

movements. At times the female apparently tried to outwalk the male (Fig. 1e), but soon he caught up with her and put one foot on her back, immediately causing her to go prone in the sedge cover. The male then quickly mounted, lowering his wings strongly over the female and seemingly nibbling or preening her head feathers but apparently not grasping her nape (Fig. 1f–g). Copulation lasted about 15 s and appeared to be performed silently (although I was about 37 m away). Afterwards, both birds stood up and ruffled their plumage (Fig. 1h), after which the female walked back to the water and began foraging, while the male moved about 5 m in the other direction. There he stood quietly in the same fluffed plumage posture (Fig. 1i) for most of the following hour, and only once more did he perform the “retching” display. When I left at 2005, the two birds were still in this situation. During the entire period, I twice heard a Bittern calling from a considerable distance, but no obvious calling was done by the birds I was watching. On 13 June an incubating female was found on her nest about 46 m away from this point.

In common with the few other reported Bittern copulations, the behavior did not occur at the nest, and the white nuptial plumes were clearly an important display component. Apparently, the European Bittern (*B. stellaris*) sometimes seems to feed the female during copulation, which might account for the evolutionary origin of the retching-like movements I observed. In most respects the behavior I observed corresponds closely to the description by Fargo (1928, *Auk* 45: 203) of a probable precopulatory sequence, but I did not notice the chirping calls that he heard from the male during the approach phase. Received 3 March 1980, accepted 12 May 1980.

Group Foraging by Mockingbirds in a Florida Strangler Fig

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Fruit is an important food of Mockingbirds (*Mimus polyglottos*), especially during the fall and winter (Beal et al. 1916, Howell 1932, Bent 1948). Mockingbirds are known to set up feeding territories at this time of year (Michener and Michener 1935, Laskey 1936, Hailman 1960), and fruiting trees may be vigorously defended (Moore 1977, 1978). Territories are maintained by single individuals or male-female pairs (Michener and Michener 1935).

The establishment of fall and winter territories is commonly observed in Mockingbirds in south Florida (O. T. Owre, pers. comm.). On 4 November 1979, however, I noticed many Mockingbirds foraging in a Florida strangler fig (*Ficus aurea*) on the University of Miami campus. The tree was about 10 m tall and had a relatively open canopy. Although *F. aurea* may be found fruiting in all seasons (Long and Lakela 1971), this represents a late fruiting date, as the peak is in early to midsummer (Carleton and Owre 1975).

Visits to the tree on 5 and 6 November revealed that Mockingbirds were not entering the fig tree in flocks, but their entrance from many directions appeared to be somewhat synchronized. Because this type of behavior has not been described in Mockingbirds, I designed a study to test the hypothesis that there was no significant difference between the observed pattern of Mockingbird entry into the tree and the pattern predicted by a random distribution.

Counts of birds entering the fig tree were made in the mornings (0600–0900) and afternoons (1300–1600) of 7–12 November 1979. Foraging behavior and aggressive interactions were noted. I recorded notes using a tape recorder. The number of Mockingbirds entering the tree in 1-min intervals was tallied in the laboratory using a stopwatch. On the mornings of 10 and 11 November I captured 27 Mockingbirds in two mist nets placed near the fig tree. Individuals were marked with U.S. Fish and Wildlife Service aluminum bands and plastic colored leg bands. Molt was noted, and the degree of skull ossification was examined by making a 4-mm median longitudinal incision in the skin on the posterior portion of the crown.

By 14 and 15 November the amount of fruit on the tree was dwindling, so to estimate the number of Mockingbirds using the fig tree I conducted 10 censuses of the area. The censuses lasted 3–5 min each and were made at intervals of greater than 1 h. I counted a Mockingbird only if I could see if it were banded or not. If the birds moved around so that I thought that I might count the same unbanded individual twice, the census was discontinued and repeated at a later time.

I recorded 1,131 Mockingbird entries into the fig tree in 1,037 min of observation. Mockingbird entries

TABLE 1. Comparison of the observed distribution of Mockingbird entries into the fig tree per min with the calculated Poisson distribution for each time period: n is the number of 1-min observation intervals, \bar{x} is the mean number of Mockingbird entries per min, SD is the standard deviation of this rate, s^2/\bar{x} is the variance-to-mean ratio of Mockingbird entries per min, and D is the maximum deviation calculated in the Kolmogorov-Smirnov one-sample test.

Time	n	\bar{x}	SD	s^2/\bar{x}	D	Level of significance
0600-0700	156	0.43	1.113	2.88	0.1218	$P < 0.025$
0700-0900	391	1.38	2.124	3.27	0.2685	$P < 0.001$
1300-1500	342	1.03	1.945	3.67	0.2281	$P < 0.001$
1500-1600	148	1.16	1.818	2.85	0.1689	$P < 0.001$

accounted for 50.5% of the total number of entries into the fig tree by 20 species of birds. Starlings (*Sturnus vulgaris*) had the next highest number of entries, representing 32.0% of the total.

For comparative purposes the observations were divided into 1-h time periods. The frequency distributions of Mockingbird entries per min in adjacent time periods were compared using the Kolmogorov-Smirnov two-sample test (Siegel 1956). Where there was no significant difference in the hourly frequency distributions ($P > 0.1$), the observations for 2-h periods were used (0700-0900 and 1300-1500) to analyze the pattern of Mockingbird entry into the tree.

The observed frequency distributions of Mockingbird entries per min have variance-to-mean ratios greater than 1 in all time periods (Table 1), indicating that the entries into the tree tended to be aggregated in time (see Zar 1974: 304-305). To determine whether the observed distributional patterns differ significantly from those predicted by random distributions, I used the Kolmogorov-Smirnov one-sample test (Siegel 1956) to compare the observed frequency distributions of entries per min with a Poisson distribution generated for each time period (Table 1, Fig. 1). The observed distributions were significantly different from the Poisson distributions in all time periods ($P < 0.025$).

Sixteen of the 27 banded Mockingbirds (59.3%) had unossified skulls indicating that they hatched in 1979. No age determination could be made on the remaining birds. Eleven of the Mockingbirds (40.7%) had various parts of their body in molt, but none had spots on the breast characteristic of the juvenile plumage.

During the 10 censuses, I saw 18 of the 27 marked birds. The mean proportion of marked birds seen during these censuses equaled 0.443 (SD = 0.091). Assuming there was no change in this proportion from the time of banding, this indicates that about 61 Mockingbirds were entering the fig tree. Applying Jackson's positive method (Begon 1979: 16-19), an extension of the Peterson estimate based on the principle that marking occurs on one occasion and is followed by several recaptures (resightings in this case), I estimated the number of Mockingbirds entering the fig tree at the time of marking by the proportion:

$$\hat{N}_o = \frac{r_o}{q_o} = \frac{27}{0.496} = 54.4,$$

where \hat{N}_o is an estimate of the total number of individuals, r_o is the total number of marked individuals, and q_o is the marked proportion of the population at the time of marking. q_o is estimated from a regression equation (see Begon loc. cit.) based on the assumption that the marked proportion of the population declines with time, and additions to the unmarked portion of the population occur at a constant rate. The values one standard error from \hat{N}_o are 50.2 and 59.0.

Nearly all aggression between Mockingbirds in the fig tree seemed to be the result of one individual attempting to defend the tree by chasing out intruders. This bird was originally identified by its frequent use of the same perch and was later banded. I observed this individual chase intruding Mockingbirds out of the tree 86 times (64 in the mornings and 22 in the afternoons). It tended to chase Mockingbirds as they entered the tree and left individuals alone if they were already foraging.

A series of loud *chuck* calls given by many nearby individuals was often heard just before the entrance of a large number of Mockingbirds into the tree. This appeared to act as a signal enabling many Mockingbirds to enter the tree synchronously from various directions and distances up to about 100 m. Once in the tree, individuals were usually silent and actively ate fruit. Mockingbirds often left the tree with ripe fruit in their bills, and one individual, captured about 75 m away after leaving the tree, regurgitated three figs.

Group foraging by Mockingbirds does not appear to be widespread. In a study of Mockingbird defense

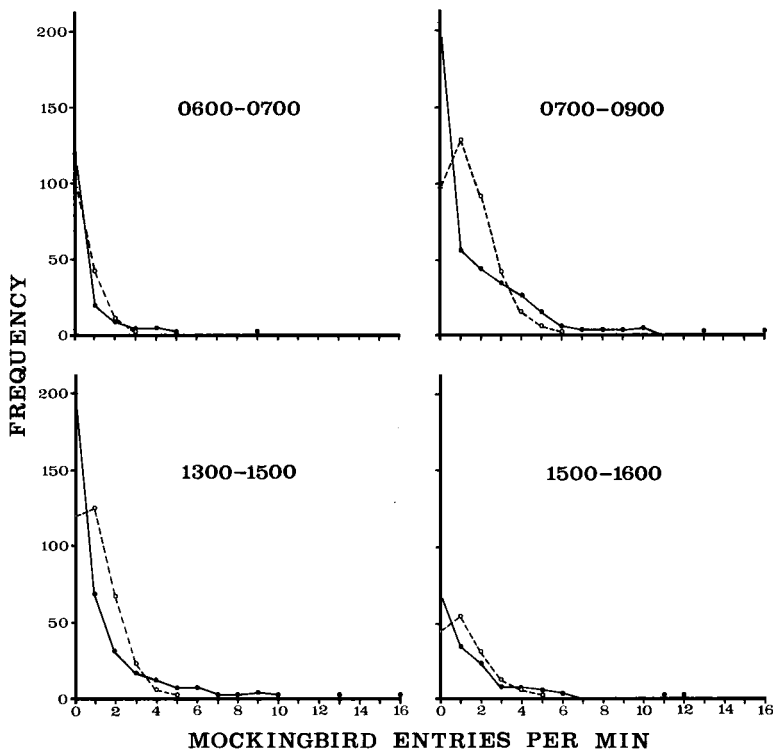


Fig. 1. Plot of the frequency of Mockingbird entries per min for the four time periods considered in Table 1. The solid lines represent the observed distributions. The dashed lines represent the Poisson distributions generated using the same mean and number of 1-min intervals as the observed in each time period.

of fruit trees in South Carolina, Moore (1977, 1978) made no mention of Mockingbirds defending against conspecifics. Furthermore, in many observations of the Red-whiskered Bulbul (*Pycnonotus jocosus*) foraging in fruit trees in south Florida, Carleton and Owre (1975) never observed a large group of Mockingbirds foraging together (pers. comm.). Kale and Jennings (1966) studied a population of immature Mockingbirds moving into and away from a swamp in Pinellas County, Florida from mid-June through most of August 1964. They captured approximately 200 individuals and observed numerous immature Mockingbirds feeding on Elder (*Sambucus simpsoni*) berries in the swamp, but it is not clear whether these birds were using any type of group foraging strategy.

The adaptive value of the coordinated entry into the fig tree might be to reduce the chances of being chased away by a territorial individual or to reduce the chances of being preyed upon (see Moore 1977). There was no direct evidence for flocking as an anti-predator tactic, so the synchronous entry into the fig tree by Mockingbirds seemed primarily to reduce the chances of being chased away by the Mockingbird defending the tree.

Some of the Mockingbirds probably held territories at various distances from the fig tree. One individual, banded on 10 November, was seen on 18 November defending a territory about 0.49 km north-west of the fig tree. Based on its plumage color and stereotyped use of perches within the territory, this apparently was the same individual studied in that territory by Julio E. Cardona in the few weeks before my banding. Michener (1951) also reported that territorial Mockingbirds traveled 0.4 km to visit a feeding station. In spring 1980 I found that Mockingbirds breeding on the University of Miami campus regularly left their territories for up to a few minutes to forage in fruiting trees, but group foraging was not observed at this time of year.

Thus, it appears that Mockingbirds wintering in south Florida exhibit social flexibility in foraging behavior. Group foraging may be most frequent in immature birds or in individuals holding territories

without ripe fruit. The occurrence of a superabundant food source in close proximity to a territory may elicit divergent foraging strategies from the same individual. Plasticity in foraging behavior and social organization was also described in the White Wagtail (*Motacilla alba*) (Zahavi 1971) and the Acorn Woodpecker (*Melanerpes formicivorus*) (Stacey and Bock 1978). The distribution and abundance of food also seem to be the main factors determining the strategies used by these birds.

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Avian Time Budgets and Distance to Cover

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One version of the “many eyes hypothesis” proposes that flocking is advantageous, because an individual group member may spend less time scanning for predators and more time feeding than a solitary

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