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Avoiding the Nest: Responses of Field Sparrows to the Threat of Nest Predation

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Nest predation is a major source of reproductive failure in birds (Ricklefs 1969, Martin 1992). Birds confronted with an enemy near the nest may use behaviors to deter the prospect of nest predation. The benefits of nest defense have been shown for many aggressive species (Martin 1992), but smaller birds that cannot deter predators may need to resort to other behaviors to reduce predation risk. These other behaviors include mobbing (Curio 1978), injury feigning and distraction displays (Gochfeld 1984), and actions to draw prospective predators from the nest (Greig-Smith 1980, East 1981, Knight and Temple 1986).

Nest avoidance is one way that parent birds can reduce predation risk, because reducing activity near the nest may reduce the possibility that the predator will locate the nest and take its contents. Parents can avoid the nest and remain cryptic (McLean 1987), or they can avoid the nest but still show aggressive or vocal responses to the predator. For example, Wheelwright and Dorsey (1991) found that Tree Swallows (*Tachycineta bicolor*) reduced nestling feeding to 5% of normal when Herring Gull (*Larus argentatus*) models were placed on nearby nest boxes, but they still gave alarm calls and dived at models.

Field Sparrows (*Spizella pusilla*) are small songbirds that rarely use direct aggression against predators (Burhans 1996). Based on experiments in which adults never directly attacked a model of a larger avian nest predator (Burhans 1996), I predicted that Field Sparrows presented with a visually oriented predator near the nest would avoid the nest, whereas they would respond indifferently to a familiar non-threatening species. I tested these predictions by documenting responses of Field Sparrows to models of a predator and a non-threatening control.

Methods.—My field assistants and I located nests in old fields and a nearby agricultural field from April through July 1998 at the Thomas S. Baskett Wildlife Research and Education Center in Boone County, Missouri (see Burhans 1997). To examine if sparrows avoided their nests in the presence of a predator, I determined the location and distance of responding adults from the nest and from a predator model. I provided two perches plus a perch for the model to make a series of three perches in line with each of 26 nests (Fig. 1). I set the line of perches in one of two random directions parallel to a wooded edge, if present. I erected perches and a blind one day before the experiment so that birds could habituate to the experimental setup. Perches were made from leafless persimmon (*Diospyros virginiana*) saplings with similar branching arrangements. I placed saplings in 1.2-cm diameter copper tubing painted a warm gray to simulate dead wood. Perches could be raised or lowered to be visible both to me and to sparrows in the surrounding vegetation (ca. 1 m above the nest).

I used a taxidermic mount of a Blue Jay (*Cyanocitta cristata*) as a model of a nest predator because Blue Jays are known predators of Field Sparrow nests (Walkinshaw 1968). For a control, I used a mount of an Eastern Towhee (*Pipilo erythrophthalmus*), which is a common nester in the same sites used by Field Sparrows; Blue Jays nest in edges adjoining the sites. Both models were posed in an upright perching position with the wings folded against the body. Experiments were performed from 0445 to 1320 CST from 18 May to 6 July 1998, but most were conducted in the morning. Although most Field Sparrows were not color banded, based on synchrony of renestings I am confident that each pair was tested only once. I performed experiments at all 26 nests during the early nestling stage when chicks were one to three days old.

I started experiments at least 30 min after entering the blind. Both models were placed sequentially in randomly determined order with at least 20 min between successive presentations to avoid "carry-over" aggression. I placed models at the central perch facing the nest (Fig. 1) after both adult sparrows voluntarily left the nest area. The 5-min test period began when the first bird returned to within 10 m of the model. I recorded the location and distance responses of nest owners as instantaneous samples (Altmann 1974). I categorized the location of the closest Field Sparrow as "near side" or "far side" based on the plane perpendicular to the line of perches from the middle perch where the model was placed (Fig. 1). I categorized responses as "location unknown" when sparrows were either behind the blind or obscured by dense vegetation. I also recorded the closest distance ($\leq$1.5 m or $>$1.5 m) of an adult sparrow from the model. If birds made long flights out of the nest area and it was clear that neither adult was present, I categorized the response as "gone from area." Birds that landed at the nest shrub and appeared to remain at the nest were considered to be

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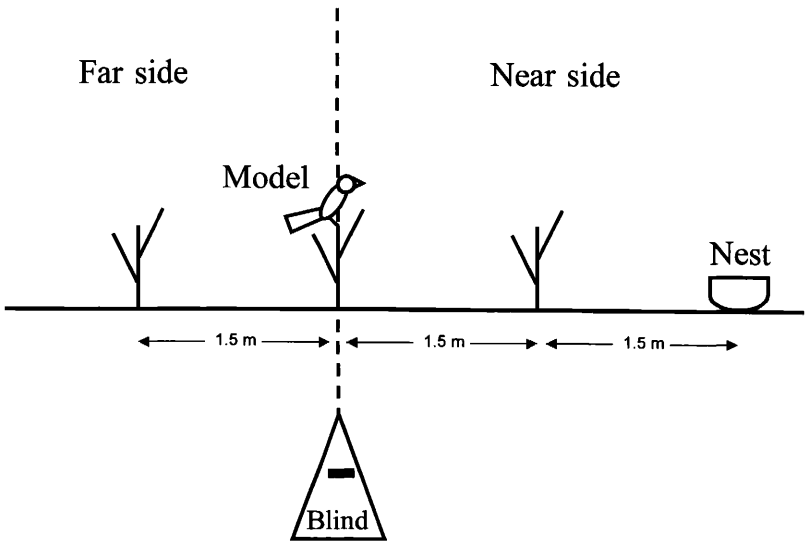

FIG. 1. Experimental setup at Field Sparrow nest showing perches relative to nest and model.

"at the nest." I combined the responses "near side" and "at the nest" to tally the number of "total near" responses relative to the nest. For all responses noted above, I recorded the behavior of the bird closest to the model. All instantaneous responses were recorded as the number of 10-s samples in which the response occurred during the 5-min test period (i.e. 30 samples per test period). The remaining response, "chip" calls (Carey et al. 1994), was recorded as the number of times a chip was given during the 5-min trial. Chip calls were summed for both birds if two birds responded. For every 5-min trial, I also noted whether one or both adults were present. Responses were spoken into a hand-held tape recorder.

To determine the relationship of responses to natural perch density, I sampled stem abundance around each nest. In a 10-m circle centered on the model perch, I counted the numbers of stems on the far and near sides relative to the nest (Fig. 1). I classified stems as small (<5 cm dbh) or large (≥5 cm dbh). The latter category included trees and wooden fence posts. I compared densities of large and small stems on far and near sides with Wilcoxon signed-rank tests. I used a chi-square test to compare the number of nest owners responding. To compare responses to jay versus towhee models, I used Wilcoxon signed-rank tests. For this series of tests, I used significance levels adjusted with the Bonferroni method (Rice 1989) and considered $P < 0.05$ to be significant. I also compared responses from the far and near sides for each model separately using Wilcoxon signed-rank tests. All tests were two-tailed.

Results.—The number of Field Sparrows that responded did not differ between the jay or the towhee models ($\chi^2 = 1.2$, df = 1, $P = 0.30$). Field Sparrows directed more chip calls toward the jay and spent more time on the far side of the nest in the presence of the jay compared with the towhee (Table 1). Field Sparrows did not spend more time on the far side than the near side when comparing responses to the jay model alone (Wilcoxon signed-rank test, $z = -1.4$, $P = 0.15$; Fig. 2), but they spent more time at the near side than the far side when responding to the towhee model alone ($z = -2.1$, $P = 0.03$). Field Sparrows spent more time >1.5 m from the jay than from the towhee (Table 1). Although one member of a Field Sparrow pair left the nest area in the presence of the jay model, at no time did both members of the pair, or a bird that responded singly, leave the nest area when the jay was present. In contrast, both birds frequently left the nest area in the presence of the towhee (gone from area; Table 1). Only one sparrow flew to the nest during the presentation of the jay model, whereas sparrows frequently landed at the nest in the presence of the towhee model (at the nest; Table 1).

Significantly more small stems occurred on the near side than the far side of the model (near side, $\bar{x} = 57.7 \pm$ SE of 11.1; far side, $\bar{x} = 44.6 \pm 9.4$; $z = -2.3$, $P = 0.02$), but the mean number of large stems did not differ between the near and far sides (near side, $\bar{x} = 3.7 \pm 1.1$; far side, $\bar{x} = 2.9 \pm 0.8$; $z = -1.2$, $P = 0.23$).

Field Sparrows did not employ injury feigning or other displays, dive at, or strike the models. Field Sparrows frequently used the experimental perches when responding to the towhee model, whereas only one bird used the perches when responding to the jay model. In four cases, owners that were initially returning to the near side of the nest area abruptly

TABLE 1. Responses of Field Sparrows to models of Blue Jay and Eastern Towhee at the nest. Values are $\bar{x} \pm$ SE for tests at 26 nests.

Response variable[a]	Blue Jay	Eastern Towhee	P[b]
Chips	452.8 ± 48.3	50.0 ± 21.9	<0.0001
Far side	15.8 ± 2.5	3.6 ± 1.5	<0.0001
Near side	10.0 ± 2.2	7.5 ± 1.6	0.30
Orientation unknown	4.1 ± 1.5	1.7 ± 0.8	0.06
≤1.5 m	2.4 ± 0.8	4.7 ± 1.1	0.14
>1.5 m	24.7 ± 1.5	6.9 ± 1.6	<0.0001
Distance unknown	2.8 ± 1.2	1.3 ± 0.6	0.40
Gone from area	0	7.0 ± 2.0	0.005
At the nest	0.1 ± 0.1	10.2 ± 2.3	0.001
Total near	10.1 ± 2.2	17.8 ± 2.2	0.03

[a] All values are based on the number of 10-s periods (out of 30) bird performed these behaviors except for chips, which are based on actual number of occurrences in trials.

[b] All values < 0.01 were significant at $P < 0.05$ after Bonferroni correction.

flew in a wide circle to the far side when responding to the jay; birds responding to the towhee model tended to fly directly to the nest from either direction.

Discussion.—Field Sparrows appeared to perceive the Blue Jay as a nest enemy compared with the Eastern Towhee and avoided the nest in the Blue Jay's presence. Although the difference in the amount of time spent in far-side versus near-side locations when only the jay was present was not significant (Fig. 2), sparrows spent significantly more time on the far side when responding to the jay than when responding to the towhee (Table 1). Sparrows were more likely to engage in nest-oriented behavior such as feeding or brooding young in the presence of the towhee (at the nest; Table 1), whereas they rarely approached the nest in the presence of the jay. Field Sparrows readily left the nest area in the presence of the towhee, presumably to forage, whereas at least one bird was always present when responding to the jay (gone from area; Table 1). The near sides of nests had more small stems, and Field Sparrows perched on the near side more frequently in response to the towhee alone. However, sparrows did not spend more time on the near side in the presence of the jay, indicating that birds avoided perching near the nest even though more natural perches were available.

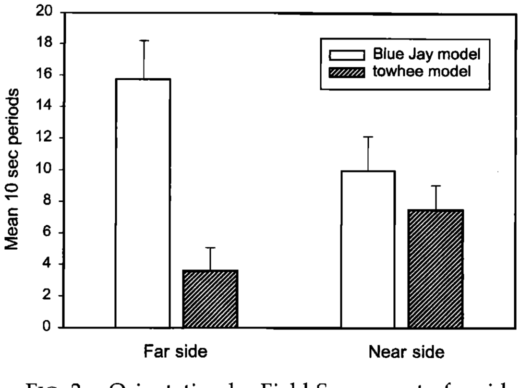

FIG. 2. Orientation by Field Sparrows to far side and near side of model ($\bar{x} \pm$ SE) relative to model type during experiments (n = 26 nests).

Several studies have shown that parent birds increase their presence near the nest in response to real or model predators (Martindale 1982, Marzluff 1985). Guarding the nest may increase reproductive success in cases where parents can deter or distract predators (Marzluff 1985, Martin 1992), but in cases where the predator cannot be deterred, nest avoidance may be the better strategy. Dale et al. (1996) found that Pied Flycatchers (*Ficedula hypoleuca*) avoided the nest in response to models of a Eurasian Sparrowhawk (*Accipiter nisus*) and a Great Spotted Woodpecker (*Dendrocopos major*). Wheelwright and Dorsey (1991) found that Tree Swallows avoided nest boxes during presentation of model gulls, and that feeding rates returned to normal soon after models were removed.

Rates of chip calls by Field Sparrows were extremely rapid in response to the jay model compared with the towhee model. The function of these calls is not clear; human disturbance causes Field Sparrow nestlings to crouch in the nest (Dawson and Evans 1957), but I do not know whether chip calls alone produce this result. Although it happened rarely in this study, during this and other model presentations (Burhans 1996), chipping by Field Sparrows has attracted other species, which may join in mobbing the model. Chipping may signal to the predator that it has been detected. Chipping by Field Sparrows, and the interspecific mobbing that sometimes results, may interfere with the hunt and force the predator to leave, as predicted by the "move on" hypothesis (Curio 1978).

Greig-Smith (1980), East (1981), and Knight and Temple (1986) conducted experiments in which they allowed adult birds to determine the route of human intruders near nests. In all three studies, adults led the observers away from the nest. My use of a stationary model did not allow nest owners to modify the actions of the predator, so it is not possible to determine if sparrows were attempting to lead the predator away from the nest, or simply were avoiding the nest. Nest owners may have reacted differently to a predator that preys preferentially on adults; to my knowledge, Blue Jays have not been documented preying upon adult Field Sparrows. Further insights into nest defense could be gained by determining whether avoidance or distraction behaviors differ in the presence of predators that pose different threats to adults versus offspring (e.g. Patterson et al. 1980, Dale et al. 1996). In my study, the Blue Jay faced the nest, which may have indicated to the parents that the predator had discovered the nest location. Responses to a predator facing away from the nest would be instructive as well.

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