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SEASONAL CHANGES IN DETECTABILITY OF SAGE AND BREWER'S SPARROWS

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Seasonal changes in the detectability of individual bird species may confound efforts to estimate population densities. This is particularly true during the breeding season, when such changes may be pronounced (e.g., Best 1981). The time and duration of the period within the breeding season when detectability is greatest for one species may differ substantially from those for another, necessitating adjustments in scheduling and interpreting census counts. Also, seasonal fluctuations in detectability may change from one year to the next. At present, little information is available on seasonal patterns of detection (or song) of North American birds during counts; the best documentation comes from European studies (see references in Best 1981:260). Best (1981) presented seasonal profiles of detection for selected bird species breeding in woodland and forest habitats of Iowa, and Emlen (1984) reported seasonal trends in song frequency of birds breeding in an arboretum in Wisconsin. Seasonal patterns of detection have not been reported for bird species occupying the vast areas of shrubsteppe in the western United States, although many studies conducted in that region have depended upon bird census results for their conclusions (e.g., Walcheck 1970, Best 1972, McGee 1976, Rotenberry et al. 1979, Wiens and Rotenberry 1981).

The Sage Sparrow (*Amphispiza belli*) and Brewer's Sparrow (*Spizella breweri*) are two of the dominant bird species breeding in the sagebrush-grasslands of Idaho, Oregon, and Washington (Wiens and Dyer 1975, Wiens and Rotenberry 1981, Reynolds and Trost 1981). Best and Petersen (1982) documented the effects of stage of the breeding cycle on Sage Sparrow detectability, but seasonal changes in detectability could not be derived directly from the breeding cycle data because the birds nested asynchronously. Seasonal changes in detectability of this species and the Brewer's Sparrow have yet to be reported. In this study, our objective was to document changes in the detectability of these two species during the breeding season. Because most birds were marked and all territories were mapped (see below), we could derive seasonal profiles of detectability, adjusted for seasonal changes in bird densities. Such profiles may be used when planning bird-count schedules and when interpreting census results for sagebrush-grassland bird communities.

The study was conducted in 1981 and 1982 on the Idaho National Engineering Laboratory (INEL), approximately 11 km south of Howe, Butte County, Idaho. The topography is flat to gently rolling. Dominant plant species included big sagebrush (*Artemisia tridentata*), green rabbitbrush (*Chrysothamnus viscidiflorus*), bluebunch wheatgrass (*Elytrigia spicata*), Indian rice grass (*Oryzopsis hymenoides*), and bottlebrush squirreltail (*Elymus elymoides*). Substantial portions of the ground were bare. Four 6.25-ha study plots, gridded throughout at 25-m intervals, were established. Most birds were mist-netted soon after their arrival on the study area and were marked with colored leg bands. In May and June, we mapped territories of all males by using the "flush" technique (Wiens 1969). Forty-three Sage Sparrow and 27 Brewer's Sparrow territories were delimited in 1981; 41 and 25 territories of the respective species were mapped in 1982. Each plot was visited at least twice weekly, thus enabling us to closely track seasonal fluctuations in population densities and pairing status of all territorial males.

Birds on each plot were counted weekly during the breeding season (5 May–2 July 1981 and 22 May–8 July 1982), by using field procedures similar to those for the spot-map method (Robbins 1970). Counts were started later in 1982 because the breeding phenology was delayed that year (see below). Counts began 15 min before sunrise and ended 2.5 h after sunrise. On a given day, birds on two plots were counted, and we alternated from week to week the plot that we visited first. Counts were not made on days with rain or strong wind (> 15 kph). Every other grid line was followed during a count until the plot had been completely traversed; the location and behavior of birds that we observed were recorded on grid maps of the plot. When we saw individual birds moving from one location to another during a count, only the initial sighting was included. We assumed that the circumstances under which birds are first observed are influenced less by the observer's presence, thus providing the best indication of seasonal changes in detectability. Multiple sightings of individual birds were regarded as separate observations only if the observer lost visual and/or auditory contact with the bird between observations. Daily weather information, measured at Howe, was obtained from the National Climatic Center, Asheville, North Carolina.

Seasonal changes in detectability of the two sparrow species were expressed in two ways: Total Observations and Singing Observations. All bird observations on each

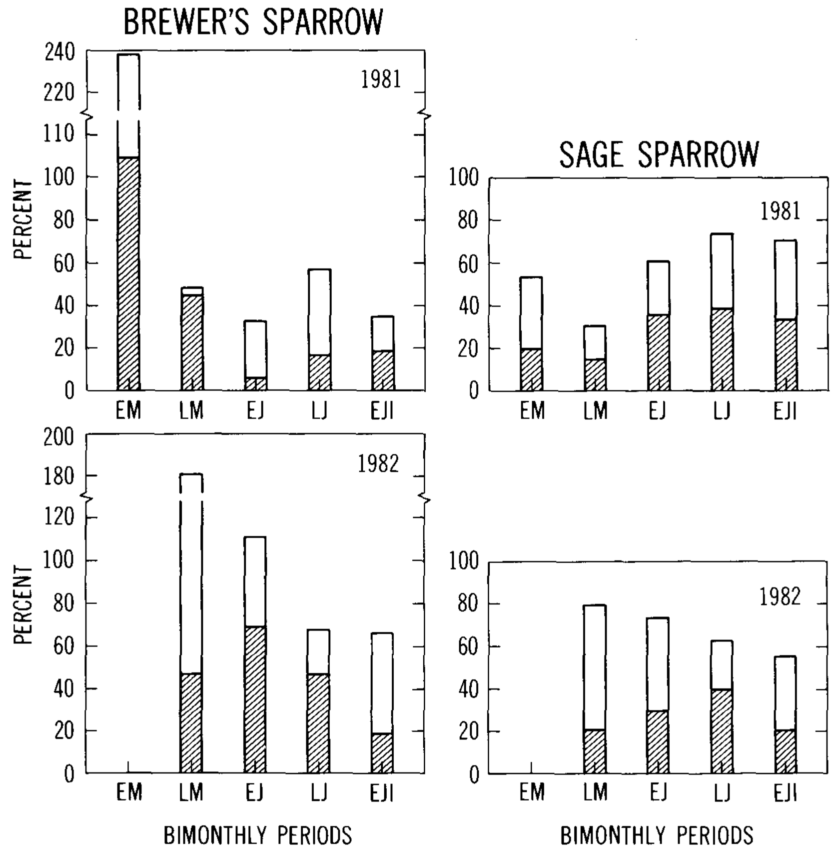

FIGURE 1. Total Observations and Singing Observations of Sage and Brewer's sparrows for bimonthly (EM = early May, LM = late May, etc.) periods, expressed as a percentage of the number of birds known to be present. Graphed values represent means for the four study plots.

study plot during each weekly count were tabulated and then divided by the number of breeding individuals actually occupying the plot (determined by mapping territories, using the flush technique). The same computations were made for the number of singing-male observations. These values were averaged bimonthly (1–15 May, 16–31 May, 1–15 June, etc.) for each plot. Thus, Total Observations and Singing Observations are the number of observations per count expressed as a percentage of the number of birds known to be present during the count. Because some individuals were recorded more than once during a count, Total Observation values could be greater than 100%; and although values greater than 100% do not necessarily mean that all individuals present on the study plots were observed, they do reflect duplicate counting of some individuals. The significance of seasonal variations in detectability was tested by analysis of variance (using arcsine transformations of the data).

Bimonthly Total Observations varied significantly for the Brewer's Sparrow in both years (1981: $F[4, 15] = 9.25$, $P < 0.01$; 1982: $F[3, 12] = 3.86$, $P < 0.05$), whereas seasonal variation in Total Observations of Sage Sparrows was significant only in 1981 (1981: $F = 5.08$, $P < 0.01$; 1982: $F = 1.08$, $P < 0.40$; Fig. 1). The Total Observations for Brewer's Sparrows were high (>180%) at the beginning of the breeding season, when some birds frequently were seen more than once, but declined precipitously later in the season. For Sage Sparrows, Total Observations were comparatively low and more uniform throughout the season. The consistent decline in Total Observations early in the breeding season for Brewer's Sparrows, but not for Sage Sparrows, may be related to the pairing status of the two species early in the census period. Most male and female Sage Sparrows are paired before arriving concurrently on their breeding territories (Rich 1980). In contrast, male Brewer's Sparrows arrive on their territories before females, and males evidently are less conspicuous after pairing than before (Petersen 1982). Best (1981) reported that Field Sparrows (*Spizella pusilla*—a congener of the Brewer's Sparrow) were least frequently missed during census counts when males were unmated. Our data suggest that the timing of census counts within the breeding season may be more critical for Brewer's Sparrows than for Sage Sparrows. To reliably compare density estimates of Brewer's Sparrow populations that are obtained from different areas, counts should be done during the same period in the breeding season (i.e., either before or after males have paired) in each case. A similar caution also applies to other species that exhibit dramatic seasonal changes in detectability.

Annual variations in the timing of pair bond formation and/or nesting can compound the problem of comparing census data obtained from different areas or from the same area in different years. In our study, there was a seasonal shift in breeding phenology for both sparrow species between 1981 and 1982. Average temperatures during the last half of April (immediately preceding the period when male Brewer's Sparrows normally first arrive) were 12°C in 1981 but only 6°C in 1982, probably delaying breeding the second year. In 1981, Brewer's Sparrows first established territories on 1 May, but in 1982, the first territories were established on 14 May. Nesting by Brewer's Sparrows also began later in the second year; first nests were completed on 25 May 1981 and 7 June 1982. The peak in

Singing Observations in 1982 was 1 month later than in 1981, and the dramatic decline in Total Observations began 2 weeks later. The breeding phenology of the Sage Sparrow likewise was delayed by about 3 weeks in 1982; first nests were completed on 27 April in 1981 and by 18 May in 1982. Such a shift in breeding phenology probably is less important in this species, however, because Sage Sparrows did not show the strong seasonal changes in detectability noted for Brewer's Sparrows. For Brewer's Sparrows or similar species, year-to-year fluctuations in breeding phenology may have important implications for censusing, particularly if the research is designed such that census counts are conducted at the same time each year.

Consistency between years in seasonal profiles of detectability is an important consideration in determining the general application of such profiles. Seasonal variation in Total Observations was more consistent between years for Brewer's Sparrows than for Sage Sparrows (Fig. 1, see statistics above). Singing Observations varied significantly throughout the season for Brewer's Sparrows in 1981, but not in 1982 (1981: $F[4, 15] = 9.63$, $P < 0.01$; 1982: $F[3, 12] = 1.60$, $P < 0.25$). Seasonal variations in Singing Observations were not significant for the Sage Sparrow in either year (1981: $F = 1.58$, $P < 0.25$; 1982: $F = 1.63$, $P < 0.25$). We have no explanation for the annual variation in Singing Observations for the Brewer's Sparrow, but it could become important with this and other species whenever a high degree of reliance is placed on aural observations to locate birds.

Consistent seasonal profiles of detectability, when known, may be used *a priori* in scheduling bird counts, after making appropriate adjustments for year-to-year differences in weather and other factors. (For a discussion of such adjustments, see Best 1981.) Where seasonal patterns of detection are inconsistent from one year to the next, the pattern for the particular year under study must be determined and then used when interpreting the census results. Emlen (1984) suggested one procedure for doing this.

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REESTABLISHMENT OF AN INSULAR WINTER WREN POPULATION FOLLOWING A SEVERE FREEZE

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Winter Wrens (*Troglodytes troglodytes*) are abundant and permanent residents of the forests of western Washington state (Jewett et al. 1953). They may be equally common, and possibly even more so, on some of the small islands off the Olympic Peninsula where, however, they may be locally eliminated by severe winter freezes. The following observations record in detail the chronology of one such episode of extinction and recolonization.

Tatoosh Island (48°24′N, 124°40′W) is approximately 0.7 km northwest of the northwestern tip of the Olympic Peninsula, a distance which is also the minimum colonization distance. The predominant vegetation, dense tangles of salmonberry (*Rubus spectabilis*) and salal (*Gaultheria shallon*), appears to provide excellent habitat for Winter Wrens and is 5–6 ha in extent. F. Richardson visited the island in July, 1956 and 1959, as did D. R. Paulson in June, 1970 and 1971, and D. Wood in July, 1974 and 1975, and they all recorded these wrens as common (maximum density: 1 singing male/0.4 ha of appropriate habitat). I noted wrens on most of my 67 trips, which usually lasted 2–8 days, between June, 1968 and October, 1978. During a visit from 26–29 December 1978, however, the island "froze." Ice formed in standing water to a depth of 10–15 cm; no heated human residences were