

Of the 69 nests, 26 (37.7%) were initiated in the wet and 43 (62.3%) during the dry season. Both sexes were reproductively active throughout the study and more nests were successful as breeding progressed. Two of 12 marked females (17%) switched from a monogamous to a polyandrous system. Because females D and E actively defended territories of multiple mates their mating system is classified as a resource defense polyandrous system (Emlen and Oring 1977).

*Discussion.*—Low success rates of reproductive attempts characteristic of jacanas in this study have also been found in polyandrous Northern Jacanas (Jenni, Am. Zool. 14:129–133, 1974) and Spotted Sandpipers (*Actitis macularia*) (Oring and Knudson, Living Bird 11:59–73, 1972). The ability of females to rapidly lay replacement clutches is also very impressive in phalaropes (Schamel and Tracy, Bird-Banding 48:316, 1977), and in Spotted Sandpipers—in one case a female laid 20 eggs (400% of her body weight) in 42 days (Emlen and Oring 1977).

Both incidences of polyandry and all five successful nests of the marked population occurred during the dry season. Unfortunately we know little about the seasonality of reproduction in Wattled Jacanas. A small marked population was monogamous in the 1974 wet season, but a female was suspected of exhibiting polyandry in August (Osborne and Bourne 1977). Nests have been reported for January, and March–September for Wattled Jacanas breeding in Surinam (Haverschmidt, Birds of Surinam, Oliver and Boyd, Edinburgh, United Kingdom, 1968). In Costa Rica, peak nesting of Northern Jacanas was at the beginning of the wet season but polyandry occurred throughout the year (Jenni and Betts, Anim. Behav. 26:207–218, 1978).

Reproductive success and the occurrence of polyandry may be related to the spatial distribution of resources (Emlen and Oring 1977). Jenni and Collier (1972) found shallow ponds in Costa Rica optimal breeding habitats for polyandrous Northern Jacanas. Interestingly, although ponds and drainage ditches together comprised only 7% of the study area, all successful nestings and polyandrous pairings of the marked population were in these habitats.

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**Habitat of Bachman's Sparrows breeding on Missouri glades.**—Bachman's Sparrow (*Aimophila aestivalis*) is an uncommon species occurring locally throughout the southeastern United States. In recent years, declining populations and uncertainty as to the bird's status have led to its being placed on the "early-warning" Blue List (Arbib, Am. Birds, 25–32, 1971–78) and to its designation as "rare" in Missouri by Nordstrom et al. (Rare and Endangered Species of Missouri, Missouri Dept. Conserv. and U.S. Soil Conserv. Serv., 1977). Missouri is at the northwestern border of Bachman's Sparrow breeding range (A.O.U. Check-list Committee, Check-list of North American Birds, 5th ed., Lord Baltimore Press, Baltimore, Maryland, 1957).

Bachman's Sparrows use pine barrens in South Carolina, grassy fields in Mississippi and

tung oil (*Aleurites fordii*) groves in Florida. Many authors have associated Bachman's Sparrows with old-field habitats (reviewed by Hardin and Probasco, *Birding*, in press).

In 1974 and 1975, Bachman's Sparrows were observed nesting on open limestone glades on the Mark Twain National Forest in Ozark and Taney counties in Missouri. Because previously described habitats do not include glades, we undertook a study in 1976 to determine detailed characteristics of habitats used by Bachman's Sparrows in this plant community.

Glades of the Ozarks are naturally open sites characterized by thin soils usually underlain by limestone. They occur in areas of hilly topography and consist of open grasslands mingled with stands of timber. Approximately 200,000 ha of these glades occur in Missouri.

*Methods.*—Singing males were located in open glade areas by listening for birds, or by playing a recording and listening for a response. Singing males were observed for 3 h; activities and locations were recorded at 5-min intervals on a map of the area. After at least 10 different locations were recorded for each male, we drew an outline of the territory and calculated the area.

We sampled herbaceous vegetation (grasses, forbs and woody plants less than 1 m tall) within 30 × 65-cm quadrats spaced 5 m apart along transects that crossed the territory at 10-m intervals. Herbaceous cover was estimated for each quadrat and recorded by the Daubenmire ranking method (Daubenmire, *Northwest Sci.* 33:43–64, 1959).

The territories were marked with a 20 × 20-m grid to sample shrubby vegetation (woody species taller than 1 m and less than 8-cm dbh). At each intersection point, the percent cover was estimated in a circle 4 m in diameter.

We measured trees (greater than 8-cm dbh) using a randomly located 10 × 10-m plot on each territory. Height, crown width and dbh were measured.

*Territories.*—Twenty-one singing male Bachman's Sparrows were found during 1976 in eastern Ozark and western Taney counties. We mapped 13 territories that ranged in size from 0.3–1.3 ha and averaged 0.62 ha. Nine of the 13 territories had west, northwest or north aspects.

Territories did not have adjoining boundaries. Four territories were found along a slope of one large glade. Distance between nearest edges of territories ranged from 65–100 m. Even in the latter instance, the male in each territory could be heard throughout the adjacent territory. Twice the males on adjacent territories appeared stimulated by one another's song and responded by singing from the closest points of their territories. Only birds in 3 of 13 territories studied were not within human hearing distance of other Bachman's Sparrows.

*Nesting.*—We found two Bachman's Sparrow nests. Both were located on the ground in 0.25-m-high grassy cover near clumps of little bluestem (*Andropogon scoparius*). Both had been formed by weaving strands of dry grass across the bottom and over the top of grass clumps.

The first nest was found 2 June 1976, when an adult carrying food approached it on the ground from 16 m. The nest at that time contained one partially feathered nestling. The nest was empty on 6 June and neither parents nor young were evident.

The contents of the second nest had been preyed upon when found on 21 June. We suspected the presence of an active nest 19 June because of the excited actions of two adult birds. Parents were not seen 21 June when the nest was discovered some 10 m from its suspected location. One white egg with two small punctures lay on the ground beside the nest.

Evidence of nesting was observed on other territories. A female with grass in her beak was seen 25 May in the presence of a singing male. Young birds were seen on four other territories. The earliest sighting of young was 21 May when two fledglings were seen. Two recently fledged young were seen 15 June on another territory, and on 27 July one fledgling

TABLE 1  
PERCENT MEAN COVER OF GRASSES AND FORBS ON 10 BACHMAN'S SPARROW TERRITORIES

| Vegetation                       | Territory number |     |     |     |     |     |     |     |     |     | Average | SD  |
|----------------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|-----|
|                                  | 1                | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |         |     |
| Little bluestem                  | 43               | 59  | 47  | 47  | 39  | 27  | 43  | 35  | 57  | 52  | 45      | ±10 |
| Co-dominant<br>grasses           | 16               | 25  | 15  | 16  | 19  | 16  | 15  | 10  | 14  | 20  | 17      | ±4  |
| Other grasses                    | 34               | 22  | 36  | 38  | 53  | 81  | 59  | 63  | 30  | 30  | 44      | ±18 |
| Composites                       | 18               | 15  | 14  | 8   | 19  | 28  | 30  | 23  | 27  | 21  | 20      | ±7  |
| Legumes                          | 1                | 1   | 1   | 4   | 1   | T   | 1   | T   | 2   | 1   | 1       | ±1  |
| Other forbs                      | 10               | 8   | 11  | 11  | 17  | 12  | 12  | 10  | 12  | 10  | 11      | ±2  |
| Total mean<br>cover <sup>a</sup> | 122              | 130 | 124 | 124 | 148 | 164 | 160 | 141 | 142 | 134 | —       | —   |

<sup>a</sup> Excess of 100% attributable to the layering of vegetational crowns.

was noted on each of two other territories. Of the 21 adult males found, at least 14 had mates. We observed some form of nesting activity in 7 of the 14 mated pairs.

*Vegetation.*—Herbaceous cover was estimated on 10 of 13 territories mapped (Table 1). Little bluestem dominated the herbaceous vegetation, comprising 40–60% of the cover on all but three of the territories. Cover for co-dominant grasses ranged from 10–25% and cover for other grasses ranged from 22–81%.

Forbs were grouped as composites, legumes and other forbs. Composites formed the dominant forb group. They ranged from 8–30% canopy cover and averaged 20%. Other forbs contributed more to cover than did legumes, ranging from 7–12% of the cover and averaging 11%. The legumes contributed only small amounts to total cover, ranging from a trace to 4% and averaging 1%.

Shrubs and trees made up a small portion of the total cover. Shrub cover occurred on all territories, but only four territories contained any tree cover. Shrub cover for the territories ranged from 0.7–6.8%, averaging 4.1%. Tree cover ranged from 0.9–4.2% and averaged 2.3% over the four territories that had trees.

Eight woody species made up the shrub (less than 8-cm dbh) vegetation. Only two species, fragrant sumac (*Rhus aromatica*) and ash (*Fraxinus* spp.) grew on all territories. Smoke tree (*Cotinus obovatus*) and eastern redcedar (*Juniperus virginiana*) were almost as widespread, being absent from only one or two territories. Only two of the shrub species—smoke tree and eastern redcedar—grew large enough to enter the tree category.

*Associated bird species.*—Seven other bird species were found in Bachman's Sparrow territories. Of these, Field Sparrows (*Spizella pusilla*) were the most numerous. Prairie Warblers (*Dendroica discolor*) and Brown-headed Cowbirds (*Molothrus ater*) also were seen frequently on the glades, the former feeding and nesting and the latter feeding and parasitizing other birds' nests. Other species with territories overlapping those of Bachman's Sparrow included the Cardinal (*Cardinalis cardinalis*), Blue-gray Gnatcatcher (*Poliophtila caerulea*), Mourning Dove (*Zenaidura macroura*) and Blue Grosbeak (*Guiraca caerulea*).

*Discussion.*—Observations of nests, eggs and young verify Bachman's Sparrow as a breeding species on the limestone glades of southwestern Missouri. The presence of 21 singing

males in a relatively small area indicates the bird may be more common than originally thought.

One distinguishing feature characterizing glade habitat is the small amount of woody plant cover above 1 m tall. Kucera and Martin (Ecology 38:285-291, 1957) noted redcedar cover ranged from only a few scattered trees on some glades to a closed canopy on others. More recently, Probasco (pp. 107-109 in Proc. Fifth Midwest Prairie Conf., 1976), studying bird use of redcedar cover, reported that Bachman's Sparrows prefer more open cover. Our data corroborate this.

Herbaceous vegetation was dense for all territories, with cover values exceeding 100%, a feature attributable to the layering of vegetational crowns. Comparable herbaceous cover values for areas with moderate and heavy shrub/tree cover were 85% and 45%, respectively (Probasco, unpubl.). Apparently, the birds prefer high density herbaceous cover and low density overstory in the limestone glade region. Typically, this comprises a dense herbaceous stand dominated by grasses and composites with scattered shrubs and trees dominated by fragrant sumac, smoke tree, persimmon (*Diospyros virginiana*), ash and eastern redcedar.

Throughout their range, Bachman's Sparrows use a number of different biotic communities. For example, pine barrens provide important breeding habitat (Weston in Bent, U.S. Natl. Mus. Bull. 237, Pt. 2, 1968; Oberholser, The Bird Life of Texas, Univ. Texas Press, Austin, Texas, 1974). Allison (Auk 16:266-270, 1899) found them breeding abundantly in grassy fields in Mississippi and common in pine woods along the Mississippi coastline. In Florida and Georgia, they have adapted to tung oil groves and borders of cultivated fields (Weston in Bent 1968). Brooks (Wilson Bull. 50:86-109, 1938) described typical habitat in Ohio and West Virginia as old fields on hilly slopes, with early stages of tree invasion, or open, scattered oak groves in Pennsylvania. Somewhat similar conditions were described by Ridgway (Bull. Nutt. Ornithol. Club 4:218-222, 1879) for Illinois; Gainer (Wilson Bull. 33:3-4, 1921) for Tennessee; and Burleigh (Georgia Birds, Univ. Oklahoma Press, Norman, Oklahoma, 1958) for the Georgia piedmont.

The one unifying feature of most published descriptions of breeding habitat of Bachman's Sparrow is herbaceous cover, usually dense, interspersed with or bordered by some shrubs and trees (reviewed by Hardin, M.S. thesis, Univ. Missouri, Columbia, Missouri, 1977). Maintenance of such conditions can be accomplished by forestry management practices in pine stands of central Louisiana, including a cycle of cutting or thinning and burning that leaves a park-like stand (Meanley, Auk 76:232-234, 1959). In Missouri's glades, prevention of overgrazing and of heavy invasion by eastern redcedar and other woody species seems essential (Hardin 1977).

We found no published information on size of Bachman's Sparrow territories, and thus could not relate territory size to habitat quality. Territories of Bachman's Sparrow in our study (range = 0.3-1.3 ha,  $\bar{x}$  = 0.62) were quite similar in size to Field Sparrow territories (range = 0.31-1.62 ha,  $\bar{x}$  = 0.76) in an Illinois study in which all available spaces were occupied (Best, Condor 79:192-204, 1977).

In this study, breeding territories of Bachman's Sparrow were not contiguous, and several areas that appeared suitable were not occupied. One possible explanation is competition by the Field Sparrow, a species which appeared to occupy a similar niche and was abundant on the glades. However, no overt signs of competition were witnessed; in fact, Field Sparrows nested and fed within known Bachman's Sparrow territories without apparent strife. These facts, together with the paucity of earlier sightings on the glades, suggest that this may be an expanding population. Bachman's Sparrows may have occupied the glades undetected before the 1950's, but then their numbers were reduced by grazing, drought and repeated burning—all reducing the amount of herbaceous cover. Recent changes in management

practices have begun increasing herbaceous cover. To some extent, then, we may have witnessed repopulation of a formerly depleted habitat.

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**A double-brooded Eastern Kingbird.**—Eastern Kingbirds (*Tyrannus tyrannus*) have not been reported to raise more than one brood per breeding season. Apparently, because of the 3-4-week period of post-fledging parental care, the time and energy needed to raise one brood to independence are too great to allow a second brood (Morehouse and Brewer, *Auk* 85:44-54, 1968). In this note, we report one instance in which a second brood was attempted and discuss reasons for the usual absence of second broods. Our observations were made at the Queen's University Biological Station, near Chaffey's Locks, Ontario, Canada, as part of a study on the factors influencing habitat distribution in the Eastern Kingbird.

For a pair of kingbirds to raise two broods in 1 year they must either lengthen the breeding season by starting earlier or finishing later than usual, thus exposing the adults and young to colder weather and lower insect food levels (see Bryant, *Ibis* 117:180-216, 1975), or begin the second brood before independence of the first brood, thereby risking lower survival of the first brood. The double-brooded pair we observed appeared to employ the latter alternative.

The first brood consisted of four young until the time of fledging (25 June) when three disappeared. The reason for disappearance was not known but was presumed to be the result of predation since the young had shown normal weight gain as nestlings. The single remaining fledgling, which had been color banded as a nestling, was sighted with the two unmarked adults during four checks of the nest area within the next 2 weeks. The female was found incubating a new clutch of three eggs on 8 July, in a nest located 3 m from the first nest. We calculated clutch initiation date as 4 July by backdating 16 days from hatch (20 July). The 9-day period from fledging to initiation of the second clutch was within the normal time for renesting after failed nests ( $7.7 \pm 1.7$  days for 15 pairs). These observations indicated that the same female was responsible for both nests.

During incubation of this second clutch, the adults were observed for three 90-min periods. In the first observation period (14 days after fledging), the fledgling was fed twice by the male and not at all by the female. This feeding rate of 1.3/h is much lower than the usual rate for feeding fledglings which have left the nest in the previous 21 days (6.5 feedings/fledgling/h in our study, 5.6 feedings/fledgling/h calculated from the extensive data in Morehouse and Brewer [1968]). During the other two periods (19 and 23 days after fledging) the fledgling was not fed by either adult despite begging and following behavior. The male vigorously chased