

Tool Usage by Juvenile *Sitta pusilla* (Brown-headed Nuthatch)

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Abstract - Although tool usage in adult birds is well documented, we have not found reports of juvenile birds using tools other than a few observations of individuals held in captivity. Here we describe the first observations of tool usage by juvenile birds in the wild. We observed juvenile *Sitta pusilla* (Brown-headed Nuthatch) using tools similar to those used by adults as early as 2 months post-fledging. We also observed juveniles attempting to use novel objects as tools, suggesting tool usage in this species may have both innate and learned components. Tool usage also takes place in 2 closely related nuthatch species and may be more common in this family of birds than currently known.

Tool usage has been documented in over 270 species of birds in 33 families (Bentley-Condit and Smith 2009). The behavior is defined as the manipulation of an external object to enhance functions normally carried out using an appendage. Use of external objects must be purposeful and goal-directed, and frequently includes a learned component as indicated by use of objects following observations of other animals using similar objects or the refined use of an object over time (Beck 1980, Bentley-Condit and Smith 2009, LeFebvre et al. 2002, Morse 1968, St. Amant and Horton 2008).

Tool usage by adult birds has been documented both in the wild and in captivity (Bentley-Condit and Smith 2009, Kenward et al. 2005); however, reported observations of juvenile birds using tools are restricted to a few individuals held in captivity. Captive juvenile *Camarhynchus pallidus* Sclater and Salvin (Woodpecker Finch) and *Corvus moneduloides* Lesson (New Caledonian Crow) have been shown to develop tool-using skills despite having no adult models from which to learn (Kenward et al. 2005, Tebbich et al. 2001). Tool use by captive juveniles suggests the behavior has a strong innate component in birds (Borsari and Ottoni 2005, Kenward et al. 2005, Tebbich et al. 2001), but the ontogeny of tool use among other juvenile animals is more variable and frequently includes a learned component. For example, juvenile *Pan troglodytes* Blumenthal (Chimpanzee) develop tool-using skills through a mixture of social learning and practice, and also display more innovative uses for tools than adults (Biro et al. 2003, Tomasello et al. 1987).

Sitta pusilla Latham (Brown-headed Nuthatch) is a *Pinus* (pine) specialist of southeastern forests that is declining throughout its range. Since 2006, we have marked adult and nestling Brown-headed Nuthatches on Tall Timbers Research Station and Land Conservancy (hereafter TTRSLC; Leon County, FL) using unique color-band combinations that enable us to monitor individual movements, survival, and productivity. This species exhibits interesting behaviors that include cooperative breeding (Cox and Slater 2007), adult tool-usage (Morse 1968), and social grooming (Cox 2012).

In 2012, we began monitoring adult and juvenile Brown-headed Nuthatches more extensively during the post-fledging period (May–Oct) to document dispersal and assess behavioral interactions. We made monthly visits to territories that successfully fledged young to determine which marked juveniles remained within natal territories. To locate juveniles that dispersed, we also visited annually hundreds of additional locations distributed randomly throughout TTRSLC. We employed binoculars and spotting scopes to read color-band combinations on the marked individuals encountered, and recorded behavioral

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activities such as agonistic interactions and social grooming (Cox 2012). Here, we describe the first records of which we are aware of tool use by wild juvenile birds; our observations were all based on color-marked birds:

- (1) 5 May 2012: juvenile used a 3-needle pine fascicle to probe a mass of dead pine needles stuck in the crotch of a limb; no food item secured.
- (2) 3 July 2014: juvenile used a pine needle to lift a bark scale and then seized a hidden caterpillar.
- (3) 13 August 2014: juvenile used a twig to remove bark scales apparently in search of food; while searching, the twig broke in half and, after inspecting the smaller stick, the juvenile resumed using the smaller stick to probe beneath bark scales; no food secured.
- (4) 7 October 2015: juvenile used a pine-bark scale to remove another pine-bark scale in search of food; prey acquisition not confirmed.
- (5) 16 October 2015: juvenile used a twig to remove bark scales and acquired a hidden grub; a second juvenile then flew in with a twig to the same spot and attempted to remove another bark scale; no food secured.

We observed juvenile Brown-headed Nuthatches using tools within a few months after fledging (which takes place March–April in this population; Cox and Slater 2007). Tool usage in this species appears to have an innate component given the early age at which the behavior appeared coupled with the rarity of observations of adult tool usage during the post-fledging period. We saw only one adult Brown-headed Nuthatch using a tool during the 680 h of field observations we collected. Other reports of adult tool usage are restricted to fall and winter (Morse 1968, Pranty 1995). The observations of multiple juveniles using novel tools soon after fledging coupled with adults using tools rarely during this period suggest the behavior is not associated with cultural transmission (Aplin et al. 2015). The tools used by adults and juveniles are abundant in the area studied, so the use of novel tools exhibited by juvenile nuthatches does not likely stem from competition for items with adults (Cole and Quinn 2011, Morand-Ferron et al. 2011). Adult tool-usage is thought to be inversely linked to winter-food availability. For example, Morse (1968) reported higher usage (on average 1 observation of tool usage in 15 h of field observation) when seed crops were low and lower usage (1 observation per 75 h of field observations) when seed crops were more abundant.

Previous reports of tool use by adult Brown-headed Nuthatches indicate they do not use flexible objects such as pine needles, but instead use hard pine-bark scales and short twigs (Morse 1968, Pranty 1995). We observed 1 juvenile successfully use an apparently novel object (pine needle) to secure food, which may reflect a form of experimentation similar to that reported in captive juvenile corvids and Woodpecker Finches (Bird and Emery 2009, Kenward et al. 2005, Tebbich et al. 2001).

Eleven members of the family *Sittidae* exhibit “proto” tool use (LeFebvre et al. 2002), but *Sitta canadensis* L. (Red-breasted Nuthatch), *Sitta pygmaea* Vigors (Pygmy Nuthatch), and Brown-headed Nuthatches are the only species that exhibit true tool use (Bentley-Condit and Smith 2009, Matthysen 1998). True tool use is defined as manipulation of objects not affixed to a substrate, while proto tool usage involves manipulation of objects that are affixed to a substrate (Bentley-Condit and Smith 2009). For example, *Sitta carolinensis* Latham (White-breasted Nuthatch) wedges seeds in gaps under bark scales that hold the seed firmly in place as the bird hammers it open (Davis 1995, Mitchell 1993). Interestingly, the 3 species exhibiting true tool use fall within a distinctive 8-species subgroup of nuthatches based on a recent phylogenetic assessment involving DNA (Pasquet et al. 2014).

To date there are no reports of tool use for the other nuthatches found in this subgroup—*Sitta yunnanensis* Ogilvie-Grant (Yunnan Nuthatch), *Sitta krueperi* Pelzeln (Kruiper's Nuthatch), *Sitta ledanti* Vielliard (Algerian Nuthatch), *Sitta villosa* Verreaux (Chinese Nuthatch), or *Sitta whiteheadi* Sharpe (Corsican Nuthatch)—but this subgroup may harbor additional undiscovered cases of tool usage because all members share other life-history traits such as nest-site excavation and a reliance on the seeds of coniferous trees (Harrap and Quinn 1995, Matthysen 1998).

Acknowledgments. This research was supported by the Wildlife Research Endowment at Tall Timbers Research Station and Land Conservancy. Marking and handling of nuthatches was conducted in compliance with the ethical standards provided in Fair et al. (2010) and approved by the Tall Timbers Institutional Animal Care and Use Committee (#1042).

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