Small protection plates against marten predation on nest boxes

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Abstract
The nest box is a powerful research tool for ecological and conservational studies of birds and several other cavity nesters. However, skilful predators such as martens sometimes invade nest boxes, thus disturbing researches. To protect nest boxes against predation by martens, we attached a small plate inside the nest box below the entrance hole, and we report here on the advantage of this device. In 1999 and 2000, respectively, 73.0% and 64.8% nest boxes were used by the Great Tit and the Varied Tit. After fitting boxes with the plate in 2000, the percentage of predated nests by martens decreased from 22.4% to 5.9%, and the percentage of successful nests increased from 29.3% to 43.8%.

Key words: Marten; nest box; protection against predation

INTRODUCTION
The nest box is a powerful and popular research tool for ecological and conservational studies. Many researchers commonly use nest boxes, noticing careful regard to estimate the results that they obtained. Nest boxes have some effects that suppress the predation rate (Nilsson, 1984a, b), increase clutch size (Nilsson, 1984b), and lower ectoparasite load (Møller, 1989, 1992). However, problems can also occur in the use of nest boxes, when skilful predators like martens, weasels, raccoons, feral cats and crows, intensively prey upon birds in nest boxes (Perrins, 1965; Dunn, 1977; Sonerud, 1985; Robertson and Rendell, 1990). It is required to prevent predation in some studies and control approaches. Here, we introduce a simple method for protecting nests in nest boxes against marten predation.

MATERIALS AND METHODS
Study area and research designs. Our study was performed at the nature reserve at Mt. Aburayama, Fukuoka, Japan (33°31'N, 130°23'E). The study area consists of a mosaic of Cryptomeria japonica plantations and young broad-leaved trees (dominant overstory trees are Machilus thunbergii, Quercus glauca, Styrax japonica, and Magnolia obovata), ranging in elevation from 210 m to 380 m above sea level. Dominant secondary cavity nesters are Varied Tits (Parus varius) and Great Tits (Parus major). Potential nest predators of the birds in the study area are snakes (mainly the Japanese rat snake [Elaphe climacophora]), Japanese martens (Martes melampus), Jungle Crows (Corvus macrorhynchos), and possibly Japanese Green Woodpeckers and feral cats (Felis catus) (NY and KMK, pers. obs.).

We erected 126 nest boxes in 263 ha and 182 nest boxes in 291 ha in 1999 and 2000, respectively. The distances between the boxes were approximately 50 m. Boxes were placed on trees at a height of approximately 2.5 m from the ground. In 2000, we attached a small wooden plate inside all nest boxes before erecting them (Fig. 1). We erected 126 of the 182 boxes on the same trees we selected in 1999. The remaining 56 boxes were erected on other trees in the expanded area.

We visited each nest box every 3 d and recorded nesting species hatching date, fledging date, and nest predation when it occurred. We determined a nest was successful when at least one of the chicks in a nest was over 15 d old. We deduced the preda-
tor in the following manner. If neither the box nor the nesting material had been damaged (or thrown about), we concluded that the predator was a snake. If the box surface had been scratched and the entrance hole gnawed, we concluded that the predator was a marten. If the entrance hole was enlarged and encircled with peck marks, we concluded that the predator was a bird (probably a crow or a woodpecker).

**Statistical analysis.** We used Fisher’s exact probability test to compare the usage of nest boxes for treated (protected) boxes with that for untreated boxes and to compare the proportions of depredated nests for each type of predator between treated boxes and untreated boxes. We tested whether the fates of the nests in treated boxes differed from those in untreated boxes using the chi-squared test. Mean values are given with ±SD. All analyses were performed with the software package of “R” (http://www.r-project.org).

**RESULTS AND DISCUSSION**

In 1999 and 2000, 92 of 126 (73.0%) and 118 of 182 (64.8%) nest boxes, respectively were used by the Great Tit or the Varied Tit. Some nest boxes were used twice in a breeding season (14 in 1999; three in 2000). The proportion of the nest boxes used did not differ between untreated boxes (erected in 1999) and treated boxes (erected in 2000) \( (p=0.14) \).

Between the two seasons, the percentage of predated nests decreased from 46.2% to 28.1%, and the percentage of successful nests increased from 29.2% to 43.8% (Fig. 2). The increase in breeding success was significant \( (\chi^2=12.0, p=0.01) \). Predation by martens declined remarkably \( (p=0.03) \) and predation by snakes did not change at all (Fig. 3).

Usage of nesting boxes did not differ between untreated and treated boxes. This result suggests that the wooden plate attached within the nest boxes did not decrease the attractiveness of the nest boxes for the two tit species (although we did not control for the effect of year). The wooden plates attached probably did not disturb fledgings, since the mean length of nestling stages did not differ between the two years (NY, unpubl. data).

Predation by martens declined remarkably after the treatment. Martens certainly inhabited the study area in both years, as we often observed their footprints and droppings. Assuming that the density of martens did not change between the two years, we suggest that the attachment of wooden plates inside may constitute an effective protection against predation by martens.

All boxes predated by martens (the boxes’ sur-
face had been scratched and the entrance hole gnawed) had nest materials drawn out from nest holes. The marten probably grasped nest material with its mouth or forelimbs and pulled it out with nestlings or eggs. So the Japanese marten can probably access clutches or broods in boxes, only when nest materials are full and the distance from the nest entrance to the nestlings is small, since the martens’ head is too large to enter a nest hole of 30 mm in diameter (mean head width = 50.05 mm ± 5.66, n=27). The wooden plates lengthen the distance between nest entrance and nest materials and prevent martens from reaching nestlings or eggs directly.

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