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Response to Nestling Throat Ligatures by Three Songbirds

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ABSTRACT.—We attempted to collect diet samples using throat ligatures from nestlings of three songbird species in a riparian woodland in southeastern Arizona from May to August 2009. We had success with Song Sparrows (*Melospiza melodia*), observed adult Yellow-breasted Chats (*Icteria virens*) reclaim food from nestlings, and discontinued the use of throat ligatures when we observed an adult Abert's Towhee (*Pipilo aberti*) remove two, 3–4-day-old ligatured nestlings from its nest. Previous studies have reported problems (e.g., aggression toward nestlings by adults) with throat ligatures, but we are the first to document removal (and subsequent nestling mortality) in response to this technique. We urge investigators to exercise caution when using throat ligatures on species for which evidence of the safety and efficacy of this method are lacking, especially when nestlings are small in size relative to adults. Received 18 February 2010. Accepted 29 April 2010.

Documenting the diet of birds is an important component of many studies designed to test hypotheses related to ecology and evolution of birds. Documenting the diet of nestling birds in an unbiased manner is particularly challenging, especially when investigators want to identify prey items to taxonomic levels beyond Order or want precise estimates of biomass. Investigators have used throat ligatures to collect diet samples from nestling birds since the 1930s (Kluyver 1933, Owen 1956, Mellott and Woods 1993). Fecal analysis, the use of artificial nestlings to collect food, analysis of stomach contents, and visual observation (Evans 1964) are often less effective or more invasive than throat ligatures. However, researchers have experienced several problems with throat ligatures related to both quality of the sample obtained and safety of the nestlings sampled. For example, food may slip past the ligature if the ligature is too loose (Owen 1956, Orians 1966), or food is disgorged if the sampling period is too long or the rate of provisioning too high (Orians 1966, Johnson et al. 1980). Moreover, parents will, at times,

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remove and eat the food from the mouth of the ligatured nestling (Robertson 1973). Ligatures have also been found to affect normal gaping (Johnson et al. 1980) and begging behavior (Orians and Horn 1969), and to occasionally cause death by strangulation (Moore 1986, Mellott and Woods 1993).

Several authors have described accounts of aggressive behavior by adults toward nestlings with throat ligatures. Robertson (1973) mentions that Red-winged Blackbirds (*Agelaius phoeniceus*) in a few cases attempted to remove ligatures from nestlings. Little et al. (2009) reported that adult Bobolinks (*Dolichonyx oryzivorus*) pecked and pulled at nestlings' throat ligatures at most nests sampled. Furthermore, aggressive behavior by adults such as grasping the ligature and forcibly pulling the nestlings' heads upwards or sideways occurred at half of the nests. Despite this aggression, Little et al. (2009) did not observe any nestling mortality resulting from the behavior of the adults. We provide the first documentation of nestling mortality resulting from removal by adults of nestlings outfitted with throat ligatures.

METHODS

We monitored nests of Abert's Towhees (*Pipilo aberti*), Yellow-breasted Chats (*Icteria virens*), and Song Sparrows (*Melospiza melodia*) from May to August 2009 in a riparian woodland along the Santa Cruz River at Tumacacori National Historic Park (31° 34' 03" N, 111° 03' 03" W), Santa Cruz County, Arizona, USA. The elevation is ~1,000 m and the plant communities are cottonwood-willow (*Populus-Salix*) riparian forest along the river and mesquite-hackberry (*Prosopis-Celtis*) woodland in the adjacent upland. We attempted to collect diet samples from nestlings of the focal species by attaching throat ligatures via the collar method (Kluyver 1933, Johnson et al. 1980). We constructed ligatures from 20–22 gauge, solid-core, black or blue plastic-coated copper wire (RadioShack Corp., Forth Worth, TX, USA) and bent the wire into a U-shape which we fitted around the nestlings' necks sufficiently tight to prevent swallowing but sufficiently loose to allow normal breathing and gaping behavior. We weighed (g) each nestling before applying the ligature and returned nestlings to their nest within 10 min. We used binoculars to observe each sampled nest from a distance of ~15 m until we saw adults return with food. We approached the nest after each feeding visit to

remove food from the nestlings' mouths with tweezers. We tried to collect samples for 2–4 consecutive feedings at each nest before removing the ligatures to maximize the size of the food sample, and to prevent handling the nestlings and disturbing the nest on more than one occasion. We compensated for the missed feedings during sampling by feeding each nestling a comparable portion of waxworms (pyralid larvae) after we removed the ligatures.

RESULTS

All three nests with ligatured Song Sparrow nestlings (3–8 days of age) yielded diet samples with no apparent problems. We observed adults at four of five Yellow-breasted Chat nests (nestlings of 2–5 days of age) remove food from ligatured nestlings' mouths before leaving the nest when the food was not swallowed (i.e., diet samples were biased; *sensu* Robertson 1973). We sampled (with black ligatures) our first Abert's Towhee nest containing two 3–4-day-old nestlings on 29 July 2009 at 1052 hrs (MST). Nestling "A" weighed 7.0 g and nestling "B" weighed 16.7 g. Both adults arrived at the nest with food ~25 min after we applied the ligatures, and attempted to feed the nestlings for 2–3 min. We observed at least one of the adults consume food that was originally placed in a nestling's mouth, similar to that observed for Yellow-breasted Chats. We approached the nest to collect diet samples after the adults left and found that only nestling "B" remained in the nest. We searched under the nest but could not find nestling "A." We took a diet sample from nestling "B" and retreated to observe the nest from a distance. An adult returned to the nest ~10 min later with food and spent ~1 min trying to feed the nestling. We then watched the adult remove the nestling from the nest and depart from the nest before we lost sight of the adult. We immediately approached the nest, began searching for nestling "B," and found nestling "B" 2 m from the nest on the ground. The ligature was missing, and we concluded the adult had carried the nestling by grasping the ligature thereby forcing the ligature to open and slide off the nestling's neck. We examined nestling "B," found no sign of injury, returned it to the nest, and moved away for observation. The adult returned about 5 min later to feed the nestling and then shaded the nestling for about 5 min. The adult appeared to resume typical behavior as soon as the ligature was removed

from the remaining nestling, suggesting the ligature elicited the adult's response and not the nestling itself. We did not find nestling "A" and assumed that it died after being removed from the nest.

DISCUSSION

Nest sanitation is the process by which parent birds rid their nests of foreign debris (Welty 1982). Several authors have described parent birds attempting to sanitize (remove) banded nestlings when parents perceived leg bands as foreign debris in the nest (Lovell 1945, Berger 1953, Brackbill 1954). No published account exists of a throat ligature eliciting nestling removal by adults despite the superficial resemblance of throat ligatures to leg bands on nestling birds. This behavior has been observed with Florida Scrub-Jays (*Aphelocoma coerulescens*) (Reed Bowman, Archbold Biological Station, pers. comm.). Ours is the first study to report an instance of nestling removal by adults (and subsequent nestling mortality) in response to use of throat ligatures.

We believe other researchers that have reported aggressive behavior of adults toward ligatured nestlings did not observe removal of young because adults in these studies were physically incapable of removing nestlings due to the relative mass of the nestlings. For example, Little et al. (2009) described aggressive behavior (but not removal) of ligatured, 6-day-old Bobolink nestlings that would have weighed 53% of adult body mass (Martin and Gavin 1995). Towhee nestlings in our study were 16 and 37% of adult body mass based on average adult body mass of 44.7 g (Tweit and Finch 1994). Nest substrate may also affect an adult's ability to successfully remove nestlings from a nest and may explain interspecific variation in this behavior.

We encourage future investigators to observe parental behavior at several nests before they use throat ligatures widely on a species for which evidence of the safety and efficacy of this method is lacking, especially on younger nestlings that weigh <50% of adult body mass. Some species accept throat ligatures without problems (e.g., Song Sparrows in our study) and other species experience problems that may bias diet samples (e.g., Yellow-breasted Chats in our study). The color or type of material used to make ligatures may affect the probability of removal and deserves further study. We used both black and

blue ligatures, but birds may respond differently to other colors similar to the way that some birds respond differently to different band colors (Burley 1988). We are concerned that removal of young by adults in response to use of throat ligatures on nestlings may be relatively widespread in birds based on recent observations of this behavior by Florida Scrub-Jays (Reed Bowman, pers. comm.), the observations described here of Abert's Towhees, and the recent report of aggression toward ligatured nestlings by Bobolinks (Little et al. 2009).

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