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Male Incubation and Multiple Brooding in Sagebrush Brewer's Sparrows

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ABSTRACT.—We report on the incidence of male incubation and multiple brooding in Sagebrush Brewer's Sparrows (*Spizella breweri breweri*) at the northwestern limit of their breeding range in southern British Columbia, 1998–2000, and in central Washington, 1996–1999. Males frequently incubated eggs, accounting for 28% of 329 observations of incubation by known individuals in British Columbia. In Washington, 51% of the males we monitored incubated eggs. Males and females appeared equally able to increase nest temperature. In British Columbia, 17% of females fledged two broods per season, and two females fledged three broods. In Washington, 5% of males fledged two broods per season. Only one previous case of male incubation has been reported in this species and multiple brooding has been poorly documented. These aspects of the breeding biology of other well-studied species may be underestimated without the careful examination of populations of marked individuals.

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Much of the breeding biology of the Sagebrush Brewer's Sparrow (*Spizella breweri breweri*) is well known (Rotenberry et al. 1999). Nevertheless, information on some aspects of its breeding behavior, including male

incubation and the frequency of multiple brooding, is lacking. Male incubation may be influenced by the thermal stress of eggs, female condition, predation risk, and chances of mating with another female (Kleindorfer and Hoi 1997). There is only one previously published report of incubation by a male Brewer's Sparrow (Rotenberry et al. 1999), and the frequency of this behavior had not been quantified. Males of the closely related Clay-colored Sparrow (*Spizella pallida*) incubated 14% of the total incubation time (Fox 1961). The only other North American sparrows for which male incubation has been reported are the Sage Sparrow (*Amphispiza belli*; Martin and Carlson 1998) and the Vesper Sparrow (*Pooecetes gramineus*; Rising and Beadle 1996), although the proportion of incubation performed by males of these species has not been determined.

Multiple brooding by Brewer's Sparrows also is poorly understood. In multibrooded species, the number of broods successfully fledged per season can depend upon predation pressure, food supply, and weather. While Brewer's Sparrows sometimes raise two broods per year (Rotenberry et al. 1999), the frequency of multiple brooding was unknown and the fledging of three broods per season had not been reported previously. With the exception of Arctic-breeding species, which are limited by the short breeding season, most North American sparrows can successfully raise two broods per year. Three successful broods per season have been documented for the Savannah Sparrow (*Passerculus sand-*

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wichensis; Wheelwright and Rising 1993), Chipping Sparrow (*Spizella passerina*; Middleton 1998), White-crowned Sparrow (*Zonotrichia leucophrys*; Chilton et al. 1995), Bachman's Sparrow (*Aimophila aestivalis*; Dunning 1993), Field Sparrow (*Spizella pusilla*; Carey et al. 1994), Grasshopper Sparrow (*Ammodramus savannarum*; Vickery 1996), and Sage Sparrow (Martin and Carlson 1998). Song Sparrows (*Melospiza melodia*) have fledged four broods during a season (Smith 1982).

Here we report on the frequency of male incubation and multiple brooding in Sagebrush Brewer's Sparrows near the northwestern limit of the breeding distribution of this subspecies.

METHODS

We observed Brewer's Sparrows in two study areas. The British Columbia study area consisted of four sites in the southern Okanagan Valley (centered on 49° 08' N, 119° 36' W), the northernmost extension of the Great Basin of western North America. All study sites were located in shrub-steppe habitat and we observed sparrows from 1998–2000. The Washington study area, 100 km to the south, included 12 sites in the Columbia River Basin (centered on 47° 30' N, 119° 42' W) that ranged from large (>1000 ha) blocks of continuous shrub-steppe to small fragments of remnant shrub-steppe surrounded by agricultural areas. We observed sparrows here from 1996–1999. On all sites in both study areas the dominant vegetation consisted of medium to dense cover of big sagebrush (*Artemisia tridentata*) shrubs with a variable understory of bunchgrasses and forbs.

In British Columbia we captured breeding adults in mist nets and gave them unique color band combinations. We located and monitored nests every few days throughout the breeding season from early May through July each year. When a bird was flushed from a nest with eggs, we followed it to check its identity. We quantified the frequency of incubation by each sex as the percentage of all observations of known individuals. Color-banded females were followed throughout the breeding season to determine the number of broods fledged.

In Washington, we captured male Brewer's Sparrows in mist nets, color banded them, and followed them throughout the breeding season (April through mid-July). We spent ≥ 30 min/week on each male's territory. We monitored nests every 3–4 days to determine fate and checked them at the end of each observation period. The proportion of males incubating eggs was calculated for nests where the sex of at least one incubating individual was documented. We determined the number of broods fledged by color-banded males that were observed for ≥ 10 weeks. Since we

did not detect a difference in the behavior of males and females flushing from the nest, we assumed both sexes were equally likely to be identified by the presence or absence of color bands; our analyses included only those birds so identified.

To sample the level of effort and effectiveness of incubation by each sex, we conducted a single 5-h nest watch on each of three color-banded pairs on three separate mornings during early June 1999. We observed nests with a 15–60 \times spotting scope from a distance of 25 m from approximately 05:15–10:39. We used temperature sensors secured underneath eggs and data loggers to record nest temperatures.

RESULTS AND DISCUSSION

Male Brewer's Sparrows frequently incubated eggs, accounting for 27.7% of all 329 observations of incubation by known individuals in British Columbia; annual percentages ranged from 23.5% ($n = 98$) during 2000 to 31.6% ($n = 158$) during 1998. In Washington, 51% of the 55 male Brewer's Sparrows followed throughout the breeding season were observed incubating eggs at least once; annual percentages ranged from 30% ($n = 10$) during 1997 to 56% ($n = 39$) during 1998. In Washington, the proportion of incubation time of males increased from 13% on a fair weather day (7–22° C) to a mean of 48% on two days with colder air temperatures (5–10° C) and rain. Males and females alternated incubation bouts on the two days with inclement weather (Fig. 1).

Despite the small sample size, these preliminary data suggest that the ability of males to raise and maintain nest temperature may be similar to that of females. The observation by BLW of a male with a partially developed brood patch in western Montana in June 2000 supports the idea that males can reduce thermal stress on eggs, although their efficiency at raising egg temperatures relative to females requires further study. Because these populations are subject to low temperatures during early spring, male incubation likely is an important factor in reproductive success. In some species, when the female leaves the nest to feed it may be necessary for the male to incubate to keep egg temperatures from dropping below the threshold for embryonic development (25° C; Carey 1980, Kleindorfer et al. 1995, Kleindorfer and Hoi 1997). This is consistent with our finding of greater male nest attentiveness on cold days.

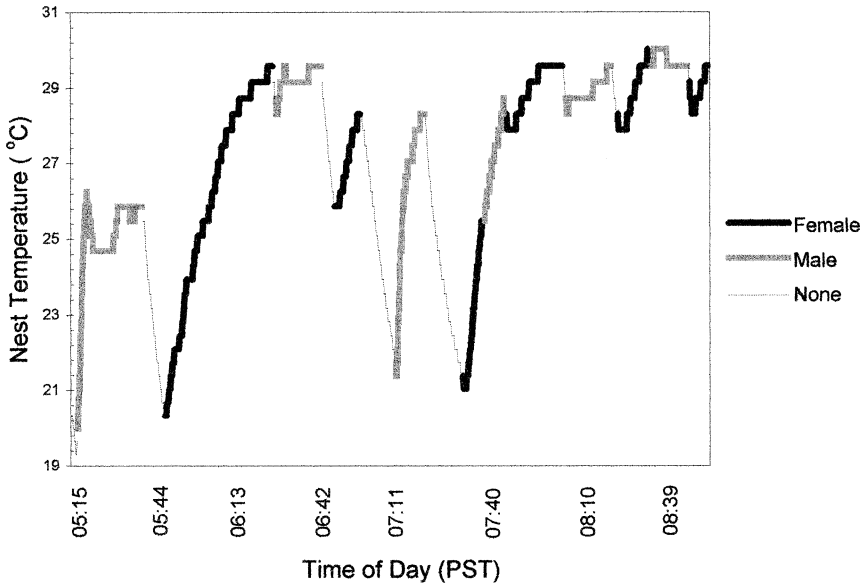


FIG. 1. Male and female Sagebrush Brewer's Sparrows exhibit similar abilities to increase nest temperature on a cold, rainy day. Data are from one pair in Douglas County, Washington, 5 June 1999.

In British Columbia, 18% of female Brewer's Sparrows ($n = 176$) fledged more than one brood per season: 53 females did not fledge any chicks, 91 fledged one brood, 30 fledged two broods, and 2 fledged three broods. In Washington, only 5% of males ($n = 59$) fledged more than one brood per season: 31 males were unsuccessful, 25 fledged one brood, and 3 fledged two broods. None of the males we observed in Washington fledged three broods during a single season.

The two cases of females fledging three broods in British Columbia are noteworthy since triple brooding has not been reported previously for this species. On 29 May 1998, a nest was found with three 5- to 6-day-old chicks. The nest was empty on 1 June, and both adults carried food to fledged chicks. We banded the female that day. Her next clutch hatched on 17 June and three chicks fledged on 26 June. Her third nest had three eggs on 7 July and two eggs plus a Brown-headed Cowbird egg on 10 July. One Brewer's Sparrow chick hatched on 12 July and fledged on 20 July. This female fledged a total of seven chicks during the breeding season.

In 1999, a female with four eggs in her nest was color banded on 27 May. Four chicks hatched on 6 June and fledged on 14 June.

She was incubating four eggs on 27 June, three of which hatched on 3 July. The three chicks were color banded and subsequently fledged on 11 July. The female was observed on 18 August with three unbanded, well-feathered but dependent, fledged young. This female fledged a total of 10 chicks that year.

Although Brewer's Sparrows are known to fledge two broods per season in some parts of their range (Rotenberry et al. 1999), our study is the first to document the proportion of multiple broods. That double brooding occurred on our sites is especially interesting because they are located near the northern limit of the subspecies' breeding range where the season may be shorter due to the later onset of spring. Other sparrows (e.g., Savannah Sparrow, White-crowned Sparrow, and Song Sparrow) that fledge three broods per season typically are widespread and multiple brooding is most common in southern or coastal populations (Wheelwright and Rising 1993, Chilton et al. 1995), although high montane White-crowned Sparrows also are double brooded (Morton and Morton 1990). While high rates of nest predation may preclude pairs from fledging multiple broods in some areas, even when the breeding season is sufficiently long, Sagebrush Brewer's Sparrows frequently are dou-

ble brooded and occasionally triple brooded at the northern extreme of their breeding range.

Our results demonstrate that intensive investigations of populations of individually color-marked birds can yield new information about the breeding biology and behavior of previously well-studied species. Similarly intensive work could be revealing for other songbirds.

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LITERATURE CITED

- CAREY, C. 1980. The ecology of avian incubation. *Biosci.* 30:819–824.
- CAREY, M., D. E. BURHANS, AND D. A. NELSON. 1994. Field Sparrow (*Spizella pusilla*). No. 103 in *The birds of North America* (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- CHILTON, G., M. C. BAKER, C. D. BARRENTINE, AND A. C. CUNNINGHAM. 1995. White-crowned Sparrow (*Zonotrichia leucophrys*). No. 183 in *The birds of North America* (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- DUNNING, J. B. 1993. Bachman's Sparrow (*Aimophila aestivalis*). No. 38 in *The birds of North America* (A. Poole, P. Stettenheim, and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- FOX, G. A. 1961. A contribution to the life history of the Clay-colored Sparrow. *Auk* 78:220–224.
- KLEINDORFER, S., B. FESSI, AND H. HOI. 1995. More is not always better: male incubation in two *Acrocephalus* warblers. *Behaviour* 132:607–625.
- KLEINDORFER, S. AND H. HOI. 1997. Nest predation avoidance: an alternative explanation for male incubation in *Acrocephalus melanopogon*. *Ethology* 103:619–631.
- MARTIN, J. W. AND B. A. CARLSON. 1998. Sage Sparrow (*Amphispiza belli*). No. 326 in *The birds of North America* (A. Poole and F. Gill, Eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania.
- MIDDLETON, A. L. A. 1998. Chipping Sparrow (*Spizella passerina*). No. 334 in *The birds of North America* (A. Poole and F. Gill, Eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania.
- MORTON, G. A. AND M. L. MORTON. 1990. Dynamics of postnuptial molt in free-living mountain White-crowned Sparrows. *Condor* 92:813–828.
- RISING, J. D. AND D. D. BEADLE. 1996. A guide to the identification and natural history of the sparrows of the United States and Canada. Academic Press, San Diego, California.
- ROTEBERRY, J. T., M. A. PATTEN, AND K. L. PRESTON. 1999. Brewer's Sparrow (*Spizella breweri*). No. 390 in *The birds of North America* (A. Poole and F. Gill, Eds.). The Birds of North America, Inc., Philadelphia, Pennsylvania.
- SMITH, J. N. M. 1982. Song Sparrow pair raise four broods in one year. *Wilson Bull.* 94:584–585.
- VICKERY, P. D. 1996. Grasshopper Sparrow (*Ammodramus savannarum*). No. 239 in *The birds of North America* (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- WHEELWRIGHT, N. T. AND J. D. RISING. 1993. Savannah Sparrow (*Passerculus sandwichensis*). No. 45 in *The birds of North America* (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.