrates. We developed a modified funneling technique to collect invertebrate samples and reduce contamination from outside sources in a field setting. We found several species of ectoparasites (lice and ticks) and other invertebrates (springtails and rove beetles) within the nests. Our findings warrant further investigation as to whether or not the presence of invertebrates in the nests of Hair-crested Drongos plays a role in the adaptation of the unique nest dismantling behavior exhibited by this species.

**Keywords** China, *Dicrurus hottentottus*, Dongzhai National Nature Reserve, ectoparasite, invertebrate, modified funneling technique

## Introduction

Some bird species are known to dismantle materials from old nests for re-nesting (Sedgwick and Knopf, 1988; Kershner et al., 2001) as well partaking in klepto-parasitism of nesting material from active nests (Jones et al., 2007; Slager et al., 2012). The Hair-crested Drongo (*Dicrurus hottentottus*) tends to reuse materials from failed nests to re-nest, but also exhibits a non-typical behavior by dismantling their own nest after the young have fledged (Li et al., 2009). Li et al. (2009) proposed that nest dismantling was an adaptive behavior to increase fitness by reducing the risk of predation, reducing competition for nesting sites, or both. Such adaptations are complex and sometimes could be explained by other hypotheses.

Parasitic and non-parasitic invertebrates can take refuge in the nests of birds (Woodroffe, 1953). Some of these invertebrates are already present in the vegetation used for nesting material, thus using the vegetation as their refugia and food source; however some will use the birds as their host (Merino and Potti, 1995; Brown et al., 2001) and are introduced into the nest via nesting birds. Often ectoparasites play a negative role on the avian species they utilize (Merino and Potti, 1995; Brown et al., 2001). Birds may avoid inhabiting parasite infested areas, and can develop ways to either eliminate or avoid recruiting parasites (Hart, 1990). The role of parasites has even been responsible for other adaptations such as preening (Marshall, 1981; Clayton, 1991; Cotgreave and Clayton, 1994). In the case of the Hair-crested Drongo, the question can be made if this unique nest dismantlement behavior is an adaptation to con-

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trol parasite populations, which may otherwise have a negative effect in the fitness of the species. Parasite control may be needed since drongos often nest in the same tree and even on the same branch used from previous nesting periods (Li et al., 2009).

To our knowledge, there has never been any formal macro or microscopic evaluations of Hair-crested Drongo nests. Our objectives in this study were to document the presence of parasitic and non-parasitic invertebrates within the nests of Hair-crested Drongos using funneling techniques in a field setting. This study was designed to further the ongoing study of drongo's nest dismantling behavior. Though this study was not designed to test any formal hypotheses, our goal was to provide the basic ground work for future hypothesis testing that could possibly help explain the nest dismantling behavior.

## Methodology

### Study species and site

This study was conducted at Dongzhai National Nature Reserve (31.95°N, 114.25°E), which is located in the Dabieshan Mountains of Henan Province of central China (Li et al., 2009). The reserve is located in the transitional area of subtropical and temperate zones. The study was conducted at Baiyun Station, which is located within the Reserve. Dongzhai National Nature Reserve is known for its high avian diversity (over 300 species) and was established initially as a bird reserve (Song and Qu, 1996). The Hair-crested Drongo is a common bird throughout much of southeast Asia and is known to breed in central and northern China (Zheng, 2011). The Hair-crested Drongo is a migratory species arriving at the study site to in April, with the breeding season lasting till early August (Li et al., 2009).

### Invertebrate/parasite sampling

Invertebrates, including parasites were sampled from collected nests of the Hair-crested Drongos. Nests were removed by cutting their main support branch after the nests became inactive and prior to the nest being dismantled by adults. Upon collection, macroscopic evaluations of ten nests were conducted to determine if any invertebrates were visible to the naked eye. Following macroscopic evaluation, the eight of the collected nests were bagged to make sure there was no outside contamination. Nests were first sampled using the Berlese funneling technique (Berlese, 1905; Nolan, 1955; Brown et al., 2001), with the sampling methodology being modified after two collections because of contamination issues. Originally, nests were put directly under a lamp, with a funnel placed directly underneath the nest to direct invertebrates into a sterile vial containing an alcohol solution (70% ethyl alcohol, 30% $H_2O$) for at least 24 hours, with nests being tapped to dislodge possible invertebrates from the nest and into the funnel. The modified sampling technique entailed taking the bagged nest and securing the funnel and vial through a hole in the bottom of the bag by tape to prevent any escape or entry of invertebrates. These modified funnels were then placed outside in an open area receiving direct sunlight for approximately 36 hours, and were set up so that the majority of this time was during daylight hours. Samples were not collected during rain events or in untypical cloud cover. Vials were labeled for identification and taken back to Beijing Normal University laboratories for evaluation. Because our goal was not to quantify the amount of parasites/invertebrates present, we only documented the presence/absence during macro and microscopic evaluations.

## Results

A total of 10 nests were observed macroscopically, and 8 of these were sampled microscopically (2 Berlese, and 6 modified funneling technique). It was immediately evident that the light used in the standard Berlese funneling technique acted as a visual lure (Neethirajan et al., 2007), thus attracted several flying insects and contaminated the first two nest microscopic evaluations. Using the modified funneling technique reduced the contamination by other insects, and using the energy of the sun proved to be a more effective and efficient method under field conditions. Due to high diversity of insects and difficulty identifying each species, collected invertebrates were identified down to the taxonomic class, order, or family level. Macroscopic observation showed that lice (order: Phthiraptera) were present in the majority of the nests, and an unidentified larvae and chrysalis were observed. Microscopic evaluations showed that parasites and other invertebrates were present within the nests (Table 1). Lice, adult and larvae rove beetles (family: Staphylinidae), springtails (class: Collembola), and of ticks (family: Ixodidae) were observed. One nest yielded rove beetles, another separate nest had springtails, and 2 nests contained ticks. Lice were present in all samples.

## Discussion

Though our research objectives were not to test methodology efficiency, much was learned about the methodology to conduct such research and could benefit similar studies in the future. In this case, modifications had to be made in order to achieve research objectives. The modified funneling technique used in this study could prove to be useful in areas where laboratories are not available, or in areas where local surroundings cannot be controlled. Our modified funneling technique shows that such research can be done using limited resources coupled with natural resources (i.e., sunlight) to produce results. Though the use of sunlight for funneling techniques is not a new concept (Bondy, 1940), this is the first time such an application has been used for investigating invertebrate and avian nest relationships.

We found that several parasitic and non-parasitic invertebrates do inhabit the nests of Hair-crested Drongos. Rove beetles belong to the family Staphylinidae, which is one of the largest and most diverse beetle families in the world and are known to inhabit the nests of many different taxa (see Klimaszewski et al., 1996). Rove beetles have been found to play different roles in avian nests depending on the beetle species (Majka et al., 2006). Certain rove beetles will feed on the vegetative material found in nests while some will feed on other invertebrates, including parasites, which in turn could be beneficial to bird species by reducing parasitic loads (Majka et al., 2006). The proportion of rove beetles in the nests of Hair-crested Drongos found in this study (17%) is comparable to the proportion found in the nests of Great Tits (*Parus major*) (13%) (Heeb et al., 2000). Because of the high diversity found in Staphylindae coupled with the lack of this type of research in this region, the possibility of the rove beetle species detected in this study being new unidentified species is likely, or could exhibit new geographic extensions of certain species. Majka et al. (2006) found 14 different beetle species in owl nests in Nova Scotia, Canada, many of which were new records demonstrating geographic range extensions, and some were first time recordings from bird nests. Majka et al. (2006) also found that 8 of the 14 species beetles found belonged to the family Staphylinidae.

**Table 1** Presence and frequency of parasitic and non parasitic invertebrates in six nests of Hair-crested Drongos at Dongzhai National Nature Reserve, Henan, China

| Nest number | Lice Phthiraptera[a] | Springtails Collembola[a] | Rove Beetles Staphylinidae[a] | Ticks Ixodidae[a] |
|---|---|---|---|---|
| 1 | √ | | √ | √ |
| 2 | √ | | | |
| 3 | √ | | | √ |
| 4 | √ | | | |
| 5 | √ | | | |
| 6 | √ | √ | | |
| Frequency (%) | 100 | 17 | 17 | 33 |

[a] Taxonomic descriptions represents the closest class, order, or family species that were able to be identified.

Springtails were another invertebrate detected within the nests of Hair-crested Drongos. Pung et al. (2000) found that springtails were found in 5% of Red-cockaded Woodpecker (*Picoides borealis*) nests. Though our results show a higher frequency of springtails (17%), this could be attributed to our low sample size, geographic variation, or could further demonstrate the variability of arthropod community structure within avian nests. Furthermore, Pung et al. (2000) found a lower frequency of springtails but detected 11 other types of arthropods, including six different types of mites, thus having a higher diversity of arthropods than what was found in our study.

The presence of parasites, such as lice and ticks, has been well documented to have host relationships with avian species, however most researches focus on the presence of such species that use the actual bird species as a host rather than the in the nest. It is important to understand what effect these invertebrates have on certain aspects of avian biology such as the nest site selection, adult survivorship, and overall fitness of a species. Lice have shown to reduce the survival in Feral Pigeons (*Colomba livia*) by increasing the energy needed for thermoregulation (Clayton et al., 1999). Parasites have played a role in the adaptation of preening behavior of birds, in which preening serves as a way to control harmful ectoparasites (Marshall, 1981; Clayton, 1991; Cotgreave and Clayton, 1994). The presence of parasites can cause the avoidance of nesting sites (Chapman, 1973; Brown and Brown, 1986; Loye and Carroll, 1991) and can even cause nest and nestling abandonment (Duffy, 1983; Calyton and Moore, 1997). The frequency of lice on live hosts or in nests is species specific (both avian and louse). Rozsa et al. (1996) found that five species of lice were found on both Hooded Crows (*Corvus corone cornix*) and Rooks (*C. frugilegus*), however the frequency was different between species with 53% of Hooded Crows and 92% of Rooks being infested. Furthermore, Rozsa et al. (1996) found Rooks to have higher lice richness, diversity, and loads, in which they contribute some of these differences to be associated with the community structure of these species with rooks being colonial and Hooded Crows being more solitary. Pung et al. (2000) only found louse in 2% of Red-cockaded Woodpecker nests. All of these findings discussed indicate the variability and complexity of invertebrate-avian host relationships.

Several studies have shown that territory may be more of a factor in nest site selection rather than decreased nest quality (see Loye and Carroll, 1998). In the case of the Hair-crested Drongo, the main supporting hypothesis as to explain the nest-dismantling behavior is that this species dismantles its nest to reduce competition for breeding sites and to increase species fitness. Having ectoparasitic present in the nests of Hair-crested Drongos certainly supports the plausibility that other behaviors, such as nest-dismantling could have been adapted to control such parasites. Even though, we do not propose the nest dismantling behavior is strictly driven by the presence of parasitic and non-parasitic invertebrates,we do suggest it may be a surrogate factor, and could warrant further investigation. Further investigations into whether or not parasites in the nests have any effects on nest site selection, rate of nest dismantlement, and fitness of this species would further benefit what we know about the Hair-crested Drongo.

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# 发冠卷尾巢内体外寄生物及其他无脊椎动物

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**摘要：**已知体外寄生物及其他无脊椎动物在鸟类行为以及诸如理羽及觅食策略的进化适应方面起一定的作用。我们于 2011 年在河南董寨国家级自然保护区对发冠卷尾（*Dicrurus hottentottus*）的巢穴进行了宏观及微观水平的调查，以确定该鸟的巢内是否存在无脊椎动物。我们运用改进的汇集技术在野外条件下收集巢内无脊椎动物样品以减少外源污染。结果表明，发冠卷尾巢内存在几种体外寄生物（虱目及硬蜱科）和无脊椎动物（弹尾目及隐翅虫科）。该发现为我们进一步研究发冠卷尾巢内的无脊椎动物对该鸟种独特的拆巢行为的进化适应所起的的作用提供了基础。

**关键词：**中国，*Dicrurus hottentottus*，董寨国家级自然保护区，体外寄生物，无脊椎动物，改进汇集技术