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## BREEDING STATUS INFLUENCES SINGING FREQUENCY IN BACHMAN'S SPARROW

**Aubrey Sirman**

*Department of Biological Science  
Florida State University  
Tallahassee, FL 32306  
aes07f@fsu.edu*

**and**

**James Cox**

*Tall Timbers Research Station and Land Conservancy  
13093 Henry Beadel Dr.  
Tallahassee, FL 32312  
Jim@ttrs.org*

### **Introduction**

Singing rates for songbirds are often influenced by extrinsic factors such as season, time of day, weather, density of conspecifics, and breeding status (Best 1981, Alldredge et al. 2007). The influence that breeding status may have on singing rates has not been quantified for many species, because measuring such effects generally requires careful monitoring of marked individuals. Nonetheless, where breeding status has been assessed, the influence on singing rates has often been pronounced and likely influences population estimates obtained from counts of singing males. For example, unpaired male Kentucky Warblers (*Geothlypis formosa*) and Ovenbirds (*Seiurus aurocapillus*) were detected more readily than paired males (Gibbs and Wenny 1993), and a majority of singing Sage (*Amphispiza belli*) and Field Sparrows (*Spizella pusilla*) recorded during surveys were unpaired males (Best and Petersen 1982).

Bachman's Sparrow (*Peucaea aestivalis*) is a declining species that is considered to be a species of special management concern by several state and

federal entities (Cox and Widener 2008). This small, enigmatic sparrow is a resident of mature pine forests and ruderal lands (Dunning 1993). Historically, the species' breeding range included northern Illinois and central Ohio. Its range has declined since the 1930s, resulting in a restricted distribution across the southeastern United States (Dunning 1993). Accordingly, monitoring programs are underway in many areas (e.g., Watts et al. 1998) to help determine the status of Bachman's Sparrows, as well as to gauge the response of sparrow populations to land management activities.

In this study, we examined the influence of breeding status on singing frequency of male Bachman's Sparrows. Male Bachman's Sparrows sing throughout all stages of the breeding cycle; however, they appear to sing less frequently in later breeding stages (Dunning 1993). We attempted to quantify this reported change in frequency by monitoring individually marked males over a period of several weeks and correlating the rates of singing to breeding status. Because most monitoring programs available for this species are based on auditory detections of singing males (Watts et al. 1998, Tucker et al. 2006), changes in singing rates that stem from changes in breeding status could lead to biased population estimates.

### Study Site

Our study was conducted on the Wade Tract (Thomas Co., GA) from May to July in 2009. The 80-ha site is an old-growth stand of longleaf pine (*Pinus palustris*) that is maintained using frequent prescribed fire ( $\leq 2$ -year return intervals). The area was burned in late April 2009 just prior to the initiation of our study, and, by late May, the study area supported a high density (ca. 0.6 males per ha) of territorial males.

### Methods

Male Bachman Sparrows were caught in mist nets using procedures described in Jones and Cox (2007) and marked with a unique combination of federal and colored leg bands (banding conducted under applicable state and federal permits). We visited territories held by 8 marked males 2-3 times each week for a total of 8 weeks. We altered the order of visits on each occasion, and playback vocalizations were used at the outset of each visit to help locate marked birds.

Once a marked individual was sighted, we moved 30-40 m from the bird

and waited 2 min. to allow time for the bird to return to normal activities. We then monitored singing rates for 10 min. The number of songs recorded within the sampling period was based on 3 vocalizations described by Dunning (1993): (1) primary song, (2) whisper song, and (3) excited song. The primary song consists of a long introductory note followed by a trill. The whisper song mimics the primary song but is broadcast at a lower volume. The excited song is a modified version of the primary song where the introductory note is replaced by a series of slurs, whistles, and trills (Dunning 1993). All 3 vocalizations are broadcast throughout the breeding season (Dunning 1993). Other vocalizations such as anxious chipping and “chitter” calls were not classified as songs.

Breeding status of marked individuals was assessed during each visit using a modification of the reproductive status index developed by Vickery et al. (1992). Our index included 3 status levels: (1) unpaired, (2) paired, building nests, or incubating, or (3) evidence of advanced nesting activity that included adults carrying food or tending fledged young. The status assigned during each visit was based on careful observations of the behavior of marked males and unbanded conspecifics in each territory. This scoring system has been shown to be a reliable indicator of breeding status for Bachman’s Sparrow (Tucker et al. 2006). Males defend territories from other singing males (Dunning 1993), so unbanded individuals observed near marked males were assumed to be paired females. Wind speeds and sky conditions also were recorded during each session using the categorical system developed for the Breeding Bird Survey (Sauer et al. 2008).

All statistical analyses were conducted using Systat (SPSS Inc. 1998). We used ANOVA to compare variation in singing rates to variation in breeding status with respect to wind and sky conditions. A post-hoc analysis using Bonferonni-adjustments was used to assess differences in singing rates by different stages of breeding (e.g., levels 1-3).

## Results

Most (>95%) of the vocalizations that we recorded were the primary song. None of the males we monitored used the whisper song, and the excited song was heard only during territorial encounters. Unpaired males sang an average of 30.7 ( $\pm$  12.9) times per session, while paired males and males associated with nests sang an average of 1.7 ( $\pm$  1.5) times per session. Males with higher nesting status codes of 2 or 3 sang an average of 0.8 ( $\pm$  0.2) times per session. Differences in singing rates by breeding status were significant ( $F_{4,32} = 15.48$ ;  $P$

< 0.01), while differences in singing rates in relation to variation in sky ( $F_{4,32} = 0.011$ ;  $P = 0.92$ ) and wind ( $F_{3,33} = 0.65$ ;  $P = 0.66$ ) conditions were not significant. There were no significant interactions between weather conditions and breeding status. In a post-hoc comparison of the 3 levels of breeding status, status 1 males were significantly different from status 2 and 3 males, while singing rates observed for status 2 and 3 males were not significantly different.

Breeding status changed for 2 individuals we monitored. One male that was unpaired at the beginning of the study became paired midway through the study. His mate then disappeared later in the study. Singing frequencies for this individual averaged 40.0 times per session during the unpaired phase, 0.67 times per session during the paired phase, and 35.0 times per session during the final unpaired phase. A second male lost a mate soon after the study was initiated. The average singing rate for this individual while paired was 1.0 time per session, but increased to an average rate of 33.5 songs per session after mate loss.

## Discussion

Singing frequency for male Bachman's Sparrows appears to be strongly influenced by breeding status. We found that males that were paired or in latter stages of a nest cycle sang significantly less frequently than unpaired males. These differences may have important implications regarding the detection of male sparrows. Similar to Borror (1971), we found that the primary song was the most common vocalization given by male Bachman's Sparrows. This vocalization averages approximately 3 seconds in length (Dunning 1993), and suggests that paired males, males with nests, and males tending young sang approximately 1% of the time that we monitored them, while unpaired birds sang ca. 15% of the time – a 15-fold difference.

Although Foote and Barber (2009) found that male Song Sparrows (*Melospiza melodia*) increased singing rate during incubation, other Emberizid sparrows generally exhibit peak singing rates just prior to nest initiation (Møller 1991). We found that average singing rates in Bachman's Sparrows follow this latter trend and generally decline as nesting status progresses (averaging 0.0 while tending fledged young). By decreasing singing rates after pairing, male Bachman's Sparrows may be shifting time budgets toward mate guarding, care of their young, and other behaviors (Wasserman 1977). A reduction in singing rates while tending young may also provide signals that reduce territorial aggression during the post-fledging period, and increase the level of care males

are able to provide, increasing the survival of young. Haggerty (1986) noted that males tending fledged young often wandered through territories held by singing males and were not expelled. However, more data from this stage in the nesting cycle are needed in order to determine the significance of these changes in behavior.

Differences in male singing rates were not significant when paired males and males with nests were compared to males tending young. Dunning (1993) noted that males sing when females are incubating, so we expected to see differences in singing rates when paired males and males with nests were compared to males tending young. Our results may have been influenced by the difficulty of assigning accurate reproductive scores to some individuals. Bachman's Sparrow nests are difficult to locate (Dunning 1993, Tucker et al. 2006), so some males listed as paired may actually have been in more advanced stages of the nesting cycle. Additional work comparing singing rates among males in advanced stages of the nesting cycle is needed.

Some of the most prolific singers that we monitored failed to attract females. In fact,  $\geq 50\%$  of the males we monitored each day were not paired. Tucker et al. (2006) found that approximately 30% of the males they monitored throughout a breeding season never obtained mates. Counts of singing males (Tucker et al. 2006, Cox and Jones 2009) suggest habitat quality for Bachman's Sparrow begins to decline 2-3 years after a fire, but measurements of nest-site conditions suggest habitat conditions may decline more quickly, perhaps within 12-16 months following a fire (Cox and Jones 2009). Males occupying sites 2-3 years post-burn may sing vigorously and be easy to count primarily because they have failed to attract mates, so inferences about habitat quality based exclusively on counts of singing males are likely confounded by the higher detectability of unpaired males. We encourage expanded investigations of the breeding biology of this species. Breeding strategies employed by male and female Bachman's Sparrows are generally unknown, but appear to have influenced the differences in singing rates that we observed.

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