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MURDER MYSTERY AT THE NEST OF A BROWN-HEADED NUTHATCH (*Sitta pusilla*)

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Conspecific aggression occurs regularly among birds but only rarely results in death. The rarity of lethal aggression is thought to stem from the imbalance that exists in the potential outcome of aggressive interactions: the benefit of winning a lethal engagement only rarely outweighs the cost of losing a lethal engagement (Piper et al. 2008). The magnitude of this cost/benefit imbalance appears to be large given the scarcity of conspecific killing documented for birds (Hof and Hazlett 2012); however, the magnitude of the imbalance can diminish during the breeding season when aggressive interactions can lead to improved reproductive success (Dunn et al. 2014). For example, female Eastern Bluebirds (*Sialia sialis*) respond with heightened aggression to intruding females during periods of the nesting cycle when eggs are present (Gowaty and Wagner 1988). The sex- and context-specific aggression that female bluebirds exhibit is thought to guard against the threat that conspecific egg-dumping may pose, but also infrequently leads to maiming or death (Blake 1954, Gowaty and Wagner 1988).

We describe the discovery of a dead female Brown-headed Nuthatch (*Sitta pusilla*) whose death may have resulted from aggressive interactions with another nuthatch. Since 2006, a large color-marked nuthatch population has been studied on Tall Timbers Research Station (Leon County, Florida) to learn more about the demography of this cooperatively breeding pineland endemic (Cox and Slater 2007). Scores of nests are monitored each year by inspecting nest cavities using flashlights and dental mirrors approximately every 4 days (Cox and Slater 2007). The field efforts document the marked adults associated with each nesting attempt and variation in nesting success and productivity among territories.

On 18 March 2016, a dead, unmarked adult nuthatch was discovered inside a nest (Fig. 1) that appeared to be excavated and tended exclusively by a marked male-female pair based on the field observations collected during previous visits to the territory. The marked pair had begun lining the cavity approximately 10 days earlier, and two eggs were observed in the nest on Mar 14. The marked pair was banded initially at a nearby nest site (< 75 m) in 2014 and had been observed in the area ever since.

The dead individual was extracted from the cavity using forceps. The corpse was stiff as a result of rigor mortis, and there were small peck marks and bruised flesh around



Figure 1. Deceased female Brown-headed Nuthatch as discovered inside the nesting cavity of a marked male-female pair of nuthatches.

the head (Fig. 2). There were also three undamaged eggs in the nest and one cracked egg. The individual appeared to be a female based on its wing chord length (< 63 mm), but we could not detect the presence of an egg inside the individual using palpation. Sex was confirmed through an analysis of DNA extracted from a few feathers plucked from the deceased (performed by Avian Biotech International, Tallahassee, Florida; a private company that uses molecular procedures to sex birds for research and commercial purposes).

The animal responsible for this death was unknown, but the entrance to the nest cavity measured 34 mm x 28 mm along the major axes and would have precluded entry by an Eastern Bluebird or any other cavity-nesting bird much larger than a nuthatch. Field observations collected up to this point had not noted any strong interactions with other species of small, cavity-nesting birds (e.g., Carolina Chickadee [*Poecile carolinensis*] or Tufted Titmouse [*Baeolophus bicolor*]). Except for the peck marks around the head, the deceased female also was unmarred and lacked the bite marks found on the carcasses of other dead females discovered in their nest cavities and thought to have been killed by small mammals (Cox and Slater 2007). Although we saw the marked pair of nuthatches



Figure 2. Close up of head wounds on the dead female. There were no marks elsewhere on the body.

giving alarm notes from a nearby pine tree during this discovery, there was no further activity observed at the nest for several days. However, 13 days later the pair initiated a new nesting attempt in the same cavity that failed due to predation on April 8.

We observe conspecific aggression regularly in this nuthatch population and often use aggressive conspecific responses as a tool for marking new adults. Adults are lured into mist nets using wood-carved nuthatch models and conspecific vocalizations broadcast through an MP3 player (Cox and Slater 2007). The models typically are placed on the lower branches of a pine tree or a low-statured snag. The adults targeted for marking regularly avoid mist nets and land on or near the models. Some adults attack the models using sharp pecking actions around the head. Direct attacks to the head have also been observed during aggressive interactions with other cavity-nesting species. During experimental manipulations where a taxidermy model of a Red-headed Woodpecker (*Melanerpes erythrocephalus*) was placed at the entrance to an active nuthatch nest, individual nuthatches were observed directly striking the head of the model.

The circumstances surrounding the death of this female are also consistent with the heightened female aggression noted for Eastern Bluebirds and other cavity-nesting birds during egg laying and incubation (Gowaty and Wagner 1988, Rosvall 2008). Female aggression appears to peak at this time in an effort to prevent brood parasitism or reduce the damage brood parasites may inflict upon an active nest (Gloag et al. 2013). Female aggression among cavity-nesting species also is hypothesized to be accentuated during the nesting period because of a presumed scarcity of available nest sites (Rosvall 2008).

Our observation also suggests that egg dumping should be considered in future studies of both maternity/paternity and cooperative breeding behavior in the Brown-headed Nuthatch. When Han et al. (2015) assessed the prevalence of extra-pair paternity in this nuthatch population using molecular techniques, they assumed that egg dumping did not occur. Egg dumping is a pathway that subordinate female helpers of other cooperatively breeding species use to produce offspring (Richardson et al. 2002).

Female helpers have been documented for this population (J. Cox, unpubl. data) and in south Florida (Cox and Slater 2007) that provide assistance to their presumed parents or to nests adjacent to the helper's natal territory. Female helpers in south Florida assist with incubation (Cox and Slater 2007), but video data collected at nests in our north Florida population suggest that dominant females consistently exclude female helpers during egg laying and incubation (J. Cusick, unpubl. data). Geographic variation in the types of assistance that dominant females are willing to accept from subordinates may reflect trade-offs between the negative threats posed by brood parasitism and the positive benefits that female helpers might provide.

Female floaters also have been documented for this population and also likely use egg dumping as a method for reproducing outside the more typical condition of a territorial pair bond. We suspect that the female killed here was a floater, not a helper, because the marked pair did not nest successfully in the previous year and had been seen exclusively at the nest site in six visits conducted prior to the discovery of the dead female in 2016. The breeding females and nestlings associated with all surrounding nests ($n = 6$) also had been marked in previous years, implying that the deceased female likely came from outside the immediate neighborhood.

Taken collectively, these observations suggest that breeding behavior in the Brown-headed Nuthatch is more complex than previously recognized and should consider egg dumping as another reproductive strategy employed by females.

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