

anis while he and his mate attempted to parasitize their nest.

The dead individual and his color-banded mate were members of an ani group (W flock) occupying a territory adjacent to the group (E flock) under whose nest the male was found. Only E flock was nesting at the time. On 8 April I observed the pair from W flock entering E flock's territory and flying directly toward the nest tree. Four E-flock anis that had been working on the nest intercepted the pair and chased both birds, pecking at their backs and heads. The pair retreated to the edge of their own territory but flew back again after 23 min and were again chased out, this time by all seven E-flock members. The W-flock female appeared to be gravid because of a conspicuous bulge in her lower abdomen. On 9 April the E-flock nest was checked and found to contain a single egg. This egg was probably laid by the W-flock female, because the nest was incompletely built and no E-flock females were observed to be carrying eggs. This was the first of two cases of apparent intraspecific egg parasitism that I observed in Smooth-bills in 1981. This behavior is common in Groove-billed Anis (*Crotophaga sulcirostris*) (Vehrencamp 1976) but has been previously unreported for Smooth-bills. By the time the dead male was found on 11 April, E flock had abandoned its nest and had begun another one about 40 m away.

Evidence suggesting that the W-flock male was killed by E-flock members is circumstantial but strong. While defending a territory against intraspecific intruders, Smooth-bills characteristically peck at the heads of the invaders (Davis 1940). The fatal wound could have been caused in this manner. Smooth-bills will kill other anis placed in their territories if they are allowed to come in direct contact with them, as in the ani trap used by Davis (1940). Also, other than the punctured skull, the dead ani had no marks on its body that might be attributable to a predator. The location and condition of the body, the previous fights with E-flock members, and the evidence of egg parasitism all point to this being an intraspecific killing.

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LITERATURE CITED

- DAVIS, D. E. 1940. Social nesting habits of the Smooth-billed Ani. *Auk* 57: 472-484.
 VEHRENCAMP, S. L. 1976. The evolution of communal nesting in Groove-billed Anis. Unpublished Ph.D. dissertation, Ithaca, New York, Cornell Univ.

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Effects of Stage of the Breeding Cycle on Sage Sparrow Detectability

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Among the myriad of factors potentially affecting the accuracy of bird census procedures are seasonal changes in detectability that correspond with different stages in the birds' breeding cycle. If detectability is influenced by the stage of the breeding cycle, then "perceived" changes in size within a single population or disparities in size among different populations may be only sampling artifacts rather than indications of actual differences in population density. In particular, this poses a problem when the census interval for a given study is long or when the results from more than one study are compared in which counts were conducted at different times in the season (see also Järvinen et al. 1977). Effects of the stage of the breeding cycle on bird detectability have been largely ignored, although Best (1981) has quantified these for the Field Sparrow (*Spizella pusilla*). During an intensive study of the breeding ecology of passerines occupying a sagebrush-grassland community, we had the opportunity to make a sim-

ilar evaluation for the Sage Sparrow (*Amphispiza belli*). Those results are reported herein.

The study area is located within the western boundary of the Idaho National Engineering Laboratory site in southeastern Idaho. The topography is flat to gently rolling. Dominant plant species include big sagebrush (*Artemisia tridentata*), green rabbitbrush (*Chrysothamnus viscidiflorus*), bluebunch wheatgrass (*Agropyron spicatum*), Indian rice grass (*Oryzopsis hymenoides*), and bottlebrush squirreltail (*Sitanion hystrix*). Substantial portions of the ground are bare.

In 1981, Sage Sparrows arrived on the study area in early March, and territory establishment was completed by mid-April. Most birds were mist netted soon after their arrival and marked with colored leg bands for individual identification. In May and June, territories of 43 males (39 mated and 4 unmated) were mapped by using the "flush" technique (Wiens 1969). Birds on each of four 6.25-ha study plots, gridded

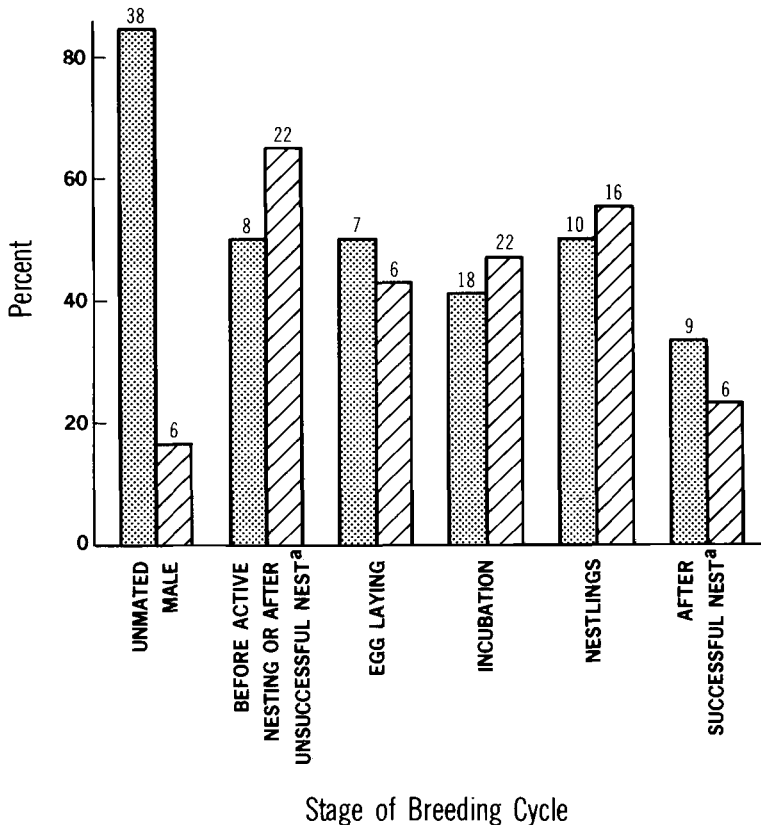


Fig. 1. The percentage of all Sage Sparrow observations during counts that consisted of singing males (stippled bars) and the percentage of the potential observations during counts when members of a pair (or unmated males) were not sighted (crosshatched bars). Categories with superscript "a" include only the interval until egg laying in a subsequent nest. Numbers above bars represent actual counts.

throughout at 25-m intervals, were counted weekly, beginning 5 May and continuing through 2 July, by employing the spot-map method (Robbins 1970). Census counts were conducted from 15 min before sunrise to 2.5 h after sunrise. On a given day, birds on two plots were counted, and we alternated the plot visited first from week to week. Counts were not conducted on days with rain or strong wind (>10 mph). Alternate grid lines were followed during a count until the plot had been completely traversed; the location and behavior of birds observed were recorded on grid maps of the plot.

During counts, a concerted effort was made to identify individual birds by colored leg bands or (for males) by characteristic song patterns (Rich 1981). Birds remained within their territories for most activities, but mated pairs occasionally were observed foraging on the ground just outside the territory. Thus, unidentified birds were assumed to be sighted within their own territory. Territory boundaries fluctuated only slightly during the breeding season. The

mating status was known for all males, and the nesting status was known for most pairs during each count. Observations of members of a pair whose nesting status was uncertain were excluded from the results reported herein.

We assumed that the circumstances under which individual birds are first observed on a given count are influenced less by the observer's presence than are those of subsequent sightings and, consequently, best indicate the effects of the stage of the breeding cycle. Therefore, only initial observations were used.

In many breeding bird studies, singing-male observations constitute the most important criterion for determining population size (Enemar 1959: 89). Thus, it is instructive to consider the percentage of all observations during counts that were of singing males (Fig. 1). A 2×6 Chi-square contingency analysis revealed that the proportion of observations that were of singing males was significantly related to the stage of the breeding cycle ($\chi^2 = 22.6$, $P < 0.005$). Singing-male observations were most likely when male Sage

Sparrows were unpaired and least likely after nests successfully fledged young (and before eggs were laid in the subsequent nest). During other stages of the breeding cycle the prevalence of singing-male observations was intermediate. A similar pattern was documented for the Field Sparrow in shrub-grassland habitat (Best 1981), although there the decline in the proportion of singing-male observations once the males had paired was much more dramatic and no males were heard singing during the interim after a successful nest and before egg laying in the subsequent nest. Singing birds constituted 84% of all observations of unmated male Sage Sparrows, whereas 45% of the observations during other stages of the breeding cycle were of singing males. This compares with 92% and 13%, respectively, for the Field Sparrow (Best 1981). Thus, pairing status does not seem to influence song activity in Sage Sparrows to the degree that it does in Field Sparrows (see also Rich 1977).

The likelihood that birds are not detected during a count also is influenced by the stage of the breeding cycle. The total number of times that birds were at given stages of the breeding cycle during counts was determined and used to calculate the percentage of the potential observations during which birds remained unsighted (Fig. 1). Unmated males and members of a pair after a successful nest were most frequently detected during counts, whereas members of a pair were most likely overlooked during the nestling stage and either before active nesting or after an unsuccessful nest (2×6 Chi-square contingency analysis comparing frequency of escaping detection with stage of the breeding cycle; $\chi^2 = 23.0$, $P < 0.005$). Because Sage Sparrows generally are mated before the usual period for censusing (see below), the factor (associated with stages in the breeding cycle) that probably influences bird counts most would be the abrupt increase in detectability of members of a pair when young fledge from the nest. The impact of this would depend upon the degree of nesting synchrony within the population and the prevalence of second nesting (see Best 1981). In comparison with Sage Sparrows, unmated Field Sparrows were least frequently missed during counts, and members of a pair were most likely overlooked during incubation.

Differences in the breeding biology of the two sparrow species probably account for part of the variation in their patterns of detectability. Male and female Sage Sparrows arrive concurrently, having paired before territory establishment (Rich 1980). Thus, singing by males (at least on the breeding site) probably serves to advertise and defend the territory and not to attract mates. Reduced singing by paired males probably reflects other demands on their time (e.g. attending the female, feeding or brooding the young). In contrast, male Field Sparrows arrive on their territories about 3 weeks before females (Walk-

inshaw 1968). In this species, song functions both to defend the territory and to attract a mate. Consequently, singing intensity and frequency decline dramatically once males have successfully paired. The function of song, therefore, has an important impact on the effects of the stage of the breeding cycle on detectability (Best 1981). This should be taken into account when comparing census results for the same species during different periods of the breeding season and when comparing census results for more than one species, particularly if song serves different functions among the species.

Differences in detectability between the two sparrow species also may be a result of differences in visual obscurement by vegetation, although the habitats of the two species were structurally similar. The Sage Sparrow spends more time on the ground than does the Field Sparrow (Miller 1968, pers. obs.), perhaps causing a greater reliance on aural cues to locate the birds. This may account for the higher percentage of singing-male observations for paired Sage Sparrows than for paired Field Sparrows.

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LITERATURE CITED

- BEST, L. B. 1981. Seasonal changes in detection of individual bird species. Pp. 252-261 in *Estimating numbers of terrestrial birds* (C. J. Ralph and J. M. Scott, Eds.). *Studies Avian Biol.* No. 6.
- ENEMAR, A. 1959. On the determination of the size and composition of a passerine bird population during the breeding season. *Vår Fågelvärld*, Suppl. 2: 1-114.
- JÄRVINEN, O., R. A. VÄISÄNEN, & Y. HAILA. 1977. Bird census results in different years, stages of the breeding season and times of the day. *Ornis Fennica* 54: 108-118.
- MILLER, A. H. 1968. *Amphispiza belli nevadensis*: Northern Sage Sparrow. Pp. 1004-1012 in *Life histories of North American Cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies* (O. L. Austin, Jr., Ed.). U.S. Natl. Mus. Bull. 237, part 2.
- RICH, T. D. G. 1977. Territorial behavior of the Sage Sparrow (*Amphispiza belli*: Fringillidae). Unpublished M.S. thesis, Pocatello, Idaho, Idaho State Univ.
- . 1980. Territorial behavior of the Sage Spar-

- . 1981. Microgeographic variation in the song of the Sage Sparrow. *Condor* 83: 113–119.
row: spatial and random aspects. *Wilson Bull.* 92: 425–438.
- ROBBINS, C. S. 1970. Recommendations for an international standard for a mapping method in bird census work. *Audubon Field Notes* 24: 723–726.
- WALKINSHAW, L. H. 1968. *Spizella pusilla pusilla*: Eastern Field Sparrow. Pp. 1217–1235 in *Life histories of North American Cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies* (O. L. Austin, Jr., Ed.). U.S. Natl. Mus. Bull. 237, part 2.
- WIENS, J. A. 1969. An approach to the study of ecological relationships among grassland birds. *Ornithol. Monogr.* 8.

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Does the Woodcock Bob or Rock—and Why?¹

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Details of the behavior of the American Woodcock (*Philohela minor*), other than those of the mating display, are little known. Undisturbed birds fly only for brief periods in twilight and are almost always well concealed while on the ground. Woodcock may become conspicuous, however, when they feed in open areas during daylight hours.

On two such occasions, I observed the repetitious body motions of undisturbed birds from a large window in my home in St. Paul, Minnesota. The birds moved about a flat-to-gently-sloping lawn and adjacent areas covered by tall sparse staghorn sumac (*Rhus typhina*) and small box elder (*Acer negundo*) that had no branches below 1–2 m. The area was 12–45 m below the window and 25–50 m away. I used either 7 × 50 binoculars or a 20× spotting scope, and, as there was a high, thin overcast and all observations were between 0630 and 1730, the light conditions were very good.

One bird, observed for a total of 8 h between 29 March and 1 April 1978, actively fed on the lawn, with a few excursions to the leaf litter under the shrubs. There was some old snow nearby but none in this area. I probed the saturated soil with an aluminum rod and found that the frost line varied from 5 to 20 cm in depth. As the bird slowly walked about, its head and neck remained on a level plane, but its body was almost continually moving back and forth, best described as “rocking.” A line between the neck and dorsal feathers was obvious, because, while the body moved, the head did not. One foot was lifted high then placed down ahead with the weight on it; the other foot was lifted so that only the tips of the toes were in contact with the ground. This repetitious movement stopped when the bird picked a small

worm from the surface, probed deeply to pull out a large worm, or extracted an insect from under a leaf. The head was well forward and held slightly to one side with the tip of the bill 3 cm or less above the surface. Sometimes progress was broken by repeated rocking in one place, and, less often, the bird stood motionless for several minutes.

On 4 April 1974, I watched another bird for 45 min in the same area during the middle of the afternoon. Although the ground had been bare for more than a week, 15–20 cm of fresh wet snow had fallen the previous afternoon and evening. This bird walked slowly on top of the snow with the same rocking motions. The next morning I tracked it for about 300 m and found no sign of probing, although it had stopped at the base of several oak trees, where a few grass stems or dry leaves protruded above the snow.

The early literature on woodcock behavior is thoroughly reviewed by Pettingill (1936), who also presented his own observations on bobbing. He cited Christy (1931: 14) who noted “the well-known teetering movement of the woodcock’s body.” Sheldon (1967: 84) quoted Glasgow (1958) as noting that “these woodcock walked a few steps in a (rumba-like manner)” on a dry lawn in east Texas. de Forges (1975: 425) reported that a nesting Eurasian Woodcock (*Scolopax rusticola*) bobbed “now and again” while feeding away from the nest. Worth (1976) gave a detailed description of body bobbing by a woodcock on a lawn in New Jersey. Severinghaus (1978: 748) said of the Eurasian Woodcock in Taiwan that “Feeding bouts were prefaced by a bobbing behavior in which the body moved (seesawed) while its head and legs remained stationary.”

Four explanations of the bobbing have been advanced. Pettingill (1936: 269) believed “that bobbing is a nervous action resulting from fear or suspicion.” The several observations cited above, however, were of undisturbed birds, as were mine. Further, the re-

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