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SCANNING BEHAVIOR BY WINTERING NORTHERN MOCKINGBIRDS

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Abstract.—Northern Mockingbirds *(Mimus polyglottos)* wintering in Florida scrub regularly scan from exposed perches shortly after sunrise and before sunset. I obtained weekly samples from ten mockingbird territories during fall and winter to determine whether mockingbird scanning was related to (1) raptor abundance or (2) conspecific activity. In addition, I took vegetation measurements to determine if scanning was related to tree density. Mockingbirds changed perches more frequently early in the season when hawk abundance was high, but mean scan time and number of scanning bouts did not vary with weekly hawk abundance. Number of scanning bouts and calls by focal birds were positively correlated with calls by conspecific neighbors. The latter data, coupled with field observations, suggest that scanning is for detection of competitors, but further study is needed.

Vigilance behavior in animals has been widely studied, principally in relation to predation risk, which is an important area of modern behavioral ecology (Pulliam 1973). Scanning behavior, sometimes defined as observation of the environment for predators (Lima 1987), is a major component of vigilance. Studies have linked evidence from scanning behaviors to larger social contexts, such as evolution of sociality (Hoogland 1979, Lima and Dill 1990) and sentinels in family groups (McGowan and Woolfenden 1989, Hailman et al. 1994). However, scanning may serve purposes other than anti-predatory vigilance; for instance, territorial individuals could scan their environment to detect neighbors against whom they are competing for territories or food resources. I noted that Northern Mockingbirds *(Mimus polyglottos)* wintering in Florida scrub at Archbold Biological Station engaged in prolonged bouts of scanning from the tops of exposed perches on a daily basis. Previous studies have mentioned mockingbird scanning in pass-

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ing (Michener and Michener 1935, Merritt 1980), but to my knowledge none has directly addressed its purpose.

I monitored mockingbird scanning behavior in the fall and winter of 1996 to describe this behavior quantitatively and to evaluate hypotheses related to scanning behavior. The first hypothesis was (1) that scanning behavior is for detection of hawks while mockingbirds go about their daily routine. Accordingly, I predicted that scanning behavior would decrease with seasonal decline of hawks after fall hawk migration. McGowan and Woolfenden (l989) found such a decrease in sentinel scanning activities by Florida Scrub-Jays *(Aphelocoma coerulescens),* whose scanning behavior is superficially similar to that of mockingbirds, except that it occurs in the context of group foraging. The second hypothesis I examined was (2) that scanning behavior is a territorial response to other mockingbirds. If the latter occurs, I predicted that mockingbird scanning activities would be correlated with vocalizations by conspecifics. Finally (3), I tested the hypothesis that scanning is related to habitat visibility. This hypothesis, not exclusive of the previous two, predicts that animals with more visual obstructions in their territories will spend more time scanning (Metcalfe 1984), regardless of the function of scanning.

METHODS

SCAN SAMPLES

I sampled scanning behavior weekly in 10 focal Northern Mockingbird territories shortly after mockingbird winter territory establishment in Florida scrub habitat. I obtained samples for nine weeks from 21 October to 22 December 1996 at Archbold Biological Station, Lake Placid Florida. Although I was only able to color-band one focal bird, it is well known that mockingbirds establish and defend stable winter territories (Laskey 1935, 1936, Breitwisch et al. 1986, Logan 1987, Derrickson and Breitwisch 1992), including mockingbirds previously studied at Archbold Biological Station (Halkin 1983). The mockingbirds I observed used the same perches for 10 weeks (median perches/territory = 5, range 2-6); thus I am confident that I observed the same territories between weeks, although I cannot be absolutely certain that a given bird was not replaced by another conspecific. Distance between territories averaged 1108.8 ± 569.6 m (SD). Sample observations were made 20-30 m from the focal mockingbird from the top of an all-terrain vehicle and offered a largely unobstructed view of the surroundings. My presence did not appear to affect the birds' behavior. I sampled each territory weekly for a period of 30 min from sunrise-0930 am or 1630-sunset. Although I looked for scanning mockingbirds throughout the day, I rarely observed mockingbirds in scanning postures at other times, and speculate that heat reduced their activity during midday hours. Birds also did not scan on extremely windy days, and morning samples were more reliably to obtain generally (median number of morning samples/territory = 6, range 3-7; median number of evening samples/territory = 2, range 1-3). I attempted to stratify sampling so that birds would have roughly similar numbers of morning and evening samples. Due to windy weather and occasional lack of evening scans, I was not able to sample all ten birds during all nine weeks (median territories sampled/week = 10, range 6-10).

I defined scanning as regular horizontal movement of the head in all directions relative to the body while on an exposed perch lasting at least 30 s, during which other activities, such as preening or flycatching, were not performed. To test the hypothesis that scanning serves an anti-predatory role, I estimated seasonal abundance of hawks in a manner similar to McGowan and Woolfenden (1989), who correlated hawk sightings with sentinel scanning behavior by Florida Scrub-Jays. I counted the number of hawks that I saw during observations and other fieldwork, excluding Red-tailed Hawks *(Buteo jamaicencis),* which rarely prey upon adult songbirds. I recorded hawk abundance as number of hawks/hour for each week of the study. To test the hypothesis that scanning is for detection of conspecifics, I counted frequency of conspecific chats and chatbursts, territorial vocalizations made by wintering mockingbirds (Logan et al. 1983, Logan 1985). I also counted the frequency of these calls by focal birds ("focal calls") to see if they were correlated with calls by conspecifics ("conspecific calls"). Finally, to test the hypothesis that scanning is related to habitat visibility (Metcalfe 1984), I flagged all focal mockingbird perches and used point-quarter methods (Barbour et al. 1987) to calculate tree density (≥10 cm dbh) near perches for each territory. Distances to the nearest tree were measured with a meter tape for trees under 17 m distance from the perch and with a rangefinder (Ranging 400) for greater distances. I was not able to take tree density estimates for one territory located on private property.

SCANNING BEHAVIOR ANALYSES

Scanning variables that I analyzed were (1) mean scan time, (2) number of scanning bouts, defined as the number of occurrences during 30 min when the focal bird was on a scanning perch; i.e. a bird scanning at the start of an observation period that left to feed and later resumed its perch would be scored as having two scanning bouts for that observation. Number of perch changes (3) was the number of times the focal bird changed position exclusive of new scanning bouts. Scan time was taken as 60 30s instantaneous samples (Altmann 1974) and was arcsin-square-root transformed, which improves the normality of proportions (Sokol and Rolf 1981). Number of bouts and perch changes were expressed as the number of occurrences during the 30 min observation period measured at the time of the instantaneous sample.

I first tested for differences between morning and evening samples by comparing seasonal means of variables for each territory using paired t-tests. To determine if responses changed over weeks I ran Spearman rank correlations of the weekly means of the scan and call variables (across all territories) against week of the observation. If variables did not differ between morning and evening samples, I retained combined samples in the subsequent correlation analyses of weekly means. If morning and evening samples by territory were significantly or marginally ($P < 0.10$) different, I used only morning samples because of the larger sample size for morning observations. I performed the same analysis to determine if focal or conspecifc calls changed over the season. To test the hypothesis that scanning is for detection of hawks, I similarly ran Spearman rank correlations of the weekly means of the scan variables against weekly hawk abundance.

To test for the importance of scanning in detecting conspecifics I ran a separate repeated-measures covariance analysis for each of the three scanning variables identified previously. For each analysis, I used "conspecific calls" as the independent continuous covariate of interest. To account for repeated sampling over the nine weeks, territory and week were included as blocking factors, with territory × week specified as the subject (Littell et al. 1996). I first ran preliminary analyses to determine if conspecific calls varied over weeks. If it did not, I excluded this interaction from subsequent analyses. I also specified parameter estimates to determine the direction of any relationship between conspecific calls and the scanning variables. I performed an analysis similar to the above for "focal calls".

Finally, I tested for the effects of vegetative obstruction on scanning behavior using territorial means calculated over the entire nine weeks of the study. I ran Spearman rank correlations between seasonal means of the three scanning variables and tree density.

RESULTS

Number of scanning bouts for focal birds were more frequent in morning compared to evening samples (Table 1, Fig. 1). Differences in average number of perch changes indicated a trend for more frequent perch changes in the morning (Table 1, Fig. 2). Scan time by mockingbirds did not vary between morning and evening samples (Table 1, Fig. 3). Focal mockingbirds and conspecific neighbors both called more frequently during morning samples (Table 1). Morning focal calls did not change with season ($P > 0.20$) nor did morning conspecific calls ($P > 0.10$).

Hawk abundance declined significantly over the 9 weeks of sampling (Fig. 1; $r_s = -0.85$, $P = 0.004$). Hawk abundance was significantly correlated only with perch changes by focal mockingbirds (morning samples; $r_s = 0.72$, $P = 0.03$; Fig. 2). Focal mockingbirds reduced perch changes over the progression of the season (Fig. 2; morning samples; $r_s = -0.69$, $P = 0.04$) but did not alter any of the other behaviors seasonally (Figs. 1 and 3). Hawks that I sighted included Merlin *(Falco columbarius),* American Kestrel *(F. sparverius),* Sharp-shinned Hawk *(Accipiter striatus),* Cooper's Hawk *(A. cooperii),* and Northern Hanier *(Circus cyaneus).* Hawks flew into focal territories during three observations. Florida Scrub-Jays were present at all three and gave hawk alarms (Elowson and Hailman 1991). Both scanning mockingbirds and scrub-jays dived into cover immediately in response to hawks. On a third occasion, jays gave the alarm and dived, but the mockingbird had already been under shrubbery for several minutes before the hawk appeared.

The repeated-measures analysis indicated that conspecific calls was significantly positively correlated with number of bouts (parame-

Table 1. Means (±SE) by territory for variables measured during mockingbird scan samples by morning, evening and combined samples. Statistics represent *t*-values and probability levels from one-sample two-tailed *t*-tests comparing morning and evening samples ($n = 10$ territories).

Variable	morning	evening	combined	*t*	*P*
Scan time (proportion of 30 min)	0.60 ± 0 03	0.66 ± 0.07	0.62 ± 0.03	1.0	0 3
Number of bouts	3.60 ± 0.28	2.37 ± 0.30	3.25 ± 0.17	-2.4	0.04
Perch changes	2.69 ± 0.38	1.35 ± 0.42	2.32 ± 0.28	-2.0	0.07
Focal calls	1.84 ± 0.28	0.15 ± 0.11	1.36 ± 0.21	-5.1	0.0007
Conspecific calls	5.53 ± 0.44	1.02 ± 0.38	4.21 ± 0.40	-11.4	0.0001

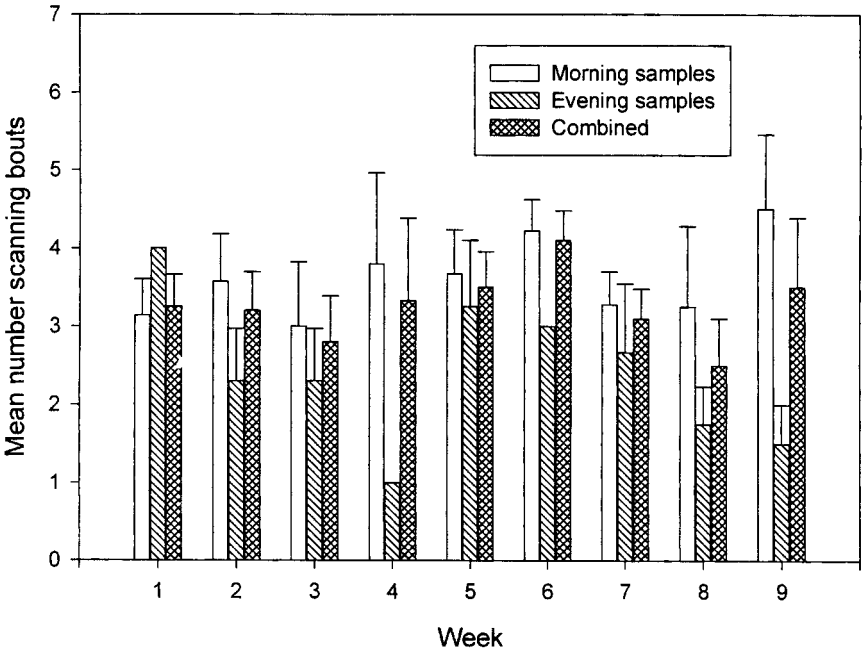

Figure 1. Number of scanning bouts (±SE) by week for focal mockingbirds by morning, evening, and combined samples.

ter estimate 0.19, $F = 12.0$, $P = 0.001$). Neither scan time or perch changes were significantly related to conspecific calls (scan time: parameter estimate - 0.02, $F = 2.2$, $P = 0.14$; perch changes: parameter estimate 0.13, $F = 2.3$, $P = 0.13$). Focal calls were significantly positively correlated with conspecific calls (parameter estimate 0.24, $F = 24.3$, $P = 0.0001$). Territory and week did not significantly explain variation for any of the scanning variables ($P \geq 0.13$, all tests) except for focal calls, where there was significant variation among territories ($F = 2.0$, $P = 0.05$). Conspecific calls × week interactions were not significant and were not included for any of the analyses.

Tree density was not significantly correlated with any of the scanning variables (mean tree density 8.35 ± 3.04 trees/ha; $P > 0.22$, all tests).

DISCUSSION

With the exception of perch changes, scanning behaviors did not change over the nine weeks of sampling. Although mean number of weekly perch changes was positively correlated with weekly hawk abundance (Fig. 2), neither mean scan time or number of scanning bouts was

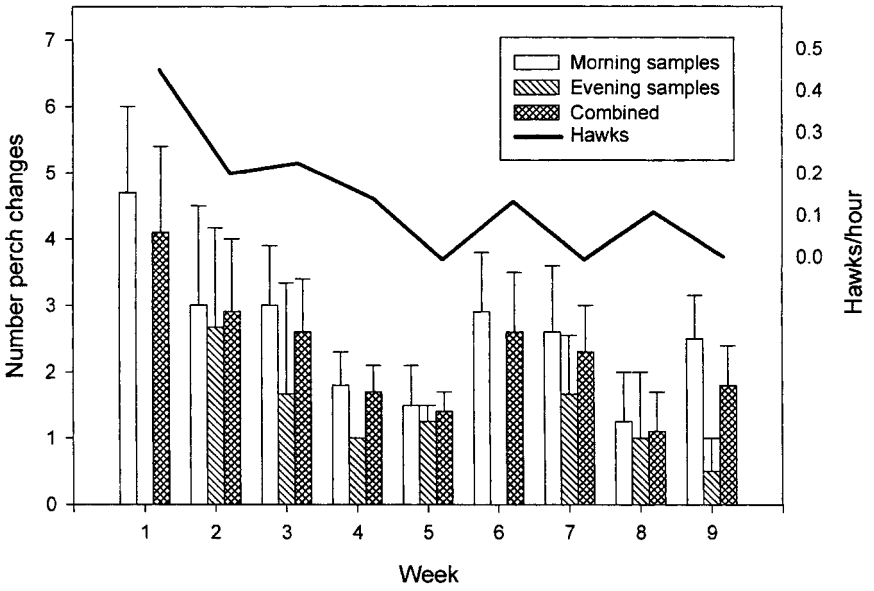

Figure 2. Hawk sightings/hour over the season and average perch changes (±SE) by week by morning, evening, and combined samples.

correlated with hawk abundance. Conspecific calls were positively correlated with both number of scanning bouts and calls by focal mockingbirds. Scanning behaviors were not correlated with tree density.

Although not the case in this study, Logan et al. (1983) and Breitwisch et al. (1986) noted that singing and calling by wintering mockingbirds declined seasonally. Breitwisch et al. (1986) viewed this as a switch from establishing to maintaining fall territories. My samples commenced shortly after fall territory establishment and overlapped temporally with Breitwisch's et al.'s samples; however, with the exception of perch changes, birds in my study did not alter behaviors seasonally. Other studies of wintering mockingbirds have observed influxes of wandering fall mockingbirds and ensuing territorial battles between floaters and territory holders (Michener and Michener 1935, Laskey 1936). If vigilance by mockingbirds serves an intra-specific purpose, these studies suggest that birds should remain vigilant throughout the nonbreeding season.

McGowan and Woolfenden (1989) documented a strong positive relationship between sentinel behavior by Florida Scrub-Jays and hawk sightings, with sentinel performance highest during periods of hawk abundance. Although scrub-jay scanning behavior appears similar to mockingbird scanning, Florida Scrub-Jays scan as sentinels in a coordinated system within the context of group living (McGowan and Wool-

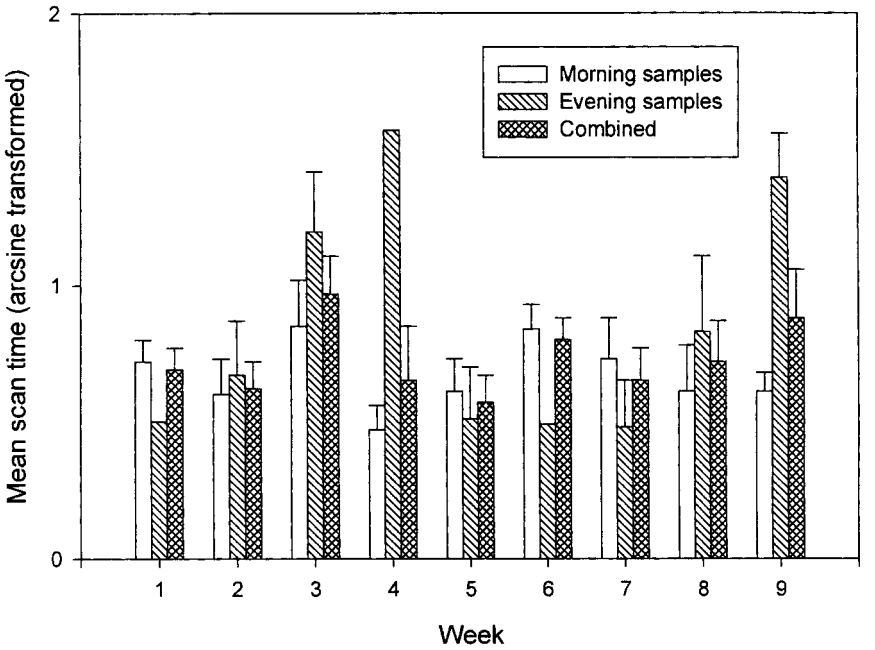

Figure 3. Mean scan time by focal mockingbirds (±SE) by week by morning, evening, and combined samples.

fenden 1989), whereas the mockingbirds I observed were always solitary. Scrub-jays also feed in open areas of sand (Woolfenden and Fitzpatrick 1996), whereas mockingbirds typically dropped directly below the scrub canopy between bouts, presumably to feed on berries or insects. Florida scrub is an open habitat affording good visibility, and my view of the shrubs and spaces between them was generally unobstructed; however, I witnessed mockingbirds feeding in the open on only a handful of brief occasions during many hours of observation. Between scanning bouts mockingbirds were typically under shrubs and out of sight until re-emerging to scan at the same or a different perch. Mockingbirds appear to be exposed to potential predation by raptors only during scanning or territorial chases. Large snakes and bobcats *(Lynx rufus)* are also present at the sites and are the only other likely predators on adult scrub-jays (McGowan and Woolfenden 1989). I saw no snakes or bobcats during my observations at mockingbird territories.

Chat and chatburst calls by conspecifics were positively correlated with both number of scanning bouts and number of calls by focal mockingbirds, but not with the other scanning variables. These findings suggest that focal birds responded to neighbor's calls by calling themselves

and by taking scanning positions more frequently, although they did not scan for longer periods when conspecifics called more frequently.

In addition to positive correlations between conspecific calls and focal bird behaviors (number of scanning bouts and focal calls), field observations suggest that mockingbird scanning is not anti-predatory in nature. Anti-predatory scanning by foraging birds occurs in brief instances, often measured in seconds, while birds actively forage (reviewed in Lima and Dill 1990). Conversely, the samples I obtained sometimes consisted of one single 30-minute scanning bout, with mockingbirds remaining perched as I left. Bouts of scanning by mockingbirds appeared to be longer than necessary compared to the vigilance needed for intermittent foraging. Scanning for conspecific or interspecific competitors could provide a strong impetus for territorial vigilance, especially given the importance of food in winter mockingbird territories (Moore 1978, Safina and Utter 1989). Although I did not measure activities of other species, Moore (1978) found that aggression by wintering mockingbirds toward other songbirds was directly proportional to the extent of frugivory among these competitors. I observed focal mockingbirds chasing a Yellow-rumped Warbler *(Dendroica coronata)* and Brown Thrasher (*Toxostoma rufum)* during one sample each, Rufous-sided Towhees *(Pipilo erythrophthalmus)* during two different samples, and Gray Catbirds *(Dumetella carolinensis)* during other field work. I witnessed several chases of conspecifics by focal birds during my samples.

Although further study is needed, qualitative and quantitative evidence are most consistent with the hypothesis that winter mockingbird scanning serves as a response to competitors. The influence of conspecific or interspecific competitors on scanning could be further ascertained by correlating densities of neighbors with scanning behaviors by focal birds. Removing competitors and monitoring the scanning and vocal responses by focal birds could then determine whether these activities increase or decrease in the absence of competitors.

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LITERATURE CITED

ALTMANN, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227-267.

BARBOUR, M. G., J. H. BURK, AND W. D. PITTS. 1987. Terrestrial plant ecology. Benjamin/Cummings, Menlo Park.

BREITWISCH, R., M. DIAZ, N. GOTTLIEB, R. LEE, AND J. ZAIAS. 1986. Defense of fall territories by mated and unmated Northern Mockingbirds in southern Florida. Journal of Field Omithology 57:16-21.

DERRICKSON, K. C., AND R. BREITWISCH. 1992. Northern Mockingbird (*Mimus polyglottos*). *In* The birds of North America, no. 7 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.

ELOWSON, A. M., AND J. P. HAILMAN. 1991. Analysis of complex variation: dichotomous sorting of predator-elicited calls in the Florida Scrub Jay. Bioacoustics 3:295-320.

HAILMAN, J. P., K. J. MCGOWAN, AND G. E. WOOLFENDEN. 1994. Role of helpers in the sentinel behaviour of the Florida Scrub Jay *(Aphelocoma c. coerulescens)*. Ethology 97:119-140.

HALKIN, S. L. 1983. Mockingbird occupancy of a wintering area little used for breeding. M.S. thesis, University of Wisconsin, Madison.

HOOGLAND, J. L. 1979. The effect of colony size on individual alertness of prairie dogs (Sciuridae: *Cynomys* spp.) Animal Behaviour 27:394-407.

LASKEY, A. R. 1935. Mockingbird life history studies. Auk 52:370-381.

LASKEY, A. R. 1936. Fall and winter behavior of Mockingbirds. Wilson Bulletin 48:241-255.

LIMA, S. L. 1987. Vigilance while feeding and its relation to the risk of predation. Journal of Theoretical Biology 124:303-316.

LIMA, S. L., AND L. M. DILL. 1990. Behavioral decisions made under the risk of predation: a review and prospectus. Canadian Journal of Zoology 68:619-640.

LITTELL, R. C., G. A. MILLIKEN, W. W. STROUP, AND R. D. WOLFINGER. 1996 SAS system for mixed models. SAS Institute, Inc. Cary.

LOGAN, C. A. 1985. Mockingbird use of chatbursts with neighbors versus strangers. Journal of Field Ornithology 56:69-71.

LOGAN, C. A. 1987. Fluctuations in fall and winter territory size in the Northern Mockingbird *(Mimus polyglottos)*. Journal of Field Ornithology 58:297-305.

LOGAN, C. A., P. D. BUDMAN, AND K. R. FULK. 1983. Role of chatburst versus song in the defense of fall territory in Mockingbirds *(Mimus polyglottos)*. Journal of Comparative Psychology 97:292-301.

MCGOWAN, K. J., AND G. E. WOOLFENDEN. 1989. A sentinel system in the Florida Scrub Jay. Animal Behaviour 37:1000-1006.

MERRITT, P. G. 1980. Group foraging by mockingbirds in a Florida strangler fig. Auk 97:869-872.

METCALFE, N. B. 1984. The effects of habitat on the vigilance of shorebirds: is visibility important? Animal Behaviour 32:981-985.

MICHENER, H., AND J. R. MICHENER. 1935. Mockingbirds, their territories and individualities. Condor 37:97-140.

MOORE, F. R. 1978. Interspecific aggression: toward whom should a mockingbird be aggressive? Behavioral Ecology and Sociobiology 3:173-176.

PULLIAM, H. R. 1973. On the advantages of flocking. Journal of Theoretical Biology 38:419422.

SAFINA, C., AND J. M. UTTER. 1989. Food and winter territories of Northern Mockingbirds. Wilson Bulletin 101:97-101.

SOKAL, R. R., AND F. J. ROHLF. 1981. Biometry. W. H. Freeman, San Francisco.

WOOLFENDEN, G. E., AND J. W. F1TZPATRICK. 1996. Florida Scrub-Jay *(Aphelocoma corulescens)*. *In* The birds of North America, no. 228 (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.