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Importance of Structural Stability to Success of Mourning Dove Nests

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Studies of nest-site selection and nesting habitats often involve a "characterization" of nests and of habitats in which nests are found. Our objective in the present work is to identify nest-site characteristics that are associated with variation in components of Mourning Dove (*Zenaida macroura*) fitness (e.g. the probability of a nest succeeding), as opposed to simply "characterizing" dove nest sites. If certain nest-site characteristics affect the probability that a nest will succeed, then we suspect that these characteristics will be associated with either concealment (the probability of detection by certain predators) or structural stability (the probability of eggs or entire nests falling to the ground as a result of wind, rain storms, parental activity, etc.). Although other workers agree that structural stability is an important determinant of Mourning Dove nesting success (e.g. McClure 1944: 384; Woolfenden and Rohwer 1969: 59), we are aware of no actual tests of this hypothesis.

Here we report results of an investigation designed to determine whether or not structural stability is associated with the probability of nesting success in Mourning Doves. First, we monitored a sample of dove nests and recorded whether they succeeded or failed. We then obtained an independent measure of structural stability and classified each nest into one of two groups based on this measure. Finally, we estimated daily survival probabilities for nests in each group and used these estimates to test the null hypothesis that nest success was independent of the structural stability measure.

Dove nests were located on the grounds of the Patuxent Wildlife Research Center (n = 56 nesting attempts) and in residential areas of Bowie and Laurel, Maryland (n = 6). Nests were located from 17 March to 3 August 1979; the majority (77%) were found during 15 April to 15 June. After their initial location, all nests were visited at intervals of 1 to 8 days until either success (fledging) or failure occurred. "Success" is difficult to determine when nestlings reach an age at which they are known to be capable of fledging (e.g. $\geq$ 10 days). For example, if a nest contains 11-day-old nestlings one day and is empty the next, determination of fledging or predation is often impossible. For this reason, we operationally defined a successful nest as one in which a single nestling was known to attain an age of 10 days. In many instances, nests were visited on the day of hatching and nestling ages were known exactly. In the remaining instances, we aged nestlings using the key and photographs of Hanson and Kossack (1963). All nests were visited on day 10 after hatching to determine success or failure.

We can envision two approaches to obtaining a "measure" of the structural stability of a nest: (1) obtain sets of actual measurements believed to be associated with structural stability, (2) obtain measures of a single integrated variable believed to reflect structural stability. We chose the second approach and used a nest persistence index (NPI). All nests monitored in 1979 were revisited in 1980 and given the following NPI ratings: (1) nest absent, (2) nest remnant present but incapable of holding eggs, (3) nest present and capable of holding eggs. NPI is thus a variable that, in effect, integrates the various components affecting structural stability of nests (see also McClure 1944: 389). A value of "1" or "2" indicates that a nest did not survive the winter intact and is assumed to reflect poor construction or site location, or both. Conversely, a value of "3" is indicative of a nest that did survive the winter and reflects good construction or site location.

Between 26 March and 5 May 1980, we assigned a NPI to 47 of 54 nests located during the previous breeding season. The remaining 7 nests were discarded for various reasons (e.g. incomplete nesting record, human disturbance of nest site, uncertainty of exact nest location). In considering the relation between nest fate and NPI, nests were separated into two groups (Table 1): (1) nests that were used only once (n = 40), plus final nesting efforts in nests that were used more than once during 1979 (n = 7); and (2) nesting efforts for nests used more than once, but not including the final effort (n = 8). If there are

TABLE 1. Mourning Dove nest fates and Nest Persistence Index (NPI).

Nesting effort	Success status	NPI[a] 1	2	3
Single-use nests and final efforts of multi-use nests[b]	Successful	9	0	14
	Not successful	12	8	4
All nesting efforts of multi-use nests other than the final effort	Successful	0	1	2
	Not successful	2	0	3

[a] NPI = 1 and 2 denotes nests not surviving winter, and nests surviving but not capable of holding eggs, respectively. NPI = 3 denotes nests surviving winter intact.
[b] This group of nesting efforts was used in estimating daily survival probability for testing the null hypothesis (Table 2).

differences in the structural stability of a single nest from one nesting effort to the next (we noted the presence of new nesting material in reused nests), then the probability of a nest surviving the winter should be most closely associated with its condition at the time of its last use. As seen in Table 1, a greater proportion of NPI = 3 nests succeeded (70%) than of NPI = 1 or 2 nests (31%). These data appear to support the hypothesis that structural stability affects nesting success.

Although the data of Table 1 appear convincing, we know that proportions of found nests that are eventually successful provide biased estimates of nesting success (Mayfield 1961, 1975; Miller and Johnson 1978; Johnson 1980; Hensler and Nichols in press). To test satisfactorily the hypothesis that nesting success (defined here as the probability that a new nest will produce at least one 10-day-old young) for the two groups of nests was similar, we estimated daily nest survival probabilities and their variances using the model of Hensler and Nichols (in press). For nests visited at intervals greater than 1 day, we used the expected number of days at risk from daily-visit nests as an approximation in the estimation equations. We estimated daily survival probabilities and their standard errors, using single-use and last-use nests, for NPI = 3 and NPI = 1 or 2. Estimated daily survival probability for NPI = 3 nests was substantially higher than that for NPI = 1 or 2 nests (Table 2). We tested the null hypothesis of no difference between these estimates using the z-test statistic suggested by Hensler and Nichols (in press). The computed test statistic, $z = 3.10$ ($P < 0.01$, one-tailed test), indicates a significant difference between the survival probabilities of nests in the two NPI groups. We interpret this as evidence that the probability of a nest succeeding is affected by its structural stability.

This conclusion is consistent with field observations and literature on Mourning Doves. Weather is thought to be an important source of nest mortality (e.g. Nice 1922, 1923; McClure 1942, 1943; Hanson and Kossack 1963), and we have observed broken dove eggs on the ground under nests after thunderstorms and periods of high winds. In addition, structurally stable nests are probably resistant to losses resulting from parental activity. We have observed, as have others (Stoner 1931), instances of eggs falling from nests as incubating parents are flushed, and this may be a relatively common form of egg loss. Stability often seems to be related to nest placement in the tree. Nice (1923: 53) reported that nests in crotches were nearly twice as successful as nests in branches. In Iowa, McClure (1943: 378) noted that doves that nested in old Robin (*Turdus migratorius*) nests had greater success than those in nests constructed by doves. Similarly, Nice (1922: 462–463) noted greater success among doves utilizing nests of other birds during one year of her study and suggested that "The chief advantage of building on another nest lies in a larger, stronger place for holding the young."

Structural stability is probably a function of both the choice of a nest site and the quality of construction. In our work we have observed considerable variation in each of these possible determinants of nest

TABLE 2. Estimated daily survival probability of the two groups of Mourning Dove nests.

Stability group[a]	n[b]	Daily survival probability: Estimate	Standard error
NPI = 3	18	0.986	0.007
NPI = 1 or 2	29	0.943	0.012

[a] NPI = 3 denotes nests surviving the winter intact. NPI = 1 or 2 denotes nests not surviving the winter, and nests surviving but not capable of holding eggs, respectively.
[b] n denotes number of nests. Only single nesting efforts (nests used once) and final efforts (nests used more than once) are included.

stability. The behavioral differences among doves that produce this variation may represent phenotypic variablity. For example, it may be that age or experience is associated with variation in choice of nest site or nest construction. Dove populations typically contain high proportions of young individuals, and age-specific variation in nesting behavior patterns could have been largely responsible for the variation we observed. If the behavioral differences associated with choice of nest site and nest construction reflect underlying genetic variability, however, then it is appropriate to ask how this variability is maintained. The estimated difference between daily survival probabilities of nests from the two NPI groups was substantial (assuming a 26-day nesting period, the probability of a new nest succeeding, P^{26}, was 0.69 for NPI = 3 and 0.22 for NPI = 1 or 2). Because nesting success is an important component of individual fitness, we might expect strong selective pressures for behavior patterns associated with structurally stable nests.

The considerable observed variation in nesting success suggests the possible existence of additional selective pressures against behaviors producing structurally stable nests. With respect to nest construction, it is possible that flimsy nests require less time (Woolfenden and Rohwer 1969: 60) and energy to construct. Nest-building activities may render doves visible and conspicuous during the period of nest construction (dove nests seem to be easily found during this period). If conspicuousness increases the probability of detection by predators, then we would expect selection for reductions in time expenditure on nest construction. Mourning Dove nest construction can require several days (average of 7 days in one study; Pearson and Moore 1939) and could thus potentially affect the number of broods produced in a year. This effect could also result in selection for reduced expenditure of time on nest construction (also see Woolfenden and Rohwer 1969). With respect to nest-site selection, we find it difficult to conceive of forces that would select against protected sites associated with stable nests. If such forces exist, then we suspect that they may involve nest concealment and the probability of detection by predators. We are currently investigating detailed nest-site characteristics associated with variation in the probability of a nest succeeding, and we hope that this work will provide additional insight into the relative importance and interaction of structural stability and nest concealment in determining nesting success and thus influencing dove fitness.

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