The Wilson Journal *of Ornithology*

Mobbing Calls of Japanese Tits Signal Predator Type: Field Observations of Natural Predator Encounters

Toshitaka N. Suzuki[1,3] and Keisuke Ueda[2]

Published by the
Wilson Ornithological Society

The Wilson Journal of Ornithology 125(2):412–415, 2013

Mobbing Calls of Japanese Tits Signal Predator Type: Field Observations of Natural Predator Encounters

Toshitaka N. Suzuki[1,3] and Keisuke Ueda[2]

ABSTRACT.—Avian nests face a wide variety of nest predators, which pose different risks that could select for the ability of parents to notify conspecifics of nest predator type. We previously demonstrated that the Japanese Tit (*Parus minor*) produces acoustically distinct mobbing calls for different nest predators (crows and snakes), thereby eliciting different and appropriate anti-predator responses not only in parents, but also in nestlings. However, the variation in mobbing call behavior may have been caused by differences in the experimental methods used, whereby each nest was presented with either a mounted crow or a live caged snake. In the present study, we observed a total of seven natural encounters of Japanese Tits with crows ($n = 4$) and snakes ($n = 3$) near their nests. Consistent with the previous experiments, Japanese Tits produced distinct mobbing calls, namely, ''chicka'' calls for crows (4/4) and ''jar'' calls for snakes (3/3). Thus, we conclude that mobbing calls of Japanese Tits signal nest predator type to both parents and nestlings. *Received 31 July 2012. Accepted 2 October 2012.*

Key words: alarm call, communication, Japanese Tit, mobbing call, nest predation, *Parus minor*, predator.

Predation is a major cause of breeding failure in most passerines (Ricklefs 1969), many of which produce intensive calls when they detect, approach, and mob a predator near their nest (Caro 2005, Fasanella and Fernández 2009, Colombelli-Négrel et al. 2010, Magrath et al. 2010). Such mobbing calls typically attract conspecific adults to the nest and elicit brood defense behavior (e.g., Welbergen and Davies 2008, Suzuki 2012). Mobbing calls can also serve to suppress begging calls and movements of nestlings, thereby making them inconspicuousness to the predator (e.g., Kleindorfer et al. 1996; Platzen and Magrath 2004, 2005). Thus, mobbing calls function to decrease the risk of predation, by eliciting appropriate anti-predator behaviors not only in parents, but also in nestlings.

Avian nests face a variety of nest predators, which pose different risks. Therefore, the ability of parents to notify conspecifics of nest predator type is likely to be adaptive. The Japanese Tit (*Parus minor*) may have evolved this complexity in communication. We previously demonstrated that Japanese Tits produce acoustically distinct mobbing calls for different models of nest predators, namely, ''chicka'' calls for Jungle Crows (*Corvus macrorhynchos*) and ''jar'' calls for Japanese rat snakes (*Elaphe climacophora*) (Suzuki 2011; Fig. 1). These two types of mobbing calls elicit appropriate responses in conspecifics. Parents scan different spatial locations (air versus ground) in response to the two call types, in order to readily detect the corresponding predators (crows versus snakes) (Suzuki 2012). Nestlings crouch down in the nest cavity in response to ''chicka'' calls, but jump out of the nest in response to ''jar'' calls (Suzuki 2011). It is predicted that the two responses help nestlings to evade the corresponding predators, because crows snatch nestlings from the nest entrances, whereas snakes invade the nest.

We previously investigated the vocal response of adult Japanese Tits by exposing them to mounted specimens of Jungle Crows or live Japanese rat snakes caged in a transparent Plexiglas box (Suzuki 2011). However, birds may exhibit different brood defense behaviors to live and mounted predators (Knight and Temple 1986), and predator behavior could affect the corresponding vocal response (Griesser 2008, Wilson and Evans 2012). Thus, although the mobbing call response of Japanese Tits to the two model predators were qualitatively different (Suzuki 2011), it is possible that this variation was caused by differences in the presentation methods, rather than by differences in the predator type. To confirm the validity of our previous experiment, it was essential to determine how adult Japanese Tits use different mobbing calls during natural encounters with these two predators.

[1] Department of Evolutionary Studies of Biosystems, The Graduate University for Advanced Studies, Kamiyamaguchi 1560-35, Hayama, Kanagawa 240-0193, Japan.

[2] Department of Life Science, Rikkyo University, 3-34-1 Nishi-Ikebukuro, Toshima, Tokyo 171-8501, Japan.

[3] Corresponding author; e-mail: toshi.n.suzuki@gmail.com

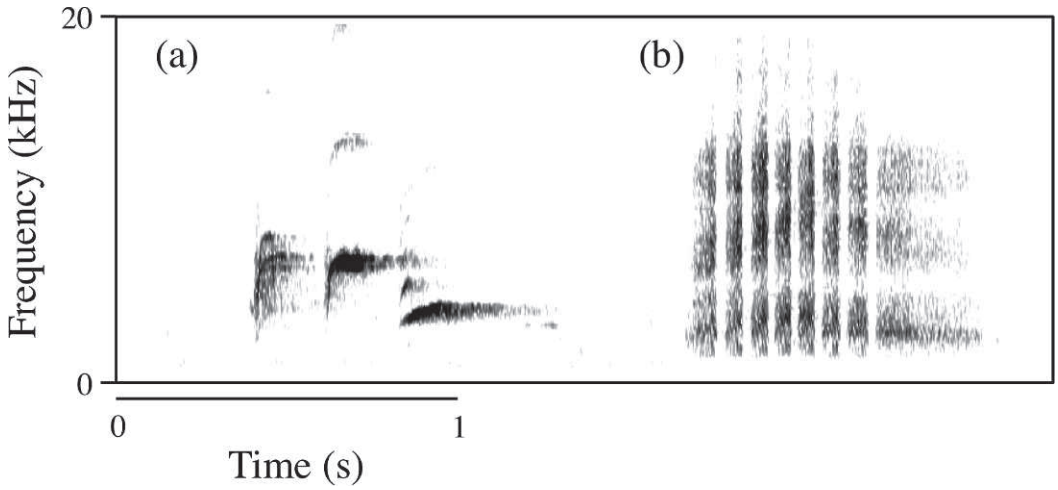

FIG. 1. Japanese Tit mobbing calls: (a) ''chicka'' and (b) ''jar'' calls. These two types of mobbing call could be easily discriminated by human ears.

We report observations of natural encounters by Japanese Tits with Jungle Crows and Japanese rat snakes. Our objective in this study is to assess whether Japanese Tits vocally discriminate between crows and snakes, regardless of the presentation methods that we used in the previous experiment (Suzuki 2011).

METHODS

Observations were made in a mixed deciduous–coniferous forest in Karuizawa, Nagano, Japan (36° 21–22′ N, 138° 35–36′ E), from 2006 to 2012. In the course of the 7-year field study, we monitored more than 180 nest boxes of Japanese Tits, every 1–4 days, during each breeding season (from May–Jul). We observed four encounters of Japanese Tits with Jungle Crows and three with Japanese rat snakes near their nest boxes. We used Fisher's exact probability test (two-tailed) to test if Japanese Tits produced different mobbing call types for crows and snakes.

OBSERVATIONS

Japanese Tits produced ''chicka'' calls for Jungle Crows (4/4; Fig. 1a) and ''jar'' calls for Japanese rat snakes (3/3; Fig. 1b). No adults produced ''chicka'' calls for snakes or ''jar'' calls for crows. There was a significant effect of predator type on the type of mobbing calls produced (Fisher's exact probability test, $P = 0.029$).

Jungle Crows always approached nests from the air (4/4) and perched on the branches of trees near the nest boxes (within ~3 m of the nests). In all cases, adult Japanese Tits approached the crows, frequently shifted their perches, and produced ''chicka'' calls immediately after they detected the crows. Jungle Crows usually flew away from the nests immediately after the adults mobbed them (4/4). These four observations were made on 7 June 2006 at 0928 hrs (Japan Standard Time), 8 June 2006 at 0943 hrs, 4 June 2008 at 1045 hrs, and 6 June 2011 at 0950 hrs. The ages of nestlings in those nests were 16, 16, 9, and 8 days old (i.e., days after hatching), respectively.

Japanese rat snakes always approached nests from the ground (3/3). On 10 June 2008 at 1242 hrs, we observed a snake climbing up a tree. Both parents approached the snake closely (<1 m from the snake), spread out their wings and tails, hovered over the snake, and produced ''jar'' calls. We captured the snake before its invasion into the nest box, and no nestlings (12 days old) were depredated. On 12 June 2008 at 1531 hrs, we observed a snake approaching a nest box and heard a male Japanese Tit produce ''jar'' calls. In response to the ''jar'' calls, all of the nestlings (18 d old) escaped from the nest box before the snake slipped in, thereby avoiding predation. On 11 June 2010 at 1011 hrs, we observed a snake slipping out of a nest box. Both parents approached the snake and produced ''jar'' calls. Only two nestlings (7 d old) and one un-hatched egg remained in the nest box, and six nestlings were confirmed from the vomit of the snake. The adults abandoned this nest, and both of the remaining nestlings died.

No direct observations of predatory events were made in 2007, 2009, or 2012, although some signs of nest predation by snakes, crows, and martens were found (TNS, unpubl. data).

DISCUSSION

In the present study, we showed that Japanese Tits produced ''chicka'' calls for Jungle Crows and ''jar'' calls for Japanese rat snakes during natural predator encounters. This pattern is consistent with the results of our previous experiment, which indicated that Japanese Tits vocally discriminate between mounted crows and live snakes (Suzuki 2011). Thus, our present findings provide field evidence for comparable results in a study using captive or taxidermic predator mounts.

A previous playback experiment revealed that adult Japanese Tits respond to ''chicka'' calls by scanning the horizon (Suzuki 2012). In this study, we showed that crows always approached nests from the air; therefore, the horizontal movements of the Japanese Tits' heads in response to the ''chicka'' call would presumably help the adults to effectively search for and detect Jungle Crows. Jungle Crows flew away from the nests after Japanese Tits produced ''chicka'' calls, suggesting that this call functions to deter and drive off the crows. Crows may give up attacking the nests, because it is hard for them to snatch nestlings which crouch down in the nest boxes in response to ''chicka'' calls (Suzuki 2011). The response of crows to ''chicka'' calls requires further investigation.

The Suzuki (2012) playback experiment also showed that adult Japanese Tits responded to ''jar'' calls by gazing downwards. In this study, we showed that snakes approached nests from the ground in our three observations. Therefore, the downwards gazing in response to ''jar'' calls would enable the adults to search for and detect Japanese rat snakes. In the present study, on one occasion, nestlings avoided the snake attack by jumping out of the nest box in response to ''jar'' calls. This observation is consistent with those of our previous experiment, in which we demonstrated that, just before their fledging date, nestlings could escape out of the nest boxes in response to ''jar'' calls (Suzuki 2011). Taken together, these findings confirm the adaptive value of the mobbing call response. However, in another case, nestlings were depredated by a snake, because they were too young to escape from the nest box. Further investigations of nestling responses to parental mobbing calls at different nestling stages may provide further insights into the evolution of communication and anti-predator adaptations in behavioral development (see also Platzen and Magrath 2005).

Japanese Tits have acoustically distinct mobbing calls that signal different nest predators (crows and snakes) to both parents and nestlings. Nestlings of Japanese Tits are also depredated by Japanese martens (*Martes melampus*) (TNS, unpub. data), and fledglings seem to be vulnerable to aerial predators such as hawks and shrikes. Further studies are needed to investigate how exactly mobbing calls of Japanese Tits signal predator type and how finely conspecifics (both parents and offspring) can detect this information from the variation in mobbing calls.

Although experimental exposure of predators is a useful method to test the response of parent birds to nest predators, the experimentally elicited response may differ from the actual behaviors of parents in their natural encounters with predators (Knight and Temple 1986, Griesser 2008). Therefore, it is essential to conduct field observations that provide descriptive contexts for the observed behaviors and test if results from experiments apply to natural cases. This is a particular challenge for the study of anti-predator behavior, given the unpredictable occurrence of predation events in space and time and the small sample size that usually characterizes data sets on natural predation events.

ACKNOWLEDGMENTS

We thank Mary Bomberger Brown and two anonymous referees for their helpful comments.

LITERATURE CITED

CARO, T. 2005. Antipredator defenses in birds and mammals. University of Chicago Press, Chicago, Illinois, USA.

COLOMBELLI-NÉGREL, D., J. ROBERTSON, AND S. KLEINDORFER. 2010. Nestling presence affects the anti-predator response of adult Superb Fairy-Wrens (*Malurus cyaneus*) Acta Ethologica 13:69–74.

FASANELLA, M. AND G. J. FERNÁNDEZ. 2009. Alarm calls of the Southern House Wren *Troglodytes musculus*: variation with nesting stage and predator model. Journal of Ornithology 150:853–863.

GRIESSER, M. 2008. Referential calls signal predator behavior in a group-living bird species. Current Biology 18:69–73.

KLEINDORFER, S., H. HOI, AND B. FESSL. 1996. Alarm calls and chick reactions in the Moustached Warbler,

Acrocephalus melanopogon. Animal Behaviour 51:1199–1206.

KNIGHT, R. L. AND S. A. TEMPLE. 1986. Methodological problems in studies of avian nest defence. Animal Behaviour 34:561–566.

MAGRATH, R. D., T. M. HAFF, A. G. HORN, AND M. L. LEONARD. 2010. Calling in the face of danger: predation risk and acoustic communication by parent birds and their offspring. Advances in the Study of Behavior 41:187–253.

PLATZEN, D. AND R. D. MAGRATH. 2004. Parental alarm calls suppress nestling vocalization. Proceedings of the Royal Society of London, Series B 271:1271–1276.

PLATZEN, D. AND R. D. MAGRATH. 2005. Adaptive differences in response to two types of parental alarm call in altricial nestlings. Proceedings of the Royal Society of London, Series B 272:1101–1106.

RICKLEFS, R. E. 1969. An analysis of nesting mortality in birds. Smithsonian Contributions to Zoology 9:1–48.

SUZUKI, T. N. 2011. Parental alarm calls warn nestlings about different predatory threats. Current Biology 21:R15–R16.

SUZUKI, T. N. 2012. Referential mobbing calls elicit different predator-searching behaviours in Japanese Great Tits. Animal Behaviour 84:53–57.

WELBERGEN, J. AND N. DAVIES. 2008. Reed Warblers discriminate cuckoos from Sparrowhawks with graded alarm signals that attract mates and neighbours. Animal Behaviour 76:811–822.

WILSON, D. R. AND C. S. EVANS. 2012. Fowl communicate the size, speed and proximity of avian stimuli through graded structure in referential alarm calls. Animal Behaviour 83:535–544.