Cost of mobbing call to breeding pied flycatcher, *Ficedula hypoleuca*

Tatjana Krama and Indrikis Krams

Institute of Zoology and Hydrobiology, University of Tartu, 51014, Tartu, Estonia, and Department of Biology, University of Daugavpils, LV-5400 Daugavpils, Latvia

Mobbing signals advertise the location of a stalking predator to all prey in an area and recruit them into the inspection aggregation. Such behavior usually causes the predator to move to another area. However, mobbing calls could be eavesdropped by other predators. Because the predation cost of mobbing calls is poorly known, we investigated whether the vocalizations of the mobbing pied flycatcher, *Ficedula hypoleuca*, a small hole nesting passerine, increase the risk of nest predation. We used mobbing calls of pied flycatchers to examine if they could lure predators such as the marten, *Martes martes*. This predator usually hunts by night and may locate its mobbing prey while resting nearby during the day. Within each of 56 experimental plots, from the top of one nest-box we played back mobbing sounds of pied flycatchers, whereas blank tapes were played from the top of another nest-box. The trials with mobbing calls were carried out before sunset. We put pieces of recently abandoned nests of pied flycatchers and a quail, *Coturnix coturnix*, egg into each of the nest-boxes. Nest-boxes with playbacks of mobbing calls were depredated by martens significantly more than were nest-boxes with blank tapes. The results of the present study indicate that repeated conspicuous mobbing calls may carry a significant cost for birds during the breeding season. Key words: antipredator behavior, *Ficedula hypoleuca*, mobbing calls, mobbing costs, pied flycatcher.

**METHODS**

This experiment was performed between 26 May and 2 July 2002 at 56 plots located near Kraslava, southeastern Latvia. On average, the study plots were 4.5 km apart (range = 2.5–30 km). To examine the risks associated with calling, we...
compared the frequency of nest predation in nest-boxes with playbacks of mobbing calls to predation in nest-boxes with blank tapes that were used as controls.

To make the experimental tapes, we recorded mobbing calls of 15 pairs of pied flycatchers (mean ± SD = 4.8 ± 0.1 kHz) (Figure 1). While mobbing predators, pied flycatchers use pik calls (Bergmann and Helb, 1982). The calls were recorded with a Sony W6DC cassette recorder connected to a parabolic microphone. A sonogram of calls was produced by using Praat software (Paul Boersma and David Weenik, Amsterdam). All of the mobbing calls were recorded while breeding pied flycatchers mobbed domestic cats, Felis domesticus (n = 7); European jays, Garrulus glandarius (n = 6); and great-spotted woodpeckers, Dendrocopos major (n = 2). Experimental tapes consisted of continuous calling without periods of silence, and this simulated the natural situation. Each 90-s calling period consisted of records taken from one pair of birds, and the next calling period contained the records taken from another pair of birds. To avoid influence of individual variability, the order of the birds on the tape was random, and the calls played back were never repeated (McGregor et al., 1992). Playback amplitude was standardized to natural sound level of 74 ± 1.5 dB (mean ± SD) at 0.5 m from the speaker by using a PI-6 sound-level meter. Calls were broadcast by using a SonyW6 DC cassette recorder connected to SA30 external speakers. The average sound pressure of blank tapes was also adjusted to natural sound level. The adjustment was done for each site separately, with the average background intensity of 39.75 ± 2.31 dB (mean ± SD).

We used wooden board nest-boxes in all experimental trials. The nest-boxes were arranged in pairs, and they were placed 80–100 m apart (90.5 ± 2.5 m, mean ± SE, n = 56). We mounted the nest-boxes on trees 1.5–2 m above groundlevel. It has been previously reported that martens can depredate up to 100% of the local population of pied flycatchers breeding in nest-boxes in Latvia (Mihelsons and Vilka, 1974). Supposedly, martens use a nest-box as a search image while hunting for nestlings and adult birds. To avoid the possible attraction of the predators, we placed empty nest-boxes at each experimental plot at least 8–11 days before the trials. Just before the beginning of the playbacks, we put pieces of recently abandoned nests of pied flycatchers and a quail, Coturnix coturnix, egg into each of the nest-boxes. This was done to equalize the olfactory attractiveness of the experimental nest-boxes. We considered predation to have occurred if the top of nest-box was opened and the egg was missing or broken. Such avian predators as European jays and great-spotted woodpeckers cannot open the nest-boxes at the study area, whereas martens easily enter nest-boxes by removing the top. In addition, we dispersed sand around the experimental trees to check for tracks of mammalian predators.

The study was carried out in young (30–50 years) dry pine plantations with a sparse understory. The density of the local bird population was low and mostly represented by tree pipits, Anthus trivialis; song thrushes, Turdus philomelos; mistle thrushes, T. viscivorus; crested tits, Parus cristatus; and chaffinches, Fringilla coelebs. All the above bird species are known as mobbers (Snow and Perrins 1997). Pied flycatcher is a common breeder in the study area. However, its occurrence in young pine forests is dependent on the presence of artificial nest-boxes.

The experimental nest-boxes were placed in pine plantations about 30–40 m away from 80–120-year-old mixed forests. The older forests were with a rich understorey dominated by common spruce, Picea abies; Scots pine, Pinus sylvestris; and common birch, Betula pendula. Martens usually live in older forests and rarely come into less productive pine plantations. The number of predators were counted mostly during winter and according to observed tracks, individuals, and feces. The results of the census indicates that the study area was inhabited by at least 50 adult martens. Just before the beginning of study, the density of martens became even higher because a number of predators immigrated from neighboring areas owing to clear-cutting of a considerable part of the older forests outside the study area.

Within each of 56 plots, from the top of one of the nest-boxes we played back mobbing sounds of pied flycatchers; no calls (blank tapes) were played back from the top of the other nest-box. The nest-boxes for the call playbacks were selected by tossing a coin. According to the design of this experiment, playbacks of both mobbing calls and blank tapes were carried out simultaneously in each plot (n = 56). The duration of the playbacks was 20 min in each plot (in total 18.7 h); under natural conditions, mobbing is usually less durable. However, hole nesting birds sometimes mob their natural enemies even longer. The trials with mobbing calls were carried out 1–2 h before sunset in calm, warm, and dry weather. We usually did playbacks at one or two areas during one evening. The nest-boxes were checked next morning, 2–4 h after sunrise. The nests were exposed to predation for 11–14 h (mean ± SD = 11.28 ± 0.12 h). The experimental trials were never repeated at the same area. This suggests that each experimental trial was carried out at the territory of a different predator. Therefore, each test can be treated as an independent data point.

**RESULTS**

Predation occurred in one-fourth of the trials across all experimental plots (Table 1). We found a significant difference in the type of response the two types of artificial nests triggered in martens. Overall, nest-boxes with playbacks of mobbing calls were depredated significantly more than were

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<th>Table 1 Number of nest-boxes depredated by martens after experimental playbacks of pied flycatcher mobbing calls and blank tapes</th>
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<td><strong>Type of playback</strong></td>
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nest-boxes with blank tapes ($\chi^2 = 11.35, df = 1, p < .01$). Nest-boxes of the same pair were never attacked during one night at one site. In 14 cases artificial nests were depleted by martens because the top of the nest-boxes had been removed and we found tracks of martens in the sand around the trees. In one case with mobbing calls, all tracks were destroyed by rain. We found remnants of the egg shell within a distance of 10 m around three of the 15 nest-boxes.

**DISCUSSION**

When a prey detects a potential predator, there are different ways it can react. Prey individuals may mob predators by emitting mobbing calls; they may inform the predator that is has been detected by giving just a few alarm calls or remain quiet. Several studies have shown that successful strategies when discovering a predator are either full-scale high-intensity mobbing, provoking the predator’s retreat, or else quietly watching the predator from seclusion and thus escaping its attention (Flaszkamp, 1994). However, when activities of a predator become dangerous to the brood, mobbing can be the only effective way of protection. By assembling in a group, mobbers can reduce the prospects of hunting and drive the predator away. As mobbers continue to drop in, the risk is reduced for all via well-established mechanisms such as risk dilution and confusion effect (Curio, 1978). However, mobbing behavior does not only have survival value for the initiator of mobbing and the rest of mobbing community; the results of this study show that mobbing calls can be eavesdropped by nest predators. Mobbing individuals giving durable, easily locatable calls can increase the risk of their brood, suggesting a new type of mobbing cost. This was supported by significantly higher levels of depredated artificial nests with mobbing calls played back.

Because mobbing incurs a fitness cost, this fact may improve our understanding of the origin and evolution of this type of antipredator behavior. Under natural conditions, prey individuals usually perform intense harassment, and the predator leaves the prey territory after some minutes of mobbing (Flaszkamp, 1994; Lorenz, 1931; Pettifor, 1990). Group size (Becker, 1984; Robinson, 1985) and stability of prey communities (Krams and Krama, 2002; Naguib et al., 1999) are important conditions for mobbing to be successful. However, when small birds cannot attract other birds to the vicinity, a mob may become durable and ineffective, which is especially possible in habitats with low density of the local bird population. The results of the present study may suggest that if the predator leaves soon after the beginning of mobbing, prey individuals may not increase the risk of predation. In the case of prolonged mobbing, the mobbing calls can significantly increase the fitness costs of prey individuals by attracting other predators from the vicinity. However, the real relationship between the risk of predator attraction and the duration of mobbing is not clear, and further experiments are needed.

Finally, the results of the present study indicate that repeated conspicuous mobbing calls, together with possible energetic expenditures, may carry a significant cost for birds during the breeding season. Therefore, we suggest that the costs associated with mobbing may prevent the exaggeration of these signals and ensure mobbing honesty because predators can eavesdrop not only territorial and mate-attraction signals of their prey but also their mobbing calls. This can make mobbing behavior, similar to begging behavior (see Godfray and Johnstone, 2000; Haskell, 2002; Leech and Leonard, 1997; Redondo and Castro, 1992), a good model for empirical studies and theoretical modelling in the field of evolutionary ecology.

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**REFERENCES**