An Evaluation of Age Characters for Chipping Sparrows in Fall and Winter

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ABSTRACT

*I examined Chipping Sparrows (*Spizella passerina*) captured in central Texas during fall and winter to evaluate the efficacy of six characters for determining age. These included crown color, molt limits in the secondaries, molt limits in the rectrices, shape and edge color of the primary coverts, the shape of outer rectrices, and the color of the supercilium. In order to evaluate each character, I first determined the ages of the birds in my sample by means that were independent of these plumage characters. I recognized those in formative plumage by their lack of complete skull pneumaticization. My sample of birds in definitive basic plumage consisted of recaptured birds originally banded in a previous fall or winter. I found no evidence that crown color, the shape and edge color of the primary coverts, and supercilium color were useful for separating the two age groups. I found that the remaining three characters had some utility for age determination although two, molt limits in the secondaries and rectrix shape, were less useful than indicated by Pyle (1997a). For example, Pyle (1997a) reported molt limits in the secondaries or tertials of 94% of immature birds whereas I found this in only 55%. I noted that some individuals of both ages could have tapered, pointed rectrices and that only those with the most truncate feathers, 22% of the adults, could be correctly aged by this character alone. My results indicate that the ages of many Chipping Sparrows in the fall and winter cannot be determined reliably by these plumage characters alone. I found that the characters that most often separated the age groups were the presence of a molt in the secondaries followed by the presence of a molt limit in the rectrices and the shape of the rectrices. I recommend that banders evaluate them in that order.*

INTRODUCTION

Determining the age of captured birds is one of the central activities of banding. Pyle (1997a) compiled information about ageing North American birds and is currently the primary reference for banders operating in North America. However, much is left to be learned about age determination and, indeed, Pyle (1997a) specifically points out many areas where further study is needed. Furthermore, Pyle (1997a) wrote that "banders are in the best position to update information in this guide" and he strongly encouraged them to publish further information.

Chipping Sparrows (*Spizella passerina*) winter from the southern United States southward into Mexico (Middleton 1998). In many southern regions, this species is abundant throughout the winter and is readily attracted to feeding stations. Consequently, these sparrows can easily be captured for banding on their wintering grounds, a time when they are in either formative or basic plumage. Pyle (1997a) described several age characters for Chipping Sparrows in these plumages including crown color, molt limits in the secondaries, molt limits in the rectrices, shape and edge color of the primary coverts, and the shape of outer rectrices. Whenever multiple characters like these are available, it is difficult to know how much relative importance to give each when determining age. My purpose in this investigation was to evaluate these five age characters for fall and winter Chipping Sparrows and to prioritize them according to their utility. Additionally, I evaluated another age character, supercilium color, described by Oberholser (1974).

METHODS

I collected data at my residence near Kempner, Texas, in Lampasas County, from 2004 to 2009. Chipping Sparrows in this region of Texas are abundant from late October to mid-May (Lockwood and Freeman 2014). I attracted these birds to millet spread on the ground, offered in hanging tube feeders and then captured them in five 6-m mist nets arrayed around three feeding areas. After examining and banding each bird,

I used a digital camera to record images of its crown, tail, and the primary coverts on its right wing. After photographing these, I photographed the band number on the datasheet so that I would know which images represented each bird. I also searched for and noted the position of any molt limits among the rectrices and the flight feathers of the right wing.

To evaluate the age characters, I first needed to determine the ages of the birds with certainty in a way that did not rely on any of the characters under evaluation. This independent means of ageing had to distinguish between two age groups, birds in formative plumage (hereafter "immatures") and those in definitive basic plumage (hereafter "adults"). I recognized immatures by their incomplete skull pneumaticization. The latest date on which I observed incomplete skull pneumaticization was 14 January and so I could only collect data on these birds between their arrival in late October and that date. This period is well before the start of prealternate molt in March that changes the crown color on these birds (Middleton 1998). The known adult group consisted of recaptured birds which I had originally banded in some previous fall or winter. I only used data from adults recaptured during the period extending from their arrival in October to 14 January to match the time period during which I collected data on immatures.

To evaluate some of the age characters, I sought evidence that immatures and adults differed in their expression of each character. Whenever I found evidence of a difference, I then determined whether that difference was frequent enough to be valuable for determining age. I judged a character to have value if it met the standard of being "reliable" or "useful". A reliable character was defined by Pyle (1997a) as one that, by itself, separates >95% of individuals whereas a useful character separates 50-95% of individuals. Useful characters, therefore, must be combined with other characters to make an age determination. However, if one state of a given character was shown exclusively by one age group, then I considered that character state to be reliable regardless of the percentage of individuals that can be separated by the character in all its states. For example, if only immatures showed a molt limit in the secondaries, but only 5% of a sample including both ages actually showed this molt limit, then I would consider the character state of having the molt limit to be a reliable indicator of immature age. I considered any character that was not reliable or useful to be "unreliable", that is, having no value for determining age.

Crown color: Based on the digital images, I generated a crown color score for each bird ranging in value from 1 to 4. These scores reflected my estimate of the coverage of rufous color in the crown to the nearest 25%. A score of 1 indicated no rufous to as much as 25% rufous. Scores 2-4 indicated approximately 50%, 75%, and 100% of rufous coverage, respectively. I scored all pictures on the same day without sorting them beforehand into age groups. This ensured that I was blind to birds' ages when I scored crown colors.

The crown color scores provided a means to compare the amount of rufous shown by the two age groups. Pyle (1997a) indicated that the crown color of immature Chipping Sparrows is "primarily brown with little or no rufous", whereas, adult crown color is "brown with few to many rufous feathers." I interpreted this to mean that adults would tend to have more rufous than immatures. Byers et al. (1995) similarly indicated that the immature plumage "lacks rufous in the crown". If this character has value for determining age, I would expect the median crown score of adults to be greater than that of immatures. I compared the median scores of the two age groups using a Mann-Whitney rank sum test (Zar 1999). I used a two-tailed test because I did not wish to rule out any difference, even if it was opposite the prediction that adults would have more rufous than immatures.

For individuals having crowns that are primarily rufous, Pyle (1997a) further indicated that immatures have "few to many distinct, black streaks" whereas, adults have "few or no black streaks". These streaks are formed by a dark brown zone along the shaft of a crown feather and

feathers with streaks are concentrated laterally along each side of the crown. I examined streaking in crowns of all birds with primarily rufous crowns (i.e., crown color scores 3 and 4) and placed them subjectively into three categories such that a streaking score of "1" had the least amount of streaks and score "3" the most. I compared the median streaking scores of the two age groups using a Mann-Whitney rank sum test (Zar 1999) and expected that immatures would have a greater median score than adults. I again used a two-tailed test for the same reason that I used it when testing for differences in the amount of rufous.

Molt limits in secondaries and rectrices.
When handling each bird, I looked for a molt limit in the tertials and secondaries of the right wing. If I detected one, I noted which specific feathers appeared to have been replaced. I next examined the rectrices for the presence of a molt limit and, again, noted which specific feathers appeared to have been replaced. Based on the account in Pyle (1997a), I expected that only immature birds would have either or both molt limits.

Pyle (1997a) reported that the preformative molt of some Chipping Sparrows, mainly those breeding in the west, does not complete until sometime after the birds reach their wintering areas. If some of the birds I sampled had not started or completed molt before reaching my location, this could cause me to underestimate the frequency of the occurrence of molt limits. However, during the years of this investigation, the only molt I noted was of head feathers despite having examined the tails and wings of over 2000 individual Chipping Sparrows between October and the end of March. Based on this evidence, I conclude that the birds I sampled had completed their preformative molt before arriving in my area.

Primary covert shape and edge color.
Nine banders assisted me in evaluating the utility of primary covert shape and edge color for determining the age of Chipping Sparrows. Three of these individuals were particularly experienced, holding certification at the "Trainer" level by the North American Banding Council. The remaining six varied in banding experience, ranging from 5-10 years (2 people), to 10-20 years (2 people), and >20 years (2 people). I asked each person to view 20 color photographs of primary coverts and determine the age of the bird depicted in each image based on the information given in Pyle (1997a). I asked them to make an age determination even if they felt uncertain but to indicate that they were uncertain. All nine banders viewed the same set of images and I allowed them to refer to Pyle (1997a) while completing this task. I chose the 20 images randomly with the restriction that each image had to clearly show feather shape, edge color, and that the feathers not be in a condition that might alter its apparent shape or color (e.g., feathers could not be damp). Half of the images were of immatures and half of adults, although I did not communicate this fact to the nine banders. I presented the 20 photographs in random order.

Pyle (1997a) indicated that immatures have "narrow, tapered" outer primary coverts with "narrow, or no buffy-gray edging" whereas adults have "broad, truncate" coverts with "distinct and broad, rufous to pale rufous edging". If the shape, edge color, and width of these feathers are valuable indicators of age, then I expected that the nine banders would correctly identify age for >50% of the 20 pictures. I assessed the results using a one-sample Signed Rank Test (Zar 1999) in which I compared the median number of correctly aged pictures for the nine banders against a score of 10 correct (50%). If the banders scored >50%, this would indicate that they did better than if they had randomly guessed the ages and I would conclude that the character had some utility for determining age.

Rectrix shape. I investigated rectrix shape using the same methods as for primary covert shape. I asked the same nine banders to determine the age of birds depicted in 20 photographs, this time showing the outer three rectrices. As before, the banders were free to refer to Pyle (1997a) while determining the age of each bird depicted.

Pyle described the rectrix shape of immatures as "somewhat tapered" in contrast to that of adults which are "truncate". If rectrix shape is a reliable indicator of age, I again expected that the nine

banders would place >50% of the images into the correct age group and evaluated this using a one-sample Signed Rank Test (Zar 1999).

After summarizing the results of the banders' ageing of birds based on photographs of their outer rectrices, I wanted to further describe the range of Chipping Sparrow rectrix shapes. To do this, I compared photographs of rectrices to the shapes depicted in Pyle's (1997a) Figure 139B. This figure shows immature and adult rectrix shapes and Pyle specifically refers to the "B" subsection of it in his descriptions of Chipping Sparrow age groups. I classified the shapes of the outer three rectrices in each photograph as the closest matching shape in Pyle's figure. If the three feathers did not all have the same shape, I categorized them as the shape of the majority (i.e., two of three feathers). Because many were more tapering and pointed than shown in Pyle's figure 139B (more closely resembling the fall HY shape shown in Pyle's Figure 139A, but often even more tapering), I classified these into a third category. The resulting three categories, I will refer to as A-Immature, B-Immature, and B-Adult, depending upon which shape in Pyle's Figure 139 they most closely matched.

Supercilium color. Oberholser (1974) described the superciliary stripe of first winter Chipping Sparrows as being "not gray, but dull buff" on males and "more buffy (less grayish)" on females. This contrasts with the "grayish white" color on adults (Oberholser 1974). I classified the supercilium color of known-age birds as either buff or white. On some individuals, the supercilium was partially white and partially buff and these I classified as "mixed". I tested whether an association existed between age and the frequency of the three supercilium colors using a chi-square test (Zar 1999) with 2 degrees of freedom. I performed all statistical tests for this study using the program SigmaPlot version 12 (Systat 2011).

RESULTS

Crown color. I evaluated the crown scores of 84 immature and 84 adult Chipping Sparrows. I was unable to detect a difference between the median crown scores of adults and immatures (Mann-Whitney rank sum test, P = 0.12). Furthermore, the distribution of crown scores were similar for both age groups with each having all four of the possible scores (Fig. 1). I compared the crown streaking scores of 18 immatures and 18 adults. As with crown color, I failed to find a difference between the age groups (Mann-Whitney rank sum test, P = 0.16).

Molt limits in secondaries and rectrices. I examined the secondaries of 89 immature and 85 adult Chipping Sparrows. No adult showed an apparent molt limit in this tract, but 49 (55%) of the immatures did. The molt limits of the immatures indicated that some combination of the three tertials and sixth secondary had been replaced. The most common pattern was for secondaries 8 and 9 to have been replaced (Fig. 2).

I examined the rectrices of 81 immatures and 80 adults. Again, none of the adults showed a molt limit, but 22 (27%) of the immatures did. The only replaced feathers were rectrices at the center of the tail. The most common patterns were for one or both of the central pair of feathers to have been replaced (Fig. 3).

Primary covert shape and edge color. The nine banders correctly aged a median of 7 of the 20 pictures of primary coverts. This result did not differ statistically from a score of 50% correct (One-sample Signed Rank Test, P = 0.99). Individual banders ranged from 3 to 12 correct. Thus, even the best score only represented 60% correct. Despite the relatively low ability to correctly place pictures into the correct age category, banders nonetheless appeared to have relatively high confidence in their answers as evidenced by a median of just two answers about which they felt uncertain (range: 0-6).

Rectrix shape. The nine banders placed a median of 14 of the 20 pictures of rectrices into the correct age group. This result, 70% correct, was statistically greater than a median score of 50%. (One-sample Signed Rank Test, P <0.01) and scores ranged from 13 to 17 correct. The degree of certainty that banders felt was similar to that of the

primary covert task with a median of two answers about which banders felt uncertain and a range of 0-7.

I classified the rectrix shapes shown in photographs of the tails of 67 adults and 57 immatures according to Pyle's Figure 139. Only some adults showed the B-Adult shape. Although the rectrix shapes of all immatures matched the putative immature shapes (either A-Immature or B-Immature), many adults also showed these same shapes (Fig. 4). Indeed, 11 of 67 adults (16%) most closely matched the most tapering, pointed shape (A-Immature).

Supercilium color. Immatures and adults differed in the frequency of the three colors ($X^2 = 12.1$, $P < 0.01$). However, supercilium color was not useful for determining age as most individuals of both age groups had a buff-colored supercilium (Fig. 5). Furthermore, none of the three color patterns was shown exclusively by either age group (Fig. 5).

DISCUSSION

Some results of this investigation agreed with information in Pyle (1997a) whereas others did not. They supported the value of molt limits and the shape of outer rectrices to recognize immatures. Furthermore, some of the percentages given by Pyle (1997a) were in rough accord with those from my results. For example, Pyle (1997a) indicated that 6% of immature birds replace secondaries 6 through 9. In my sample, 1% had done so. Likewise, Pyle (1997a, 1997b) indicated that 27-32% of immatures replace one or two central rectrices and 27% of my sample had done so.

My results indicate that crown color, crown streaking, the shape and edge color of primary coverts, and supercilium color are all unreliable for determining the age of Chipping Sparrows in fall and winter. Another discrepancy relative to the information in Pyle (1997a, 1997b) was that I observed a much lower percentage of immatures with a molt limit in their secondaries than did Pyle (1997a), 55% versus 94%. This seems of practical significance because Pyle's relatively high percentage could lead one to think that the lack of a molt limit weighs heavily in favor of concluding a bird is an adult, but the lower percentage I found indicates that this same condition may be ambiguous with regard to age.

The results of this investigation indicate not only which characters to examine when attempting to determine the age of a Chipping Sparrow, but also their priority or order. I recommend starting with an examination of the secondaries because this is the most likely character to reveal that a bird is an immature. If one discerns no molt limit there, examine the middle rectrices next and then shapes of the rectrices and do not ignore the shapes of the central pair unless it is clear that both have been replaced.

One should still use caution when using rectrix shape to determine age for Chipping Sparrows and it is best considered a useful rather than reliable character. The nine banders in this investigation misclassified the ages of three to seven out of twenty sparrows based on rectrix shape alone. Although it is possible that they might have scored higher if first given training or practice with Chipping Sparrows, these errors likely stemmed from the overlap between age groups in rectrix shape. For example, I found that 28% of immatures and 61% of adults had the B-Immature shape. There is a degree of subjectivity involved in classifying feather shapes and it is possible that another observer might find less (or more) overlap in shape between age groups than I did. Nonetheless, the large overlap I found argues strongly for the existence of some significant degree of overlap. Rectrix shape is best considered a useful character for this species except when the shape is strongly truncate which I observed only in adults.

I found that 45% of immatures and all adult Chipping Sparrows lack molt limits in their remiges. For this relatively large proportion of these birds, the age of few could be determined by other means. For example, only 27% of immatures could be recognized by a molt limit in their rectrices and 22% of adults by the shape of their outer rectrices. This leaves many fall and winter Chipping Sparrows whose ages could only be classified as unknown before 1 January and AHY afterward based on the six characters I evaluated. However, it may still be possible to determine the

ages of some individuals based on a contrast in color and wear between the primary coverts and greater secondary coverts. According to Pyle (1997a), there could be a contrast between the two feather groups in immatures because the primary coverts are retained whereas the greater secondary coverts have been replaced in the preformative molt. Although I did not evaluate this character, I found it difficult to evaluate in Chipping Sparrows. I was confident of the existence of this contrast in relatively few individuals and felt uncertain in most cases. However, the more rapid wear and fading of the juvenile primary coverts relative to the formative greater coverts may make this molt limit more evident, and therefore more valuable for ageing, later in the winter or spring.

The technique of having experienced banders view pictures as a means to assess the usefulness of age or sex characters has great potential. One limitation of the technique is that viewing a picture may not always be equivalent to viewing a bird in-hand. One cannot smooth the tips of rectrices to get a better impression of their shape, for example. Nonetheless, the technique has several strengths, a major one being that characters can be evaluated in isolation from others so that the bander's judgement of one character cannot be influenced by knowledge (inadvertent or not) of another. Consequently, one can rank characters fairly according to their value. The technique also allows flexibility in presenting characters for evaluation. For example, if an investigator wants banders to view more than one character before assessing each bird, just as one would in an actual banding situation, then this could easily be accomplished by providing multiple pictures depicting several aspects of the same individual bird. Another strength of the technique is that numerous independent observers can view characters on the same set of birds in a standardized way. This is rarely possible, or even advisable, with live birds.

The banders who assisted with this investigation seemed to be relatively confident of their age determinations despite their relatively low accuracy. The small number of cases in which most of them indicated uncertainty provided evidence of this. This phenomenon might have significant implications for the accuracy of banders' age determinations in the field. It suggests that banders can differentiate feather shapes accurately and confidently. However, if feather shape does not reflect bird age as accurately as currently believed, then banders may be confidently assigning incorrect ages to some of the birds they band. The reliability of feather shape for determining age may vary among species and the subject warrants further investigation by banders. The methods I employed in this investigation may provide a potential model for such future investigations.

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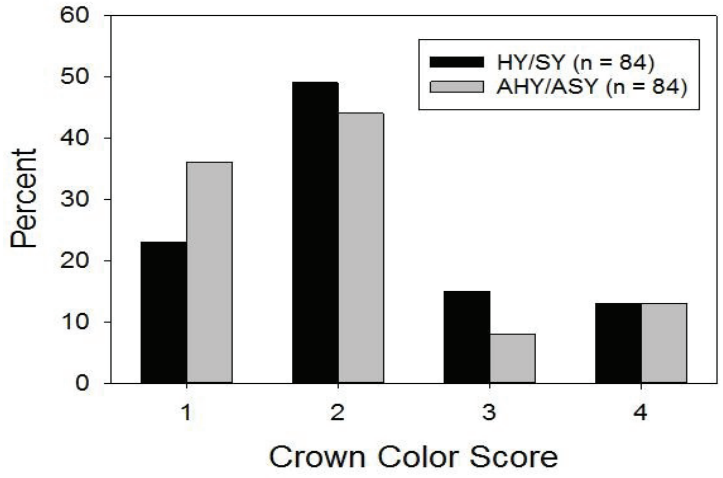


Figure 1. The distribution of crown color scores for adult Chipping Sparrows (basic plumage) was similar to that of immatures (formative plumage). Scores indicate the amount of rufous color in the crown (see text for details).

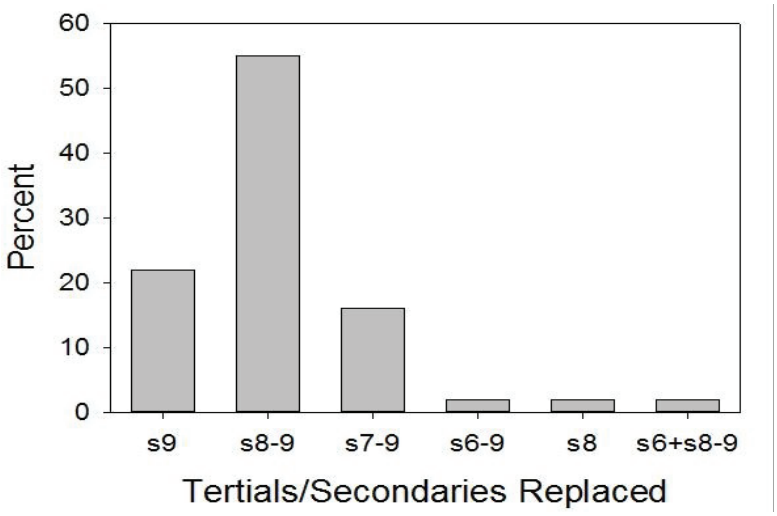


Figure 2. Molt limit patterns in the remiges of 49 Chipping Sparrows in formative plumage.

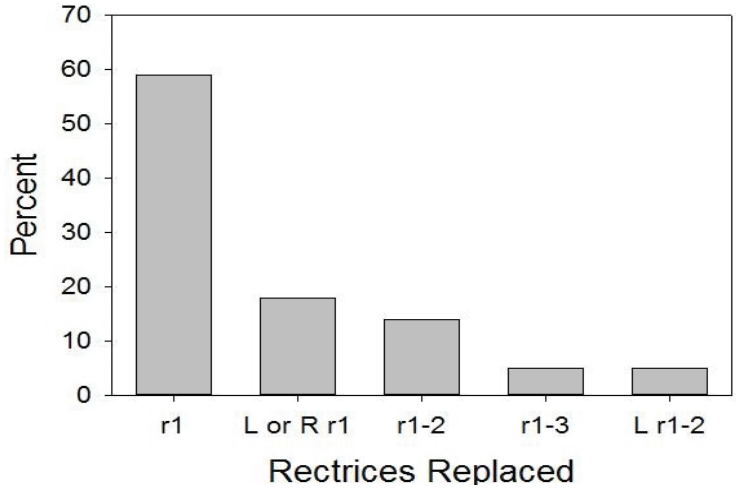


Figure 3. Molt limit patterns in the rectrices of 22 Chipping Sparrows in formative plumage. "L" or "R" indicate that rectrices only on the left or right side of the tail were replaced.

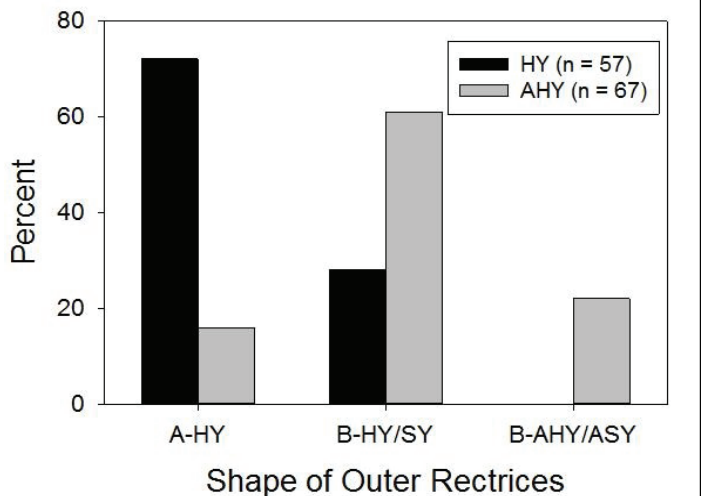


Figure 4. The shapes of the outer rectrices of adult Chipping Sparrows (basic plumage) overlapped with those of immatures (formative plumage). The three shape categories correspond to those depicted in Pyle's (1997a) Figure 139 and are labeled to match that figure with "A-HY" having a tapered and pointed tip, "B-HY/SY" having a tapered and rounded tip, and "B-AHY/ASY" having a truncate tip without taper.

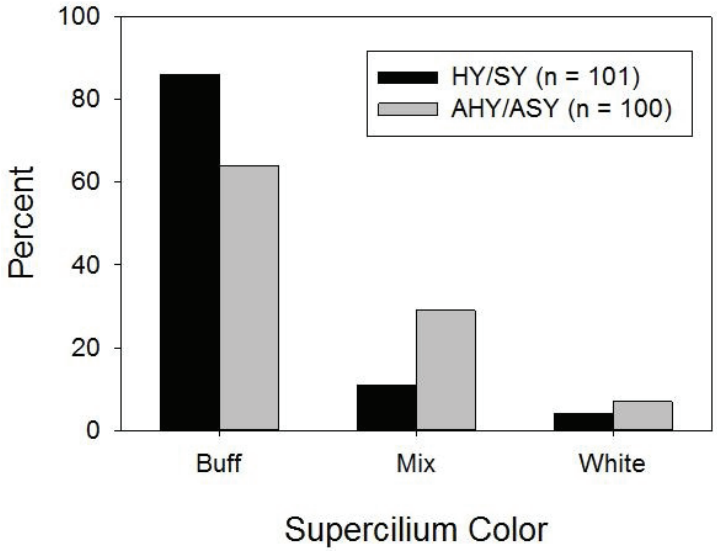
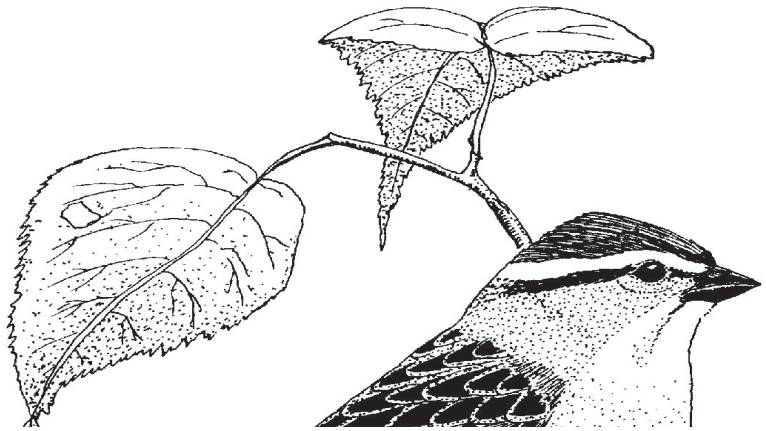


Figure 5. Supercilium color did not separate adult (basic plumage) and immature (formative plumage) Chipping Sparrows.



Chipping sparrow
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