

Sexual Behavior of Tufted Titmice in the Mid-Atlantic Piedmont and Southern New Jersey

Matthew R. Halley

The Tufted Titmouse (*Baeolophus bicolor*) is a non-migratory resident of eastern North America and frequent attendee of backyard bird feeders in the Mid-Atlantic States during the winter months. Our knowledge of the species' breeding behavior is scant, as the sexes are monomorphic and nests are often located in inaccessible tree cavities several meters from the ground. For this reason, most studies of Tufted Titmouse nesting activities have relied on data from artificial nest boxes (e.g., Brackbill, 1970; Laskey, 1957). Social monogamy appears to be the most prevalent mode of parental care in this species. However, there has only been one genetic study of parentage, and it found in a population in Ohio that both sexes were sexually promiscuous to some extent (Pravosudova et al., 2002). Interestingly, the proportion of young that were sired by extra-pair males in that study — 3 of 34 nestlings (8.8%) — was relatively low compared to other songbird species with extra-pair mating systems (e.g., 32% of offspring on average in Neotropical migrants; Stutchbury et al., 2005). Evans et al. (2008) attributed a similarly low extra-pair fertilization rate (6.6%) in the Wood Thrush (*Hylocichla mustelina*) to steadfast mate guarding behavior, wherein a male remains in proximity of a particular female during her fertile period and physically deters other males from copulating with her.

In the Tufted Titmouse, copulatory behavior is more or less restricted to a brief temporal window in the early breeding season and is rarely observed (e.g., Brackbill, 1970; Johnston, 1944). Prior to copulation, females give a “flutter display” during which the wings are rapidly vibrated and a series of high-frequency *chip* notes are uttered, although this display may also be used by males in agonistic contexts (Brackbill, 1970). Whether mate guarding occurs is not known. I have observed what I have interpreted to be mate guarding behavior at a nest site of the Tufted Titmouse in the Mid-Atlantic Piedmont of northern Delaware in 2013 and recorded digital audio of two copulation events

in which multiple males mounted the female simultaneously. In both instances, the birds used a previously undescribed call note (*seee-a*), which was later recorded and heard at sites in Cape May County, New Jersey and Chester County, Pennsylvania, respectively. These observations are recounted below, followed by a brief discussion of potential directions for future study of the Tufted Titmouse mating system.

Methods

My study was conducted in 2013 in White Clay Creek State Park, Newark, Delaware (39° 41' N, 75° 45' W), where the creek meanders through suburban residences along Papermill Road. My observations were made in the vicinity of a Tufted Titmouse nest that was located in a natural tree cavity 8 m from the ground (American Beech, *Fagus grandifolia*). I located the nest on April 16 by following a bird with nest material at a distance of 10 m until it entered the cavity. From April 16–30, I made approximately 10 hours of behavioral observations from a concealed position on the ground 10–15 m from the base of the tree. I observed copulation events on April 19 and 23 that enabled me to distinguish the sexes and discern separately their behavior during the preceding and subsequent interactions. I recorded vocalizations in an uncompressed audio format (.wav) with a shotgun condenser microphone (Audio-Technica ATR6550) and portable digital recorder (Zoom H1 Handy Recorder) and then visualized the files with Raven Pro 1.4 software (Cornell Lab of Ornithology, Ithaca, NY, US).

Observations

At 5:40 a.m. on April 16, I watched a nest-building titmouse (presumably female) that was being closely followed (≤ 5 m distant) by a second titmouse (hereafter, “follower”). The first titmouse perched silently within 1 m of the nest cavity while the follower, at a distance of 3 m, gave a flutter display that lasted for approximately 5 min, of which the final 2 min 40 secs were recorded (Fig. 1A). The follower issued 409 calls

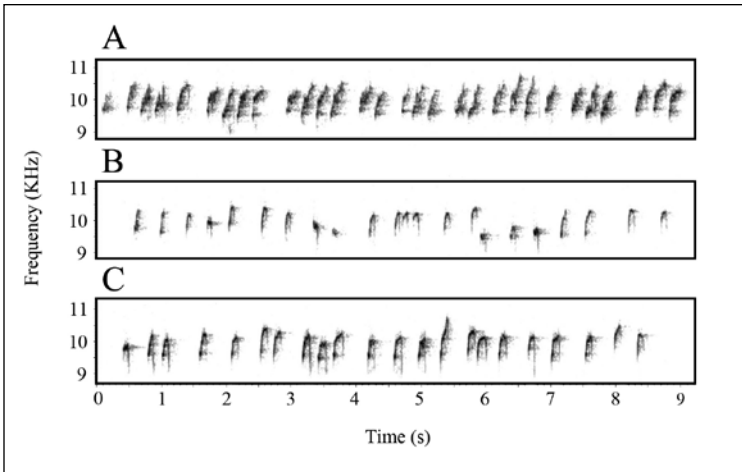


Figure 1. Audio spectrograms of excerpted flutter displays given by the two male Tufted Titmice described at length in the present study (A and B), while in the presence of the female and the other male, at a nesting site in White Clay Creek State Park, Delaware, and (C) an excerpt from a flutter display recorded during a hostile encounter between two presumed males in Tuckahoe, New Jersey (see text), on May 5, 2013.

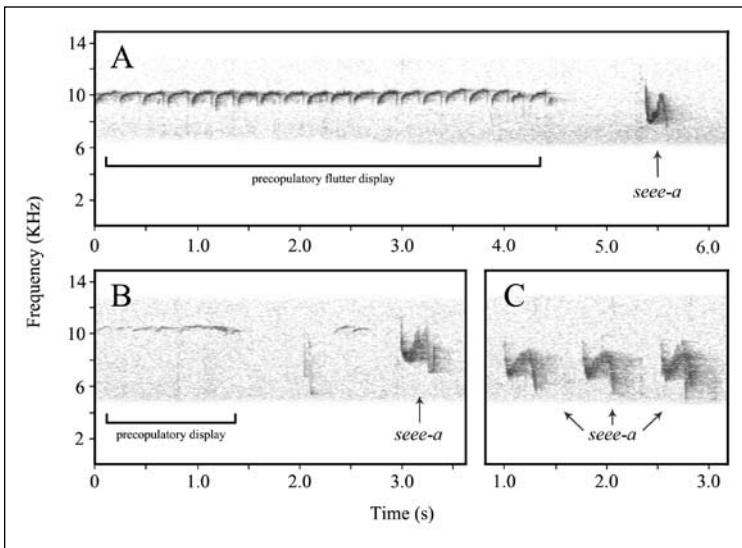


Figure 2. Spectrograms of audio recordings from copulation events on April 19 and 23, 2013 (A and B, respectively), at a nest of the Tufted Titmouse in White Clay Creek State Park, Delaware, and (C) from a hostile encounter observed in Tuckahoe, New Jersey on May 5, 2013. See text for detailed descriptions.

in the recorded portion (2.6 per sec), followed by 15 secs of silence and then gave another flutter display that lasted 24 secs (26 calls, 1.1 per sec). The follower immediately switched to song, which lasted 1 min 13 secs (13 songs, 10.7 per min) and was followed by 28

secs of silence. This was followed by yet another flutter display lasting 1 min 14 secs (135 calls, 1.8 per sec) and another bout of singing (21 songs, 9.5 per min). When a third adult approached to within 10 m of the nest site, the follower emitted a series of harsh *chick-a-dee* calls and made a swooping flight, driving it away in the direction from which it had come. The follower immediately returned to the nest site and resumed intermittent flutter displays and singing bouts, all while remaining in proximity of the practically silent, nest-building bird. From April 16–19, I made daily observations of lengthy flutter displays (> 3 min duration) and the occasional chasing of a conspecific from the nest vicinity.

On April 19, the (presumed) female visited the cavity at approximately 30 min intervals with bits of dried leaf or other material, each time accompanied by a (presumed) male that sang or performed flutter displays while she was in the cavity. At 1:36 p.m., the female exited the cavity and landed on a perch approximately 2 m distant. She gave a flutter display that lasted 11 secs (45 calls, 4.1 per sec; Fig. 2A) during which the male approached her from behind with a slow fluttering flight. He carried a food item (a moth or butterfly) which he transferred to the female as he initiated copulation. Suddenly, a second male flew in from behind and mounted the

copulating pair. Stuck in between the female and the second male, the first male immediately issued a loud two-syllable *seee-a* call (Fig. 2A) and lunged aggressively at the second male. They grappled in the air for a moment, and then the first male chased the second

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to a perch approximately 10 m from the nest site. They perched side by side in silence for approximately 30 secs, during which time the silent female eventually ate the moth. For the remainder of my observations at this nest (April 20, 21, 23, 25, 28, and 30), the same general pattern of behavior was observed: one bird (presumed female) brought nesting materials in and out of the cavity, while the other two (presumed males) remained in proximity to her while occasionally swooping aggressively at each other and performing flutter displays (e.g., Fig. 1B) interspersed with bouts of singing.

On April 23, I observed a copulation that was similar in every respect to the one on April 19 except that there was apparently no transfer of food before the copulation. The female brought lichens and fine rootlets to the nest site at 12:04 p.m. and was flanked by two males. At 12:27 p.m., she flew to the entrance of the cavity. One male gave a flutter display that lasted 14 secs (30 calls, 2.1 per sec), after which the female flew to a perch approximately 2 m distant and initiated a flutter display that lasted 1.4 secs (7 calls, 5 per sec). The male followed and mounted her, but the second male followed closely behind him and once again awkwardly mounted the copulating pair. A *seee-a* call was issued by one of the males (Fig. 2B), which was followed by a physical clash of greater intensity than the one observed on April 19. The two males hovered in the air while clawing at each other and emitting *seee-a* and *chick-a-dee* calls. This type of fighting was interspersed with circular flights and aggressive swooping. Approximately eight additional Tufted Titmice descended on the scene from the surrounding area, presumably attracted by the loud calling of the two males. A group of 3–4 titmice gave *chick-a-dee* calls as they approached from the far side of White Clay Creek, approximately 75 m distant.

At 12:37 p.m., one of the fighting males pursued the other in flight, tailing his target by only 1–2 m despite many twisting turns at high speed. They traced a circular path around me at a varying distance of 5–15 m. The males alighted in proximity on a tree branch, 7 m from my position, and performed flutter displays interspersed with *chick-a-dee* calls. They reprised the chase for a few seconds before separating and leaving my range of detection. The same male seemed to be

the chaser in both cases. The “bystanders” dispersed from the area within a few minutes after the conflict abated. At 12:47 p.m., the (presumed) female alighted at the entrance to the nest cavity with nesting material. She was flanked once again by two (presumed) males which countersang and intermittently performed flutter displays and made swooping flights at one another. I continued to observe the interaction of three adults in the vicinity of this nest until April 30. When I returned in the middle of May after a two week absence with the hopes of observing parental behavior, I found that the nest had apparently failed during the incubation period. I was unable to relocate the titmice in the immediate area and have no knowledge of their subsequent nesting attempts.

On May 5, 2013, in a roadside forest patch near Tuckahoe, New Jersey, I recorded the *seee-a* call during a hostile interaction between two (presumed) males that were observed countersinging and performing flutter displays immediately afterward (e.g., Fig. 1C). The birds made fluttering jumps about 1 m from the ground and clawed at each other with their feet. This happened 4–5 times and was accompanied by *seee-a* calls from at least one of the birds (Fig. 2C). On May 7, 2013, I heard (but alas, did not record) the *seee-a* call at Warwick County Park in Chester County, Pennsylvania given during a hostile encounter similar to the one that I had observed in New Jersey.

Discussion

With only one genetic study conducted to date, empirical knowledge of the Tufted Titmouse mating system is very limited (Pravosudova et al., 2002). Copulatory behavior is known from brief anecdote only (Brackbill, 1970; Johnston, 1944). To my knowledge, this is the first report of copulations involving multiple males vying for access to the same female. Copulations of Tufted Titmice and other Parids are frequently preceded by flutter displays by one or both sexes (Brackbill, 1970; Hinde, 1952; Johnston, 1944; Offutt, 1965), but the display has also been observed in the defense of a contested food resource (Wallace, 1967), and flutter displays by the female do not invariably elicit copulatory behavior in males. In fact, most of the flutter displays that I observed were given by a male in the presence of the nest-building female or in proximity of another male that was competing for

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copulatory access to the same female. It is for this reason that homing in on areas where frequent and prolonged flutter displays are heard in mid-April may be a productive way to increase one's probability of observing sexual behavior in this species.

I attempted and failed to locate in public archives any audio recording of a flutter display and/or copulation event, nor mention in the scientific literature of the vocalization that I have termed *seee-a*. The recordings discussed in this paper have been deposited in an online archive for future reference (www.xeno-canto.org). Known vocalizations of the Tufted Titmouse include “songs,” which are learned in the first year of life and consist of repeated whistled syllables between 2.0 and 2.7 KHz and “calls,” which are sounds of higher frequency that may vary with inflection (e.g., Gaddis, 1979, 1983; Offutt, 1965; Schroeder & Wiley, 1983). Offutt (1965) described three call types based on their acoustic structure and the social context(s) of their use: (1) “Contact calls” (e.g., *chip*, *chink*, Sieving et al., 2010) are of short duration and given in multiple contexts, tending to increase in amplitude and frequency during agonistic encounters (e.g., flutter displays, Figs. 1–2). They can be given in isolation or appended to the wide-band *dee* note to form (2) “distress calls” (*chick-a-dee*), as are frequently used during the mobbing of predators and during confrontations with conspecifics (Courter & Ritchison, 2010; Owens & Freeberg, 2007; Sieving et al., 2010). (3) High frequency “whistles” (*seet*), sharing a similar structure and function to those of other Parids, are frequently emitted in the presence of a hawk or other aerial predator and induce nearby conspecifics to freeze or dive for cover (Ficken, 1989; Sieving et al., 2010). “*Seee-a* calls” are structurally dissimilar from Offutt’s (1965) three types. They have a distinctive two syllable cadence and their spectrogram trace resembles an inverted tilde (Fig. 2). *Seee-a* calls were detected during hostile interactions between conspecifics and the call seems to be associated with a strong (internal) attack drive in the caller (i.e., in contrast to “escape drive,” see Dilger, 1956). From my limited observations in the Mid-Atlantic region, use of the vocalization seems to be geographically widespread; more study is clearly needed.

That the *seee-a* call is not known to ornithologists may be due to its being more or less temporally

restricted to the 2–3 week pre-nesting period during which sexual conflict among males is greatest. All of my detections of the call have fallen between the dates of April 19 and May 7, and without exception, it has only been detected during hostile interactions between birds that were known or presumed to be males. Nevertheless, its function is not entirely clear. Experiments using audio playback at various points in the year may help to clarify these points and would enable an assessment of the degree to which the acoustic structure of the call degrades with distance from the source. Such experiments will be necessary if we are to determine its effectiveness in short and long distance communication in forest and woodland habitats (e.g., Morton, 1977) and thereby shed light on the proximate and ultimate causes of its evolution.

Although the Tufted Titmouse is widely assumed to be socially monogamous, there have been multiple reports of cooperative parental care (e.g., Brackbill, 1958; Davis, 1978; Wight *in* Laskey 1957, p. 142). Field research of color-banded individuals will be needed to properly assess the degree to which patterns of parental care and genetic parentage vary within and between populations and years. Recent studies of sexually monomorphic thrushes have shown that cryptic patterns of social behavior can be difficult to detect without the use of video cameras and genetic analysis of marked populations (e.g., Goetz et al., 2003; Halley, *in press*; Halley & Heckscher, 2012). Clearly, an empirically founded understanding of the species’ mating system will require an integrated approach in which quantitative data derived from digital and genetic tools provide context for the interpretation of behavior in wild populations. In the meantime, considering the paucity of our knowledge of Tufted Titmouse behavior, even observations of a more descriptive nature may hold considerable value.

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Matthew R. Halley

115 West Allens Lane

Philadelphia, PA 19119