Age-Specific Crown Variation in Basic-Plumaged Golden-crowned Sparrows

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ABSTRACT

Winter crown plumage of Golden-crowned Sparrows *(Zonotrichia atricapilla)* of the same age group can vary in appearance. To determine how age affects the development of crown appearance, I examined known-aged individuals in three consecutive years. Birds were assigned specific crown types according to a qualitative scale, then aged by skull ossification. Results show that returning basic-plumaged second-year birds acquired either an advanced crown type or reverted to an immature crown type. Adults returned with similar crown types to those with which they were banded. Wing length analysis suggests that sex may be related to this dichromatism. In addition, known-sexed museum specimens collected during the winter season were evaluated for age and crown appearance. All adult males were found to show bolder, more advanced crown-types than either young males or young females. Most adult females showed an immature-like crown, but a small percentage had advanced crowns. These findings show that the stronger-marked basic-plumaged Golden-crowned Sparrows are mostly males, at least two years of age. This difference in winter crown appearance may serve as a status signal affecting the winter flock hierarchy of this species.

INTRODUCTION

Individual Golden-crowned Sparrows *(Zonotrichia atricapilla)* in basic plumage vary considerably in crown appearance. Rising (1996) and Byers et al. (1995) state that some adults in basic plumage can have crowns looking either immature-like or crowns remaining almost as bright as in alternate plumage, but that most immature birds typically have an obscurely patterned brownish crown. They go on to describe some young individuals' crowns, however, as being brighter and appearing like some winter adults. In an attempt to understand crown variations in wintering Golden-crowned Sparrows, Mailliard (1932) followed specific individuals in consecutive years and observed that returning banded birds either advanced in crown appearances or regressed to immature crowns. In his field work, Vargas (1971) found that basic-plumaged Golden-crowned Sparrows with immature crown types showed a bimodal distribution of wing length, while basic-plumaged birds with advanced crown types possessed predominantly longer wings. He found in examining museum specimens collected during winter months that a higher proportion of males than females had advanced crown types.

Plumage variability in different age/sex groups of a flocking species during winter months has been shown to be a status signal allowing for associations to form between dominant and subordinate individuals (Rohwer 1975, Jarvi and Bakken 1984, Ketterson 1979, Keys and Rothstein 1991). Several studies involving *Zonotrichia* sparrows have demonstrated that dominant individuals tend to have more advanced plumage characteristics and are older or larger individuals than subordinates (Rohwer 1973, Rohwer et al. 1981, Fugle et al. 1984, Watt 1986). Because age seemingly affects the appearance of the crown plumage in wintering Golden-crowned Sparrows, I recaptured many of the same individuals in three consecutive years and evaluated how the development of crown coloration is affected by increased maturity in known-aged birds.

METHODS

Field data for this study were collected primarily during October and November of 1995, 1996, and 1997. Two sites were used: a small field populated with grasses, forbs, and shrubs adjacent to San Francisco Bay in Palo Alto, Santa Clara County, California; and a similarly composed field adjacent to a willow riparian area, located along the Pacific Ocean near Moss Beach, San Mateo County, California. In addition, Golden-crowned Sparrows were examined in January, February, and March 1994-1997 at a feeding station at a private residence located near Calaveras Reservoir in the Inner Coast Range, Santa Clara County, California.

I also examined Golden-crowned Sparrow museum skins at California Academy of Sciences (CAS), San Francisco, to correlate age, sex, and crown appearance of basic-plumaged birds. I classified crown types on known-sexed specimens and aged them according to plumage appearance of rectrices and primary coverts (Pyle 1997). The distribution of these samples is shown in Table 1.

Table 1. Distribution of Age, Sex, and Crown type of California Academy of Science Golden-crowned Sparrow Specimens. n=110

Crown Type	HY/SY Females (n=23)	HY/SY Males (n=42)	AHY/ASY Females (n=16)	AHY/ASY Males (n=19)
Crown 1	5 (4.5%)	1 (0.9%)	0	0
Crown 2	27 (24.5%)	41 (37.3%)	10 (9.0%)	0
Crown 3	1 (0.9%)	0	2 (1.8%)	0
Crown 4	0	0	2 (1.8%)	6 (5.6%)
Crown 5	0	0	2 (1.8%)	13 (11.9%)

In the field, birds were captured in mist nets and seed-baited sparrow traps. Plumage throughout this study was evaluated by the same two banders. Age was determined by skull ossification which, in the most advanced hatching year (HY) Golden-crowned Sparrows, is complete by 15 November (Pyle 1997). Incomplete ossification could be determined in some individuals well into December and these individuals were included. Crown types were assigned according to Cogswell (1958) in which classification among the five crown types was based on the appearance of the lateral stripes:

- Crown 1 has a diffuse streaky brown crown and no well-defined brown or black lateral stripes.
- Crown 2 has lateral stripes that are composed of light, medium, or dark brown feathers, which vary in length from either just starting above the nostrils or to as long as extending beyond the posterior of the eyes.
- Crown 3 has brown lateral stripes with a mixture of a few black feathers found in both of the lateral stripes (modified by this author from Cogswell's description).
- Crown 4 has mostly solid black lateral stripes that extend beyond the posterior of the eye. The stripes can have some brown feathers in the portion posterior to the eye.
- Crown 5 has solid wide black lateral stripes.

Only birds returning in consecutive years were used in this study enabling comparison of yearly changes. The distribution of crown types for all HY and after-hatching year (AHY) birds banded is shown in Table 2.

Table 2. Distribution of Crown types of Golden-crowned Sparrows Banded at Fall Sites for 1995-1997. n=268.

Crown Type	HY (n=176)	AHY (n=92)
Crown 1	5 (1.9%)	0
Crown 2	158 (59.0%)	30 (11.2%)
Crown 3	13 (4.8%)	13 (4.8%)
Crown 4	0	20 (7.5%)
Crown 5	0	29 (10.8%)

In this paper, Crowns 1 and 2 are referred to as basal crown types while Crowns 4 and 5 are referred to as advanced crown types. Crown 3 is termed an intermediate crown type.

RESULTS

We banded 108 sparrows at both fall sites during 1995. In 1996 twenty-five returning birds (23%) were recaptured from both sites, and in 1997 seven (4%) of those twenty-five were recaptured. In 1996 we banded 111 sparrows at both sites and

had 17 of these 1996 birds (15%) return in 1997. First year return results are pooled for discussion below.

Returning second-year (SY) individuals separated into three categories by crown appearance. The first category included 19 HY birds banded with basal crown types that returned with advanced crown types. The second category consisted of seven HY birds banded with basal crown types that returned with basal crown types. The third category included three birds: two showed a minor change from basal crown types to an intermediate crown type and the third individual returned with the same intermediate crown with which it was banded. The first two birds essentially retained thinner brown lateral stripes, but also had acquired some random scattering of black feathers in the laterals.

Birds banded as adults showed two types of returning crown patterns. First, all AHY birds with advanced crown types (n=10) returned with advanced crown types. Of these ten, three individuals returned for three consecutive years and the other seven returned for two consecutive years. Second, AHY birds with basal crown types (n=3) returned with basal crown types. All of these birds were two consecutive-year returns.

Other crown characteristics appeared to be affected as birds aged, including width and length of the lateral stripes and area of unstreaked gold on the crown. Efforts were made to quantify these parameters but measurements were not repeatable, so I did not include the results in this study. The brown lateral stripes of crown types 2 and 3, however, were generally found to be narrower and shorter than the advanced black lateral stripes of crown types 4 and 5. The area of unstreaked gold also tended to be larger in the advanced crowns than in the basal crowns.

Seven additional Golden-crowned Sparrows banded near Calaveras Reservoir in the late winter of 1994-1995 were recaptured in successive winters and their crowns were examined. Of the seven, three birds were banded with an advanced crown type, making them after-second-year (ASY) birds at the time, and they returned for three additional winters with that crown type. The remaining four were banded as AHY (adult of unknown age) birds in late March 1995. Two of these individuals were banded with basal crown types and returned with the same crown types in all three years. A third was originally banded while in pre-alternate crown molt and was not assigned a crown type. It returned, however, in each of the following three winters with a Crown 2. The fourth bird also was in pre-alternate molt when banded, returned in the winter of 1995-1996 with a Crown 2, and in the winters of 1996-1997 and 1997-1998 with a Crown 3.

The mean wing length of 29 returning birds with advanced crowns (19 SY and 10 ASY) was 80.0 mm, while that of 10 returning birds with basal crowns (7 SY and 3 ASY) was 77.5 mm. Mann Whitney U-test showed a statistically significant difference between the mean wing length of these two samples ($U= 204$; $P < 0.05$).

DISCUSSION

During this study I found that all individuals with black lateral-striped crowns were adults, at least two years old. I observed that if an individual changed from the basal to the advanced crown pattern, the change occurred during the second prebasic molt. Individuals that did not achieve an advanced crown type at this molt reverted to brown lateral-striped crowns at their third prebasic molt. Thus, it appears that almost all adults return to the same crown type they achieved at the second prebasic molt during succeeding prebasic molts.

Mailliard's (1932) results were similar; he noted an advancement in crown appearance in certain birds returning the next year or a regression to immature-like crowns in other individuals. He assumed that if the crown type of an individual did not change at the second prebasic molt, then it must be at the third prebasic molt that a change to the advanced crown-type took place. His attempt to sort out these changes, however, was obscured by his use of only the crown plumage characteristics to determine age of individuals. Similar to my study, Vargas (1971) also used Cogswell's (1958) crown descriptions and scored individuals according to crown type. Although he did not investigate changes in crown plumage as individuals aged, he did determine that birds with

Crowns 4 and 5 tended to possess predominantly longer wings. His examination of museum skins showed that of those birds with Crown 1, females outnumbered males, but that in the Crown 4 and 5 categories, males predominated. My examination of 110 CAS museum skins (Table 1) showed similar results. Basal crowns predominated in HY/SY birds of both sexes, while advanced crowns were most numerous in AHY/ASY males. Most AHY/ASY females showed basal crowns, but a few were judged to have advanced crowns. These females with advanced crowns could either be mis-sexed specimens (a 3-5% error rate can be expected in museum specimens), or it is possible that older females, some time after their third year, acquire the plumage status that males achieve at their second prebasic molt.

Crown variations in basic-plumage Golden-crowned Sparrows seem to be based both on the age and sex of individuals. In winter these sparrows assemble in flocks of mixed ages, and some intraspecific aggressive behavior has been observed during foraging periods (Kelly 1968, Davis 1973). Several studies on winter flocks have shown that young birds profit from association with older birds but are dominated by the more boldly marked adults (Rohwer 1973, Rohwer et al. 1981 Fugle et al. 1984). First-winter Golden-crowned Sparrows of either sex do not show advanced crown types, while older males tend to show more advanced coloration (this study, Stewart 1972).

Studies on *Zonotrichia* sparrows in the non-breeding season suggest that sexual differences can cause some plumage variation and that longer winged birds tend to be males (Vardy 1971, Norment and Shackleton 1993, Falls and Kopachena 1994, Norment et al. 1998). My examination of study skins of known-sexed basic-plumaged Golden-crowned Sparrows showed that most adult females are less boldly marked than adult males. Another indication supporting dichromatism in this species is that Norment et al. (1998) found that Golden-crowned Sparrow females in alternate plumage generally have duller yellow and less extensive black in their crowns than males. My analysis of the wing lengths of the sparrows in each of the two crown pattern categories indicates that the sex of the individual may well influence crown plumage, because birds with basal crowns had significantly shorter wings than birds with advanced crowns. These findings imply status signaling could be occurring in this species.

Additional study with an increased sample size is needed on basic-plumaged Golden-crowned Sparrows to ascertain more precisely when changes to advanced crowns take place in birds that do not change at the second prebasic molt. Winter flock behavior of this species has been poorly studied. More information is needed to assess if status signaling occurs, and to evaluate the relationship between dominant and subordinate individuals with reference to their plumage characteristics.

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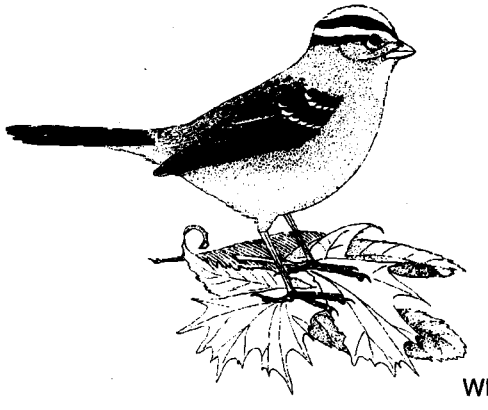

White-crowned Sparrow by George West