

## DEFENSE OF FALL TERRITORIES BY MATED AND UNMATED NORTHERN MOCKINGBIRDS IN SOUTHERN FLORIDA

BY RANDALL BREITWISCH, MARILYN DIAZ, NATASHA GOTTLIEB, RONALD LEE, AND JULIA ZAIAS

Many passerines defend territories in the non-breeding season, either as permanent residents (e.g., Verbeek 1973, Morton and Shalter 1977) or migrants with temperate zone breeding territories and winter feeding territories in the tropics (e.g., Gorski 1969, Smith 1971, Greenberg 1979, Price 1981). However, the relation between defense of fall territory and mating status has not been investigated. Resident Northern Mockingbirds (*Mimus polyglottos*) in southern Florida defend fall territories, and for most individuals these become breeding territories. Both sexes defend fall territories, either as mated pairs or unmated birds, although unmated females defend territories infrequently. We studied the behavioral maintenance of fall territories by individually color-banded mockingbirds. We hypothesized that both members of a mated pair defend their fall territory, that both males and females engage in one to several kinds of territorial behavior, but that females do so at lower frequencies. Based on Merritt's (1985) finding that unmated males attack intruding conspecifics less frequently than mated males in the breeding season, we predicted that unmated males engage in less defense of fall territories than mated males.

### STUDY AREA AND METHODS

A color-banded population of Northern Mockingbirds inhabits the main campus at the University of Miami, Coral Gables, Florida (described in Breitwisch et al. 1984, Merritt 1985). We sampled 11 mated males, 8 unmated males, and 8 mated females.

We recorded 4 kinds of territorial behavior: (1) singing, (2) calling (single chats, chatbursts, and counterchatbursts, Logan et al. 1983), (3) conspecific chases, and (4) boundary dances (Laskey 1935, 1936; Hailman 1960). We employed focal animal sampling of individual mockingbirds for 1-h periods ( $n = 59$ ), confining ourselves to their behaviorally most active morning hours (0600 to 1000) on days with good weather (at least partially sunny with no rain and little wind) from 23 October to 30 November 1984.

We noted each minute in which song occurred and recorded all calls, chases, and boundary dances. Chats and chatbursts separated by 15 s were considered distinct events. All calls within 15 s were scored as one calling bout. Although the 15-s separation was arbitrary and used partially for convenience, previous study (R. Breitwisch, pers. obs.) indicated that this interval was reasonable in separating sequential calling events.

Mockingbirds frequently respond to neighbors' calls by themselves calling (counterchats and counterchatbursts), and calls often spread "contagiously" among neighbors (Michener and Michener 1935, Laskey 1935, 1936, Logan et al. 1983). We divided all calling bouts into those in which the focal bird initiated the sequence (or was the only caller) and those in which the focal bird responded to another bird's calls. We also divided all chases into those where the focal bird chased vs those in which it was chased.

We sometimes lost sight of birds under observation and noted for each hour of observation the number of minutes during which the observer was in visual contact with the focal bird. We maintained visual contact with mated males 96%, unmated males 94%, and mated females 86% of observation time. Data were transformed for analyses into calls and chases per minute of visual contact and proportion of minutes in which song occurred. We used nonparametric tests (Siegel 1956) in analyses of these skewed behavioral data.

#### RESULTS

*Singing.*—Focal birds sang in only 17 of 59 observation periods (29%). Mated males sang in 8 of 22 (36%) observation periods, unmated males in 6 of 17 (35%), and mated females in 3 of 20 (15%). The proportions of periods with song to periods without song did not differ among the three categories of birds (*G*-test for heterogeneity,  $G = 3.03$ ,  $P > 0.05$ , 2 d.f.; Table 1).

*Calling.*—The frequencies of calls were very similar across categories of birds and averaged about 0.10 calling bouts/min (Table 1). In contrast to singing, birds called in 55 of 59 sample periods (93%). There were no differences among the three categories in frequencies of calls where the focal bird initiated the calling event nor in cases where the focal bird responded to neighbors' calls (Table 1).

*Chases.*—Both mated males and mated females were involved in more chases than unmated males (Median tests,  $G = 11.64$ ,  $P < 0.05$ , 1 d.f.;  $G = 5.19$ ,  $P < 0.05$ , 1 d.f.; Table 1). Mated males and mated females were involved in similar numbers of chases (Median test,  $G = 1.47$ ,  $P > 0.05$ , 1 d.f.). Mated males chased more frequently than either unmated males or mated females (Mann-Whitney *U*-tests,  $z = 3.33$  for comparison with unmated males,  $z = 2.75$  for comparison with mated females, both  $P$ s  $< 0.05$ ). Unmated males and mated females were chasers at similar frequencies (Mann-Whitney *U*-test,  $z = 0.66$ ,  $P > 0.05$ ). Although females were chased at a higher frequency than either mated or unmated males (Table 1), none of the paired comparisons (Mann-Whitney *U*-tests) were significantly different. For only those periods in which focal birds chased and/or were chased, mated males were chasers 89% of the time, unmated males 83%, and mated females 54% (*G*-test for heterogeneity,  $G = 5.14$ ,  $0.10 > P > 0.05$ , 2 d.f.). We also tested for heterogeneity among categories of birds in frequencies of observation

TABLE 1. Frequency of territorial behavior by Northern Mockingbirds in southern Florida, October–November 1984.

Behavior	Mated males ( $N = 11$ ) <sup>a</sup> $\bar{x}$ (SE)	Unmated males ( $N = 8$ ) $\bar{x}$ (SE)	Mated females ( $N = 8$ ) $\bar{x}$ (SE)	Comparison among three categories <sup>b</sup>
Singing (min singing/ total min observed)	0.020 (0.0089)	0.016 (0.0077)	0.005 (0.0030)	$G = 3.03$ ; NS
Calling (calls/min)	0.104 (0.0251)	0.082 (0.0122)	0.097 (0.0163)	$H = 0.15$ ; NS
Initiated	0.066 (0.0168)	0.046 (0.0099)	0.052 (0.0142)	$H = 1.07$ ; NS
Responded	0.038 (0.0094)	0.036 (0.0090)	0.046 (0.0093)	$H = 0.69$ ; NS
Chasing (chases/min)	0.029 (0.0050)	0.007 (0.0023)	0.020 (0.0053)	$H = 9.58$ ; $P < 0.05$
Chaser	0.028 (0.0048)	0.006 (0.0022)	0.010 (0.0035)	$H = 13.78$ ; $P < 0.05$
Chased	0.002 (0.0011)	0.001 (0.0010)	0.010 (0.0037)	$H = 6.10$ ; $P < 0.05$

<sup>a</sup> Number of observation periods: mated males ( $N = 22$ ), unmated males ( $N = 17$ ), mated females ( $N = 20$ ).

<sup>b</sup> For singing,  $G$ -test for heterogeneity; for calling and chasing, Kruskal-Wallis one-way ANOVA; 2 d.f. for each comparison.

periods with chases vs periods without chases. The frequencies of periods with chases out of all periods were 73%, 50%, and 35% for mated males, and mated females, and unmated males, respectively ( $G$ -test for heterogeneity,  $G = 5.78$ ,  $0.10 > P > 0.05$ , 2 d.f.).

*Boundary dances.*—We observed only two boundary dances in the 59 observation periods. These two dances involved the same unmated male.

*Seasonal change in territorial behavior.*—All three categories of birds displayed a seasonal decline in singing frequencies from October to November (Spearman rank correlations:  $r_s = -0.60$  for mated males,  $r_s = -0.56$  for unmated males,  $r_s = -0.48$  for mated females, all  $P$ s  $< 0.05$ ). All three categories also showed seasonal declines in calling frequencies ( $r_s = -0.45$  for mated males,  $r_s = -0.50$  for unmated males,  $r_s = -0.54$  for mated females, all  $P$ s  $< 0.05$ ). Mated females also showed a decline in chases ( $r_s = -0.54$ ,  $P < 0.05$ ), although mated males ( $r_s = -0.17$ ,  $P > 0.05$ ) and unmated males ( $r_s = 0.11$ ,  $P > 0.05$ ) did not.

#### DISCUSSION

Mated female mockingbirds defend territories in the fall, as well as in the breeding season. On fall territories, females call as frequently as males, and they are involved in as many chases as mated males. However, mated females are chasers less frequently than are mated males. Unfortunately, the very rapid, darting flight characteristic of chases prevented us from identifying conspecifics involved in chases with focal birds. Although intrasexual territorial defense has commonly been recorded in birds (Welty 1975:239–240), we do not know whether female mockingbirds chase neighboring females more often than they chase neighboring males.

Unmated males were involved in fewer chases than were mated males. This agrees with Merritt's (1985) results from the breeding season, when he found that attack rate by unmated males toward conspecific intruders was less than that of mated males toward intruders. While unmated males in the fall engaged in calls, they appeared less frequently to support their calls with active defense via chasing. Yet, intrusions by conspecifics into territories of unmated males occurred, both in the fall and in the breeding season (Merritt 1985).

Juvenile mockingbirds commonly wander in August and early September (Kale and Jennings 1966) or even later in the fall (Merritt 1980) and on the study site aggregate in small numbers among defended territories of mated pairs, where they frequently call at and chase one another. Since all three categories of birds were chasers more than they were chased, some of these chases probably were directed at wandering juveniles or nonterritorial birds ("floaters") attempting to find space among established mockingbird territories.

One of the observed unmated birds was less than 1 yr old, banded as a nestling in 1984. Observations in previous years (P. G. Merritt, unpubl.) have shown that some unmated birds (probably males) holding fall territories do not maintain these into the next breeding season. Al-

though immature birds may survive the dry winter season quite near to their natal territories, they may not be able to defend these territories for breeding in the immediate locality where they were raised.

A fall seasonal decline in song and calls, also documented by Logan et al. (1983) for mockingbirds in North Carolina, may reflect a change from establishment to maintenance of fall territories. In southern Florida, the breeding season extends into early August, with some parent mockingbirds still feeding fledglings as late as mid-August. Fall territories are established from mid-September to mid-October, and singing is quite common then (P. G. Merritt, unpubl.; R. Breitwisch, pers. obs.). Our study sampled the latter part of fall territory establishment in October, followed by maintenance in November. The decline in frequencies of territorial behavior may reflect a difference in the amount of defense required to establish vs maintain fall territories (see, e.g., Lack 1966, 1968, Brown and Orians 1970).

The role of song during establishment of fall territories remains an open question (Logan and Fulk 1984). In agreement with Logan et al. (1983) and Logan and Fulk (1984), we found singing an infrequent behavior in fall relative to spring. Further study should focus on establishment rather than maintenance of fall territories. We expect higher levels of territorial behavior, including singing, in early fall during establishment, although we predict the relative levels of defensive behavior between mated and unmated mockingbirds to remain the same.

#### SUMMARY

We studied defense of fall territories by mated and unmated mockingbirds in southern Florida from 23 October to 30 November 1984. Mated and unmated males and mated females all sang, but at low levels. Chat and chatburst calling and chases were more frequent than singing. Unmated males called as much as mated birds but were involved in fewer chases than mated males. Boundary dances were very infrequent at this time of year. A seasonal decline in frequencies of singing and calling by mated and unmated mockingbirds during this study may reflect a change from establishment to maintenance of fall territories.

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## LITERATURE CITED

- BREITWISCH, R., P. G. MERRITT, AND G. H. WHITESIDES. 1984. Why do Northern Mockingbirds feed fruit to their nestlings? *Condor* 86:281-287.
- BROWN, J. L., AND G. H. ORIANS. 1970. Spacing patterns in mobile animals. *Annu. Rev. Ecol. Syst.* 1:239-262.
- GORSKI, L. J. 1969. Traill's Flycatcher of the "fitz-bew" songform wintering in Panama. *Auk* 86:745-747.
- GREENBERG, R. 1979. Body size, breeding habitat, and winter exploitation systems in *Dendroica*. *Auk* 96:756-766.
- HAILMAN, J. P. 1960. Hostile dancing and fall territory of a color-banded Mockingbird. *Condor* 62:464-468.
- KALE, H. W., AND W. L. JENNINGS. 1966. Movements of immature mockingbirds between swamp and residential areas of Pinellas County, Florida. *Bird-Banding* 37:113-120.
- LACK, D. 1966. Population studies of birds. Clarendon Press, Oxford.
- . 1968. Ecological adaptations for breeding in birds. Methuen, London.
- LASKEY, A. R. 1935. Mockingbird life history studies. *Auk* 52:370-381.
- . 1936. Fall and winter behavior of mockingbirds. *Wilson Bull.* 48:241-255.
- 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*). *J. Comp. Psychol.* 97:292-301.
- , AND K. R. FULK. 1984. Differential responding to spring and fall song in Mockingbirds (*Mimus polyglottos*). *J. Comp. Psychol.* 98:3-9.
- MERRITT, P. G. 1980. Group foraging by mockingbirds in a Florida strangler fig. *Auk* 97:869-872.
- . 1985. Song function and the evolution of song repertoires in the Northern Mockingbird, *Mimus polyglottos*. Ph.D. diss., Univ. of Miami, Coral Gables.
- MICHENER, H., AND J. R. MICHENER. 1935. Mockingbirds, their territories and individualities. *Condor* 37:97-140.
- MORTON, E. S., AND M. D. SHALTER. 1977. Vocal response to predators in pair-banded Carolina wrens. *Condor* 79:222-227.
- PRICE, T. 1981. The ecology of the Greenish Warbler *Phylloscopus trochiloides* in its winter quarters. *Ibis* 123:131-144.
- SIEGEL, S. 1956. Non-parametric statistics for the behavioral sciences. McGraw-Hill, New York.
- SMITH, K. D. 1971. Notes on *Oenanthe* species in winter in Africa. *Bird Study* 18:71-79.
- VERBEEK, N. A. M. 1973. The exploitation system of the yellow-billed magpie. *Univ. Calif. Publ. Zool.* 99:1-58.
- WELTY, J. C. 1975. The life of birds, 2nd ed. Saunders, Philadelphia.
- Department of Biology, University of Miami, Coral Gables, Florida 33124.*  
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