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#### Observer Visitation Frequency and Success of Mourning Dove Nests: a Field Experiment

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Field studies of nesting success generally require visits by the investigator to the nests under study. Such visits may themselves influence nesting success, however, and this possibility has been discussed and investigated by a number of workers with a variety of bird species. Livezey (1980) reviewed the relevant literature for duck nests and noted that most studies failed to demonstrate differences in nesting success between visited nests and those not visited. Livezey (1980) found in his own work that nest abandonment may have occurred as a result of disturbance by observers but that nest predation was not related to time spent by observers at nests or number of observers approaching nests. Various components of nesting and breeding success in seabirds are thought to be adversely affected by human disturbance and nest visitation (Gillett et al. 1975, Robert and Ralph 1975, Ollason and Dunnet 1980). Upland, ground-nesting species have also been studied (e.g. Stoddard 1931, Evans and Wolfe 1967, Henry 1969, Roseberry and Klimstra 1970, Klimstra and Roseberry 1975), and, although conclusions have varied, a number of these workers found no effect of observers on nest-predation rates.

The effects of human visitation on nest success in tree- and hole-nesting species have received some study. Willis (1973) found no difference between survival rates of visited and unvisited Bicolored Antbird (*Gymnophis bicolor*) nests that were monitored by observation of adult behavior patterns away from the nests. Anderson and Storer (1976) found no relationship between nest-visit frequency and nest success in Kirtland's Warbler (*Dendroica kirtlandii*). Using a convincing field-experiment approach, Gottfried and Thompson (1978) and Gottfried (1978) found no difference in predation rates on experimental nests (abandoned nests of American Robins, *Turdus migratorius*, Northern Cardinals, *Cardinalis cardinalis*, and Field Sparrows, *Spizella pusilla*, were used) that were visited daily and those that were not visited at all. Using data from Cornell's North American Nest Record Card Program, Bart (1977) concluded that daily mortality rates of nests of American Robins, Eastern Bluebirds (*Sialia sialis*), and Mourning Doves (*Zenaidura macroura*) were higher the first day after a nest visit than on subsequent days during the nestling period. Bart and Robson (1982), however, later pointed out that these results could also be explained by an hy-

pothesis involving unrecorded visits to nests. Specifically, they noted that ornithologists sometimes draw inferences about the state of a nest by observing it from a distance. Any evidence suggesting nest failure may prompt a visit to the nest, whereas the absence of such evidence may cause observers to stay away from the nest in order to avoid disturbing it. This behavior can result in an overrepresentation of fatalities in short-visitation intervals and an underrepresentation in long intervals, the same pattern that is expected under a "visitor impact" hypothesis. In any case, no general statement about the effects of nest visitation seems to emerge from previous studies.

In 1979 we began a study of factors affecting the nesting success of Mourning Doves at Patuxent Wildlife Research Center, Laurel, Maryland. We have three reasons for wanting to visit dove nests daily during our investigation. First, we were interested in determining the causes of nest failure whenever possible, and we believed that such determinations would be facilitated by frequent nest visits. Second, we were interested in discovering whether or not daily survival probabilities of nests differed between egg-stage and nestling-stage nests. We do not believe it possible to estimate such stage-specific probabilities properly without frequent nest visits. For example, if nests are visited weekly and one observes eggs on day  $t$  and an empty nest on day  $t + 7$ , it is usually not possible to assign the loss to either the egg or nestling stage. Our third reason for preferring daily visits was that the type of model we used for estimating nesting success assumes constant daily survival probabilities over the period of interest (Mayfield 1961, 1975; Johnson 1979; Hensler and Nichols 1981; Bart and Robson 1982). Thus, we wished to be able to estimate stage-specific probabilities separately in order to obtain the best possible estimate of total nesting success (Mayfield 1961, 1975; Johnson 1979; Bart and Robson 1982; Klett and Johnson 1982).

Despite the desirability of daily nest visits, we were naturally concerned about the possibility that we would influence nesting success to a greater extent with daily than with weekly visits (we considered 7 days to be the longest interval we could use and still obtain relevant data for our studies). Therefore, in 1979 and 1980 we divided studied dove nests into two groups. Nests in one group were visited daily, and nests in the other group were visited weekly. We then estimated daily survival probabilities for the two groups and tested the null hypothesis that survival probabilities were the same for both groups.

*Field methods.*—Dove nests were located on the grounds of Patuxent Wildlife Research Center (PWRC) and in nearby residential areas of Bowie and Laurel, Maryland, during the nesting seasons of 1979 and 1980. Nests were located from 17 March to 3 August in 1979 and 27 March to 17 September in 1980, with the majority found between 15 April and 15 June in

both years. Nests found throughout the season in both years were allocated to one of two treatment groups. We had two main study areas on PWRC. All nests found on one of the areas were allocated to the daily-visit treatment; nests on the other area were visited weekly. These two study areas were adjacent and located in virtually identical old-field and rural-residential habitat. We allocated nests to treatment in this manner, rather than randomly or alternately assigning nests to treatments within the combined area, because we did not want to make daily walks near the weekly-visit nests or daily checks in nearby or possibly the same vegetation as locations of weekly-visit nests. Although most of our nests were found on these two adjacent study areas, some additional nests were located in other areas. These other nests were generally in isolated (relative to other nests) locations and were thus allocated randomly to treatment groups.

Nests in one group were visited daily until either success (fledging of at least one bird) or failure occurred. Nests in the other group were visited at weekly intervals (usually 7 days but including some instances of 6 and 8 days) after they were initially found, with the exception that all nests were visited on day 10 after hatching (regardless of when they were last visited). For both groups of nests, we operationally defined a successful nest as one in which at least one nestling was known to attain an age of 10 days, and the day 10 visit was necessary in order to make this determination. Nestling ages were known exactly for all nests that were visited on the day of hatching. These included 76% of the daily-visit nests, as most were first found in the egg stage, and 17% of the weekly-visit nests. The lower percentage for weekly-visit nests results from the fact that many of these nests hatched during the interval between nest visits. For the remaining nests we aged nestlings using the key and photographs of Hanson and Kossack (1963).

Most nest visits were made during the period 1300–1600. At each visit we observed the contents of the nest. These observations generally required flushing the attending adult from the nest, and in some cases aggressive adults actually had to be pushed off the nest with a mirror-pole. The only nests from which adults did not have to be flushed were those unattended at the time of our visit and those in which old nestlings could be seen despite the adult's presence. On rainy days we tried to visit when no rain was falling, but, if rain did not cease by mid- or late-afternoon, visits were made then.

*Statistical methods.*—Nesting success is defined here as the probability that a newly initiated nest will survive to produce at least one 10-day-old young and was estimated using the Mayfield method (Mayfield 1961, 1975; Johnson 1979; Hensler and Nichols 1981; Bart and Robson 1982). We tested for differences in nesting success by using our estimates of daily sur-

TABLE 1. Estimates of daily survival probability,  $P$ , for nests visited at daily and weekly intervals.

Visitation interval	Year	Nests	$\hat{P}$	$\widehat{SE}(\hat{P})$	Test of 1979 vs. 1980 <sup>a</sup>	
					$z$	$P$
Daily	1979	31	0.9557	0.0102	0.28	0.78
	1980	28	0.9474	0.0128		
	1979-1980	59	0.9521	0.0080		
Weekly	1979	28	0.9612	0.0102	0.27	0.79
	1980	32	0.9574	0.0096		
	1979-1980	60	0.9591	0.0070		

<sup>a</sup> A test of the null hypothesis that  $P_{79} = P_{80}$  within daily and weekly nests, respectively.

vival probability and its sampling variance to compute  $z$ -test statistics (Johnson 1979, Hensler and Nichols 1981, Bart and Robson 1982). We tested for differences between years by using two-tailed  $z$ -tests and for differences between the daily- versus weekly-visit groups by using one-tailed  $z$ -tests, assuming that daily visits would not increase nesting success but might cause it to decrease. For nests that were visited at intervals of greater than 1 day and were lost, we used the expected number of days at risk based on daily-visit estimates as an approximation in the estimation equations of Hensler and Nichols (1981) (see Johnson 1979: 654). Although nesting success was the variable that we thought was most likely to have been affected by visitation frequency, we also tested for a difference between the two groups in the proportion of successful nests fledging two (rather than one) young (we again operationally defined fledged young as 10-day-old nestlings). We used a one-tailed  $z$ -test for this comparison also (Snedecor and Cochran 1967: 220).

*Results.*—Estimates of daily survival probability were first computed for each of the 4-yr visitation-frequency combinations (Table 1). The null hypothesis of no difference between the 2 yr was not rejected ( $P > 0.10$ ) for nests with either visitation frequency, and nests were thus pooled over years within each of these two experimental categories (Table 1). The point estimates for these pooled data sets were very similar (daily, 0.9521; weekly, 0.9591). The  $z$ -test for the null hypothesis of no difference between the survival rates for the two nest visitation frequencies was not significant ( $z = 0.66$ ,  $P = 0.26$ ). The power of this test to detect true differences between daily survival probabilities of 0.01, 0.02, and 0.03 at the  $\alpha = 0.10$  rejection level was approximately 0.36, 0.72, and 0.94, respectively. Thus, our chances of detecting a difference at least as large as 0.02 were good in this experiment. As an alternative approach we computed individual  $z$  statistics for each year, and a composite  $Z$  statistic for both years as  $Z = (z_{79} + z_{80})/\sqrt{2}$  (where  $z_{79}$  and  $z_{80}$  denote the  $z$  statistics for 1979 and 1980, respectively). Results again failed to indicate rejection of the null hypothesis ( $z_{79} = 0.38$ ,

$P = 0.35$ ;  $z_{80} = 0.63$ ,  $P = 0.26$ ;  $Z = 0.71$ ,  $P = 0.24$ ). We conclude that the probabilities of nest success were very similar for nests visited daily and weekly.

We also examined the numbers of one- versus two-fledgling nests among nests visited daily and weekly. Tests of the null hypothesis of no difference between years in the proportion of two-fledgling nests among successful nests visited daily and weekly were not significant ( $P > 0.10$ , Table 2). We thus pooled results over years. Among successful nests visited weekly, 0.81 fledged two young; the comparable value for nests visited daily was 0.76. We tested the null hypothesis of no difference in the proportion of two-fledgling nests for daily- versus weekly-visit nests and obtained a nonsignificant statistic ( $z = 0.48$ ,  $P = 0.32$ ). The power of this test ( $\alpha = 0.10$ ), however, assuming true differences of 0.10 and 0.20 between the true proportions, was only 0.34 and 0.68, respectively. As an alternative approach, we again computed separate  $z$  statistics for 1979 and 1980 and then a composite  $Z$  for both years using these values. Results again failed to indicate rejection of the null hypothesis ( $z_{79} = 0.56$ ,  $P = 0.29$ ;  $z_{80} = 0.09$ ,  $P = 0.46$ ;  $Z = 0.46$ ,  $P = 0.32$ ). In either case, we have no evidence of a

TABLE 2. Numbers of fledglings per successful nest for nests visited at daily and weekly intervals.

Visitation interval	Year	Successful nests		Test of 1979 vs. 1980 <sup>a</sup>	
		One fledgling	Two fledglings	$z$	$P$
Daily	1979	4	9	1.59	0.11
	1980	2	10		
	1979-1980	6	19		
Weekly	1979	3	11	0.41	0.68
	1980	2	11		
	1979-1980	5	22		

<sup>a</sup> A test of the null hypothesis of equal numbers of one- and two-fledgling nests among successful nests in 1979 vs. 1980 (Snedecor and Cochran 1967: 220).

TABLE 3. Numbers of nests and surviving nests associated with different numbers of days observed (daily-visit nests only).

Observation day ( <i>i</i> )	Egg-stage nests			Nestling-stage nests		
	Number observed	Number surviving (days <i>i</i> to <i>i</i> + 1)	Proportion surviving	Number observed	Number surviving (days <i>i</i> to <i>i</i> + 1)	Proportion surviving
1	48	47	0.9792	11	11	1.0000
2	46	44	0.9565	11	11	1.0000
3	43	42	0.9767	11	9	0.8182
4	41	37	0.9024	9	9	1.0000
5	37	33	0.8919	9	9	1.0000
6	32	32	1.0000	9	8	0.8889
7	29	28	0.9655	8	7	0.8750
8	26	26	1.0000	7	7	1.0000
9	25	24	0.9600	6	6	1.0000
10	22	20	0.9091	—	—	—

difference in the number of fledglings produced by successful nests visited at daily and weekly intervals.

Although the principal hypotheses toward which our experiment was directed involved the data in Tables 1 and 2, we believe that data from daily-visit nests may provide additional evidence about possible adverse effects of nest visitation. If cues left by human observers are obvious and readily perceived by predators, then the probability of a nest surviving the first day or so following the initial visit would be lower than for subsequent days. Nests visited daily were thus categorized by the number of days observed, and proportions surviving each 1-day interval were computed. For example, 48 nests were discovered in the egg stage and 47 of these survived the 1-day interval following their initial observation, 44 of 46 egg-stage nests survived the 1-day interval following their second day of observation, and so on (Table 3). There was no evidence of a tendency towards low-survival proportions for the first few days of observation among nests found in either the egg or nestling stage (Table 3).

*Discussion.*—Our results are consistent with those of Gottfried and Thompson (1978) and Gottfried (1978), who also used an experimental approach to investigate the effects of nest-visitation frequency in habitat similar to ours. Gottfried and Thompson (1978: 307) placed experimental nests in "sites that we think closely resembled nest sites of Cardinals, Chats, Mourning Doves and Field Sparrows. Most frequently selected sites were in multiflora rose, red cedar, and on the ground at the base of small cedars and saplings." Although we found no ground nests of Mourning Doves on our study areas, we found some nests in multiflora rose (*Rosa multiflora*) and many in red cedars (*Juniperus virginiana*). The principal difference between the studies of Gottfried and Thompson (1978) and Gottfried (1978) and our study involved our concentration on a single species and the pres-

ence of normal parental activity at our nests. Gottfried and Thompson (1978) examined a small sample of natural nests with parents (species not specified) and found that 18 of 30 succeeded (60%) compared to 79 of 119 experimental nests (66%). This difference was not significant, and they concluded that predation on natural and experimental nests was similar; the power of their test ( $\alpha = 0.10$ ), however, was not extremely high (0.26 and 0.64 for true differences in success rates of 0.10 and 0.20, respectively). In any case, our study included potential visitation effects on parental desertion of the nest as well as any predator response that may have been influenced by parental activity. The similarity of our results to those of Gottfried and Thompson (1978) and Gottfried (1978) suggests that these latter factors are not very important to Mourning Dove nesting success.

Our study area contained mammals, birds, and reptiles that were potential nest predators. Of these classes, mammals are often thought to be most likely to find nests as a result of human activity (Willis 1973, Gottfried and Thompson 1978), although in some areas such activity is also thought to be very important to avian predators (e.g. Strang 1980). The eastern chipmunk (*Tamias striatus*) was abundant on our study area, and one was observed taking eggs at an American Robin nest. As noted by Stoddard (1931), however, even predators that potentially can use signs of human activity to locate nests may not be able to do so in areas that normally exhibit moderate human activity. Human activity was common throughout our study area. Black rat snakes (*Elaphe obsoleta*) were seen in nests on the area and were also abundant. We suspect that rat snakes, like chipmunks, are important nest predators on our study area, but we would not expect them to be influenced much by human activity at nest sites. We do not know how important avian predation might be on our area. Blue Jays (*Cyanocitta cristata*) were certainly present, and they have

been suspected to be responsive to human cues (see Gottfried and Thompson 1978). In any case, our results indicate that the various predators did not respond differently to nests visited at daily and weekly intervals.

We conclude that, on our study area, success rates of Mourning Dove nests visited at daily and weekly intervals are very similar. We suspect that this similarity would also be true for other species nesting at similar sites in our study area (e.g. American Robins), as well as for Mourning Doves nesting in other areas having similar predators and levels of human activity.

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