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Homogeneity of Vegetational Cover around the Nest and Avoidance of Nest Predation in Mockingbirds

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Reproductive failure by open-nesting passerines is largely caused by predators of eggs and nestlings (Lack 1954, Nice 1957, Best and Stauffer 1980). Besides active parental defense, two major antipredator tactics might be expected: (1) placement of the nest in a well-concealed site and (2) placement of the nest in a site where predator access or abundance is reduced. To determine the existence of such tactics would require both assaying the effect of nest-site characteristics on nesting success and testing for nest-site choice (independently of such confounding influences as territoriality). Several workers have quantified the mean density of vegetation around nests and related it to nesting success (Gluck 1979, Wray and Whitmore 1979), but none has examined the effect of the homogeneity of such vegetational coverage. We report here the results of an assay of the effects of nest-site characteristics upon nesting success in Mockingbirds (*Mimus polyglottos*) and describe an apparatus for measuring density and homogeneity of vegetation near nests.

The study was conducted in three southcentral Louisiana parishes—east Lafayette, west St. Martin, and south St. Landry. Nests were located along fence rows and the edges of thickets that were bordered by pastures and cultivated fields. During the breeding seasons of 1980 and 1981, 50 and 58 nests were studied, respectively. Once an active nest was located, we monitored its status on alternate days by using a mirror attached to a pole to view the contents (Parker 1972). The effects of the investigator's presence were assumed to be minimal (see Willis 1973, Anderson and Storer 1976, Gottfried and Thompson 1978). Nests yielding at least one fledgling were defined as successful. Losses were attributed to predation when whole clutches of eggs or whole broods of unfledged young disappeared (Skutch 1976).

Measurements of the vegetation were made after each nest became vacant. The primary species of vegetation surrounding the nest was recorded. The 14 variables measured, or computed from measurements, at each nest were: (1) and (2) distance continuous vegetation extended directly above nest (DA) and below nest (DB); (3) average of DA, DB, and four measurements, separated from one another by 90°,

of distance of continuous vegetation lateral to the nest (DM); (4) height of nest from ground (H); (5) maximum height of vegetation supporting nest (TH); (6–8) mean percentage of reduction in light transmittance lateral to nest (ML), above nest (MA), and below nest (MB); (9) mean percentage of reduction in light transmittance lateral to, above, and below nest (MLAB); (10–12) standard deviation of percentage of reduction in light transmittance lateral to nest (SDL), above nest (SDA), and below nest (SDB); (13) mean standard deviation of percentage of reduction in light transmittance lateral to, above, and below nest (SDLAB); (14) qualitative score for degree of isolation of site (ISOL), assigned values of 1 = along line of continuous woody vegetation, 2 = along broken line of woody vegetation, 3 = an isolated mass of woody vegetation.

Variables 6–13 were derived from photometer readings of a standard light-source to obtain a relative measurement of the density of vegetation immediately around nests. This procedure was performed only at night in essentially complete darkness except for that light provided by the standard light-source. The photometer used was a Science and Mechanics Model 102. The apparatus employed to establish measuring points consisted of a central wooden disc with a diameter of 10 cm. A 250-mA light bulb at the center of the disc was powered by a 6 V battery. Six wooden dowels could be inserted laterally into holes along the lateral margin of the disc separated by angles of 60°. Four holes on the top of the disc held four dowels at 60° angles to the flat surface of the disc. When the disc was turned upside down, readings could be obtained for four points under the nest. The distance from the distal end of the dowels to the light bulb was 61 cm. By placing the light probe of the photometer at the distal end of each dowel, the amount of light from the bulb that passed through the intervening vegetation could be recorded. This was converted to a relative measurement of the percentage of light reduction by comparing each reading with equivalent readings taken without any vegetational barrier. Before the disc was placed in the nest, light readings were recorded in an open area near the nest site where there were no

TABLE 1. Means and standard deviations (in parentheses) of nest-site variables by nesting outcome. First five variables in cm; next eight variables calculated from arcsin transformations of percentage of reductions in light transmittance. Standardized discriminant coefficients and probability levels for differences between the two outcomes are given for the five variables included in the discriminant function.

| Variable | Successful (<i>n</i> = 48) | Unsuccessful (<i>n</i> = 60) | Standardized discriminant coefficient | <i>P</i> |
|----------|--------------------------------|----------------------------------|---|----------|
| DA | 122.9 (115.8) | 96.7 (75.8) | | |
| DB | 61.3 (71.6) | 50.1 (50.4) | | |
| DM | 83.7 (68.5) | 70.0 (51.4) | 0.5366 | 0.236 |
| H | 166.7 (61.9) | 180.5 (70.0) | | |
| TH | 357.5 (179.7) | 354.5 (212.1) | | |
| ML | 48.4 (16.4) | 45.6 (17.0) | | |
| SDL | 25.4 (8.0) | 24.2 (7.1) | 0.3354 | 0.410 |
| MA | 57.3 (19.1) | 53.0 (14.9) | | |
| SDA | 18.5 (12.1) | 24.9 (12.4) | -0.5879 | 0.008 |
| MB | 42.6 (22.5) | 42.0 (21.2) | | |
| SDB | 19.8 (13.4) | 21.8 (12.2) | | |
| MLAB | 49.4 (16.0) | 46.9 (12.3) | | |
| SDLAB | 17.4 (6.4) | 18.9 (7.9) | -0.3770 | 0.292 |
| ISOL | 2.5 (0.6) | 2.2 (0.5) | 0.7408 | 0.007 |

obstructions between the light source and the photometer. The disc was then placed upon the top of the nest. The lateral dowels were inserted first and the light readings were recorded. The four upper dowels were then placed in position and the readings above the nest were taken. The dowels were then removed and the disc was placed upside down below the nest. The four dowels were inserted pointing below the nest and light readings were taken at their distal ends. After the 14 light readings around the nest were recorded, a second set of control readings was made in the open to monitor the stability of light emission by the bulb. Each reading taken around the nest was divided by the average of the homologous before and after control readings (and multiplied by 100) to obtain the percentage of reduction in light transmittance due to vegetation near the nest. These percentages were then arcsin transformed (Zar 1974). For each of the three directions from each nest (lateral, above, below), the mean and standard deviation were calculated from the several individual values of transformed percentage of reduction in light transmittance; these then served as nest-site characteristics.

We began this study each year during the second week of May, well after nesting had started, and ended it in early July (1980) or early August (1981) at the approximate termination of the nesting seasons in those years. The maximum number of active nests monitored per day (15–25) occurred between late May and mid-June; the number of active nests steadily declined thereafter. Successful nests averaged 14 days for incubation and 12 days for the nestling period. All losses of complete clutches or broods were apparently due to predation. Of the 50 nests monitored

in 1980, 44% fledged at least one young; in 1981 43% of the 58 nests were successful. In both years, an average of 1.3 offspring was fledged per nesting attempt.

A total of 25 different primary plant species was used for nest substrates during both seasons. No plant species was overwhelmingly predominant. The water oak (*Quercus nigra*) made up 19% of the 108 nest substrates. Several species were nested in only once. The dogwood tree (*Cornus drummondii*) was the only primary plant species significantly associated with nesting outcome; 10 of 12 nests in this plant were unsuccessful (two-tailed binomial test; $P < 0.05$).

The means and standard deviations of the 14 parameters of successful and unsuccessful nest sites are presented in Table 1. The hypothesis of equal multivariate means between the groups was tested by Hotelling's T^2 and rejected ($P < 0.1$; two-tailed). Next, a stepwise discriminant analysis was performed. Only five variables had sufficient discriminatory power to be included; in order of inclusion they were ISOL, SDA, DM, SDLAB, and SDL. The largest standardized coefficients in the discriminant function were those of ISOL and SDA (Table 1). Differences between the two groups of nests were evaluated by two-tailed t -tests for the five variables chosen by the discriminant procedure. Only ISOL and SDA differed significantly (Table 1). The discriminant scores of the two groups differed significantly ($P < 0.01$; two-tailed t -test), but 34% of the nests were misclassified by the discriminant function.

In the analysis above, the success of a nest site was defined by fledging of an offspring. As an alternative way of analyzing nest site characteristics, we regressed them stepwise against a dependent vari-

able that provided another criterion of nest-site success: the number of days that offspring survived in the nest. SDA was the single best predictor of the number of days that offspring survived in the nest. It was entered first by the stepwise procedure and had a significant negative partial regression coefficient when fewer than seven independent variables were included ($P < 0.05$). When all 14 variables were included, only ISOL and SDLAB had significant partial regression coefficients (positive and negative, respectively; $P < 0.05$).

Potential predators in the area include Blue Jays (*Cyanocitta cristata*), Common Crows (*Corvus brachyrhynchos*), Fish Crows (*Corvus ossifragus*), Texas ratsnakes (*Elaphe obsoleta lindheimeri*), speckled kingsnakes (*Lampropeltis getulus holbrooki*), eastern yellow-bellied racers (*Coluber constrictor flavigaster*), prairie kingsnakes (*Lampropeltis calligaster*), raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), fox squirrels (*Sciurus niger*), and feral housecats. Most nests were inaccessible to the larger mammals and very few nests were either tilted or contained shell fragments. Thus, the large majority of the predation must have been due to birds and snakes. No avian predation was witnessed, but in three instances snakes were found feeding on Mockingbirds at nests. In two of the cases, the predators were a Texas ratsnake and a speckled kingsnake, both of which were observed swallowing fledglings. The third occurrence involved a Texas ratsnake 102 cm long, which was found about 1 m from a nest that contained three eggs. Upon capture, the snake regurgitated an adult female Mockingbird. The snake was released where it had been captured. The eggs disappeared within 3 days.

Nests in isolated patches of vegetation suffered significantly less predation than those in continuous strips of woody vegetation. We do not have quantitative measures of predator abundance, but all of the actual or potential ophidian predators were observed in continuous strips of woody vegetation. Fence rows or other forms of continuous vegetation may provide the larger, semi-arboreal species of snakes with concealment from their predators and, hence, may experience more ophidian foraging activity. Nest sites away from such areas are, perhaps, less often approached by snakes.

Quantitative investigations of the effect of nest concealment on reproductive success have typically defined concealment in terms of mean vegetation density (Caccamise 1977, Gluck 1979, Wray and Whitmore 1979, Osborne and Osborne 1980). Our results indicate that such a definition may sometimes be inadequate. Although typically greater at suc-

cessful Mockingbird nests, mean densities of vegetation (i.e. percentage of reductions in light transmittance) close to the nest did not differ significantly between successful and unsuccessful nests. The variables that showed significant effects on nesting success were the standard deviations of percentage of reductions in light transmittance, particularly above the nest. These apparently represent the degree of homogeneity of vegetational cover near the nest. Vegetation of high mean density around the nest may have marginal antipredator value if it includes a combination of very dense patches interspersed with open corridors.

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