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HOUSE SPARROW RESPONSE TO MONOFILAMENT LINES AT NEST BOXES AND ADJACENT FEEDING SITES

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ABSTRACT.—Previous studies show that House Sparrows (*Passer domesticus*) are repelled from feeding sites by monofilament lines spaced 30 or 60 cm apart. We examined House Sparrow response at nest boxes using monofilament lines placed around the boxes about 37 cm apart. During 1990, we installed 73 control and 73 line-treated boxes (lines held by wire prongs) and in 1991, 60 control, 60 prong + line treated, and 60 hoop + line treated (lines held by wire half-hoops). During 1990, the lines delayed initial acceptance of nest boxes, which reduced time for renesting attempts and subsequently reduced the number of fledglings produced per nest box. Breeding success, however, did not differ. Over winter House Sparrows used both control and treated boxes for night roosting. During the 1991 nesting season, House Sparrows used more control boxes for egg laying than hoop + line treatments, but otherwise, control and treatment results were similar. House Sparrows nesting in line-treated boxes were repelled by lines placed over nearby feeding sites, a situation-specific response. Lines may repel House Sparrows from feeding sites because of predation risk and need for rapid escape but not from nest sites, which are selected in secure locations.
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Widely-spaced lines or wires have been used to repel certain gull and waterfowl species from fish ponds, reservoirs, public places, crop fields, and landfills (Pochop et al. 1990). Recently, Agüero et al. (1991) and Kessler (1991) found that monofilament lines placed over or around feeding stations consistently repelled 95–99% of House Sparrows (*Passer domesticus*) in winter and about 80–90% in summer, while most other associated species were not repelled. The reduced repellency in summer appears to be related to the presence of juveniles and possibly to reduced wariness in adults because of time-energy constraints (Agüero et al. 1991). The technique appears to affect only certain species and the repellency appears to persist, even in no-choice trials where control and treatments are offered independently (Kessler 1991). However, yet unstudied was House Sparrow response to lines at nest sites, which might result in management implications, such as preventing House Sparrows from nesting in or on structures, and possibly selectively excluding House Sparrows from nest boxes used by more desirable species. Therefore, we evaluated whether monofilament lines would repel House Sparrows from nest boxes during the breeding season or during winter. Additionally, if House Sparrows nested in boxes with lines, we wanted to determine their reproductive

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success and whether these same sparrows would avoid lines at adjacent feeding sites.

STUDY AREA AND METHODS

The study was conducted during 1990 and 1991 at the Univ. of Nebraska–Lincoln (UNL) agronomy farm and UNL east campus, which included a poultry complex, a horticulture garden, and an old barn area. In 1991, we also used three barns at the State Fair grounds in Lincoln. We made nest boxes from four 1.9 liter milk cartons (Fig. 1A, Pochop and Johnson 1993). During both years, three wire prongs (prong + line treatment; Fig. 1B) were used to hold lines about 18 cm from nest boxes and about 37 cm apart. During 1991, we also used wire half-hoops (hoop + line treatment; Fig. 1C) to hold lines in place, a modification from Kessler (1991). Nest boxes were installed on buildings or fence posts at least 2 m above the ground, and at least 3 m apart (North 1973, Indykiewicz 1990). From 10–15 February 1990, we installed 146 nest boxes and randomly assigned prong + line treatments to half of them and control to the other half. Nest boxes remained up during winter to determine roosting use. From 5–18 February 1991, to accommodate the new treatment, we removed all 146 of the original nest boxes and randomly reinstalled 120 of them with 60 new boxes, using the 1990 box locations except where physical conditions or inaccessibility made the spot inappropriate. The control, prong + line, and hoop + line treatments were then randomly assigned to 60 nest boxes each (40 original, 20 new), with equal proportions within sites.

Nest boxes were monitored every five days during the nesting seasons from 17 March through 6 September 1990 and from 2 April through 9 September 1991. Before looking inside, we lightly tapped nest boxes to chase out adult birds (North 1970). We recorded the amount of nest material, the number of eggs and nestlings, and approximate nestling ages (Weaver 1942). We defined a successful clutch as one that fledged at least one bird. Nestlings surviving to at least 13 days were assumed to have fledged. We checked for winter roosting every seven days from 9 December 1990 through 11 March 1991, weather permitting (12 times total), beginning directly after sunset. We approached nest boxes quietly, lifted the top, and recorded the bird(s) present.

For binary variables (e.g., presence or absence of eggs), we compared the number of control versus treatment nest boxes used for a particular activity using 2 × 2 contingency tables with treatment as one factor and response (+ or −) as the other. We then analyzed the tables using chi-square analysis (Snedecor and Cochran 1967). For quantitative variables (e.g., eggs, nestlings, or fledglings per nest box), control versus treatment means were analyzed using two-tailed t-tests (Steel and Torrie 1980). Sites were analyzed separately and combined, but because of low statistical power using individual sites and the overall similarity among sites in pattern of results, we present only combined data (Pochop 1991).

During 1990 (8–13 June), we assessed nesting House Sparrow use of feeding stations by direct observation and by a red fluorescent dye marker (Lemen and Freeman 1985) placed on perches of occupied nest boxes with lines. To provide a surface for the dye, we attached wood lath perches (20 × 3.7 × 0.7 cm) covered with upholstery fabric to the dowel perch on all nest boxes. Only line-treated nest boxes that were ¼ or more full of nesting material had dye put on the perch, a total of 44. The dye was put out after sunset on days zero (7 June), one, two, and four. Ten feeding stations were constructed from wood, 60 × 60 cm with a 4-cm-high outside edge, and lined with muslin to accumulate dye transferred by the birds. These stations were placed on the ground in pairs 3 m apart, one pair each at the agronomy farm, horticulture garden, and barn area, and two pairs at the poultry complex. All stations were in place for four days prior to the experiment and all were baited daily

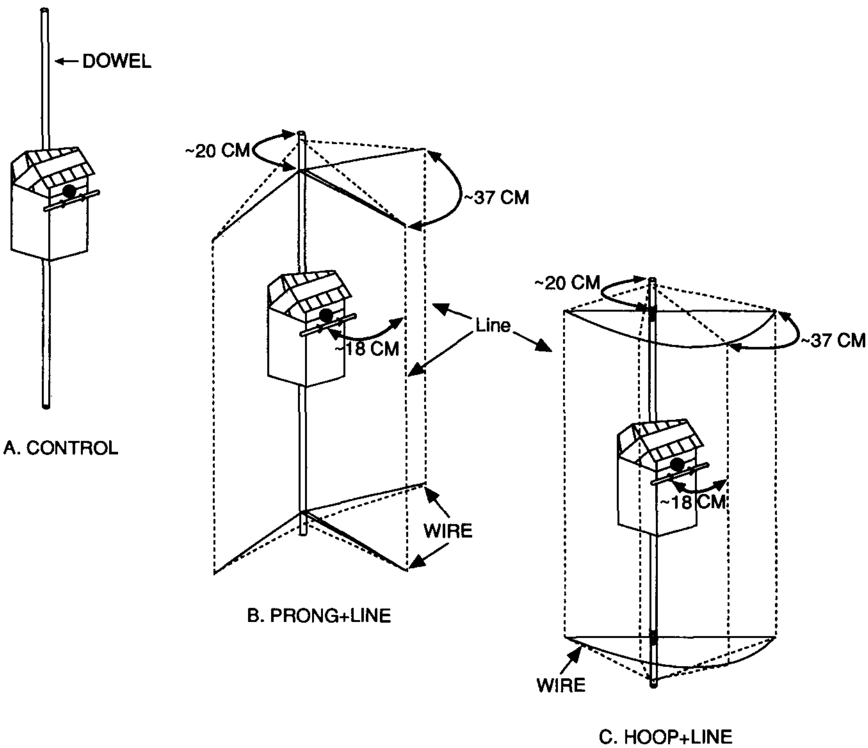

FIG. 1. Nest boxes had wooden dowels (1.2 cm dia., 122 cm long) attached to facilitate installation on buildings or fence posts. The wooden dowels (A) supported the 14-gauge wire prong (B) or hoop (C) attachments, which in turn held the monofilament lines (5.4-kg test) approximately 37 cm apart and about 18 cm from the box.

with 200 g of finely-cracked corn. Monofilament lines were installed 60 cm apart and 17 cm above (Agüero et al. 1991) one of the two stations in each pair, and treated and control stations were switched after the first three days. We collected the muslin at the end of each day and counted the number of squares with dye marks (dye-grids) using a 1.27-cm mesh hardware cloth as a grid and a UV lamp (Model ML-49, UVP Inc., San Gabriel, California).

We also directly observed birds on feeding stations at two of the five sites, the agronomy farm and poultry complex-one. We recorded the number and species of birds present each day in four 15-min intervals randomly selected from sunrise to 3 h after (Agüero et al. 1991). Cloths on the trays at these stations were changed 3 h after sunrise and another 200 g of corn were added. Thus, the 3-h observation results could be compared to the same 3-h interval of dye-grid results. All other sites had the cloths on the trays for the entire day. All feeding stations had the cloths changed each night after sunset.

Data collected included bird observations and dye-grids counted during the 3-h morning period, and the daily total (morning included) number of dye-grids. For a single site, the experimental design was a 2 × 2 Latin square with station and period (days 1–3 or 4–6) as blocking factors. Each station-period combination was an experimental unit. Data were

TABLE 1
PERCENTAGE OF HOUSE SPARROW NEST BOXES WITH NEST MATERIALS, EGGS, AND SUCCESSFUL CLUTCHES, 1990 AND 1991 NESTING SEASONS

Year	Treatment	Number of boxes	Nest boxes with: Nest materials	Eggs	Successful clutches[a]
1990	Control	73	96	70	53
	Prong + line	73	92	47	29
	P-value[b]		0.302	0.004	0.002
1991	Control	60	87	80	65
	Prong + line	60	83	75	70
	P-value[b]		0.609	0.512	0.559
	Hoop + line	60	85	63	55
	P-value[b]		0.793	0.043	0.264

[a] A clutch that fledged at least one bird.
[b] *P*-values for control versus treated nest boxes (df = 1) were determined using chi-square.

combined across sites and analyzed using a replicated Latin square analysis of variance (ANOVA) (Neter and Wasserman 1974), which allowed testing for site by treatment interactions.

RESULTS

House Sparrows used boxes with and without lines at all sites both years. The proportion of control versus treated boxes with nest materials did not differ either year ($P \geq 0.302$, Table 1). However, during 1990 more control than prong + line boxes had eggs ($P = 0.004$), and controls subsequently had more boxes with successful clutches ($P = 0.002$). House Sparrows initiated first clutches a mean of 24.6 days earlier in control boxes during 1990 than in prong + line-treated boxes ($P = 0.0001$), and controls had more boxes with at least three clutches ($P = 0.0002$). During 1991, there was no difference between control and prong + line treatments in the proportion of boxes with eggs ($P = 0.512$) or successful clutches ($P = 0.559$), but a lower proportion of hoop + line boxes had eggs ($P = 0.043$). Mean date of first clutch initiation in 1991 ($P \geq 0.399$) and number of boxes with at least three clutches ($P \geq 0.122$) did not differ.

During 1990, there were greater mean numbers of clutches, eggs, nestlings, and fledglings in control than in treated boxes ($P \leq 0.055$, Table 2), but these differences did not occur in 1991 ($P \geq 0.468$). Further, during both 1990 and 1991, the mean number of eggs per clutch and the percentage of eggs that hatched (hatching success), nestlings that fledged (fledging success), or eggs that produced fledglings (breeding success) did not differ between the control and treated boxes ($P \geq 0.078$, Table 2).

TABLE 2

MEAN NUMBER OF CLUTCHES, EGGS, NESTLINGS, AND FLEDGLINGS PRODUCED PER HOUSE SPARROW NEST BOX AND REPRODUCTIVE SUCCESS (%) AVERAGED ACROSS NEST BOXES, 1990 AND 1991 NESTING SEASONS

Year	Treatment	Number of boxes[a]	Clutches	Eggs	Nestlings	Fledglings	Eggs per clutch	Hatching success[b]	Fledging success[c]	Breeding success[d]
1990	Control	51	2.2	9.9	5.4	3.4	4.4	49.6	60.9	30.4
	Prong + line	34	1.5	6.3	3.9	2.0	4.2	56.3	49.8	28.2
	P-value[e]		0.0002	0.0001	0.055	0.022	0.409	0.371	0.163	0.701
1991	Control	48	2.6	11.9	6.5	4.3	4.6	52.4	64.0	33.9
	Prong + line	45	2.6	11.5	6.6	4.8	4.5	58.6	72.1	42.3
	P-value[e]		0.682	0.702	0.857	0.517	0.796	0.248	0.188	0.078
	Hoop + line	38	2.5	11.3	5.8	3.9	4.5	50.8	70.4	36.5
	P-value[e]		0.503	0.679	0.468	0.478	0.916	0.781	0.340	0.611

[a] Only nest boxes that had eggs were included.
[b] Percentage of eggs laid that hatched.
[c] Percentage of nestlings hatched that fledged.
[d] Percentage of eggs laid that resulted in fledged young.
[e] *P*-values for control versus treated nest boxes were determined using a *t*-test.

TABLE 3
HOUSE SPARROW VISITS OBSERVED AND DYE-MARKED GRIDS COUNTED ON FEEDING STATIONS FROM THREE-HOUR MORNING SAMPLING INTERVALS (TWO SITES) OR FROM DAILY TOTAL DATA (FIVE SITES)

Method	Treatment[a]	Mean	Range
Early morning			
Bird visits	Control	105.2*	44–198
	Lines	13.7	0–53
Dye-grids	Control	479.9*	0–2070
	Lines	149.1	0–404
Daily totals			
Dye-grids	Control	531.7*	0–2770
	Lines	131.2	0–803

[a] Control versus line treatments were compared, sites combined, using replicated Latin square ANOVA.
* Control differed from lines ($P \leq 0.003$).

Only House Sparrows used the boxes for winter roosting. The proportions of control versus treatment boxes used per night showed no consistent pattern and, with one exception, did not differ before ($P \geq 0.152$) nor after (prong + line: $P \geq 0.461$; hoop + line: $P \geq 0.362$) the 5–18 February addition of hoop + line boxes. The one exception (4 February), apparently an anomaly, showed greater use of control than of prong + line boxes ($P = 0.026$). Prior to 4 February, House Sparrows used a mean of 46.4 boxes per night (range: 35–67), 55% in control and 45% in prong + line. After 18 February, House Sparrows used a mean of 34.8 boxes (range: 32–37), 32% in control, 30% in prong + line, and 38% in hoop + line.

Feeding station results using the dye method showed site by treatment interactions ($P \leq 0.006$), but there was no crossover interaction: at all sites, counts on control were higher. Bird count data had no site by treatment interactions ($P = 0.124$). Thus, means averaged over all sites were used to estimate treatment differences with both methods. Results from morning observations ($P = 0.0001$), morning dye-grids ($P = 0.003$), and daily-total dye-grids ($P = 0.0001$) consistently showed higher counts on control than on treated stations (Table 3). Direct morning observations indicated that 88% of all House Sparrow visits were at control feeding stations; morning and daily-total dye-grid counts indicated 76% and 80%, respectively. House Sparrows accounted for 99.4% of all birds observed on feeding stations at the poultry complex and were the only bird species observed on feeding stations at the agronomy farm. We saw no evidence that using the dye on nest box perches affected House Sparrow nesting activity (Pochop 1991).

DISCUSSION

Our initial question was whether lines would deter House Sparrows from using nest boxes. The lines were installed at the same time as nest boxes so that House Sparrows would have no experience with the nest box or prior motivation to pass through the lines. However, in both 1990 and 1991, House Sparrows nested in treated as well as control nest boxes, and during winter, they roosted in both. However, during the first year, lines delayed clutch initiation and had other related effects on reproductive success. During 1991, reproductive success did not differ between control and treated nest boxes except that a lower proportion of hoop + line boxes had eggs laid.

Our nesting results are within ranges reported from other studies of House Sparrows. North (1970, 1973) found nest materials in 86% and eggs in 30–34% of nest boxes in Wisconsin, and 92% of Lowther's (1983) nest boxes were used at least once. Salaet and Cordero (1988) had clutches in 2–44% of boxes in Spain, and Ivanov (1987) reported nest box occupation (boxes with broods) of 6–12% at one site and 36.7–41.7% at another in Bulgaria. Breeding success rates of 31% (North 1973), 70.5% (Weaver 1942), 50–68% (Ivanov 1987), and 45% (Salaet and Cordero 1988) have been reported. The large variation in nest box use and reproductive success among sites may have been related to availability and/or quality of food or nest sites; competition from other box-nesting species present; depredations by predators; and/or nest disturbances (Anderson 1990, North 1973).

The lower success of the 1990 prong + line treatment, due in part to later occupation and less renesting than in control boxes, might have resulted from use of prong + line boxes by inexperienced or lower-ranking birds. It has been shown that first-year birds start nesting later than do older adults (Selander and Johnston 1967, Seel 1968a), lay slightly smaller clutches (Seel 1968b), make use of inferior sites, and have less experience (Summers-Smith 1988). Alternatively, it is possible that initial avoidance of monofilament lines was eventually overcome by the need to find a suitable nesting site. This is consistent with observations of House Sparrow avoidance of novel stimuli within a familiar environment (Rana 1989). Similarly, the lower use of hoop + line boxes for egg laying during 1991 might also have resulted because the hoop + line treatment was somewhat novel. House Sparrows were accustomed to control and prong + line boxes because they were left up through the winter.

Our feeding station results using both direct observation and dye-grid counts are comparable to earlier findings from summer (Agüero et al. 1991, Kessler 1991). Our results show that House Sparrows used nest boxes with lines but avoided lines at nearby feeding sites, a situation-specific response. One possible reason for this behavior is that nest sites may be selected because they are secure from predation (Indykiewicz 1990). House Sparrows often abandon nest boxes from which they are captured (North 1970, Pinowski et al. 1973) and avoid boxes that are lower than 2 m high (North 1973, Indykiewicz 1990). In contrast, feeding occurs where food is located, often in open sites where the risk of predation exists. House Sparrows tend to be alert and wary birds and are among the first to take flight from feeding areas (Dennis 1978). Thus, at feeding sites, lines may interfere with the need for rapid escape, whereas at nest boxes exits may be more deliberate and lines around the box not viewed as an obstruction. The avoidance of feeding stations with lines and the concurrent use of nest sites with lines has been documented only in the House Sparrow. Ring-billed Gulls (*Larus delawarensis*) have been repelled from both nesting and feeding areas by lines (Blokpoel and Tessier 1983, 1984), and preliminary evaluations indicate that Barn Swallows (*Hirundo rustica*; J. E. Knight, pers. comm.) and Cliff Swallows (*H. pyrrhonota*; T. E. Lassek, unpubl. data) were repelled from nesting on structures by certain line treatments. However, unlike House Sparrows nesting in protected cavities, the Ring-billed Gulls were nesting in open areas subject to predation, and the swallow nests were attached to outer parts of structures.

Although lines did not repel House Sparrows from nest boxes, they apparently caused an initial delay in use of newly-erected boxes. Further study might develop this result as a method to help other cavity nesters initiate and more successfully defend nests from House Sparrows, assuming that the other species were unaffected. The potential value of lines as a management tool to discourage House Sparrow roosting in trees or on structures remains unknown, but results to date indicate potential for use in open trees where House Sparrows would be exposed to predation risk.

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