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## ABSTRACT

*Ageing birds in the hand is a challenging technical skill that requires experience, objectivity, and careful observation. For a variety of reasons, we occasionally find Black-capped Chickadees* (Poecile atricapillus) *difficult to age. Pyle (1997) suggests that the degree of color of the upper mandible lining may be a useful characteristic for ageing. We tested whether mouth lining color can be used in the absence of a reliable skull or other diagnostic age characteristic. Mandible lining color in adults tended to be darker on a 1-5 ranked color scale (mean = 2.64 ± 0.15, n = 44) than juvenile birds (mean = 1.82 ± 0.08, n = 141) and a Welch's two-sample t-test resulted in a highly significant difference ($p < 0.001$) between groups. However, variation within groups was very high. Therefore, we recommend that banders use mandible lining color strictly as a complementary confirmation of age and never as a primary characteristic for ageing Black-capped Chickadees.*

## INTRODUCTION

Proper field identification of birds is critical for accurate data collection. Further, when birds are captured, information on age, sex, body condition, molt, morpho-metrics, and other characteristics can also be collected. Because age of birds is an important attribute often used in deriving metrics for tracking bird populations, it is critical to be well trained and collect accurate data on the age of captured birds. There are a variety of reliable characteristics that provide this data, such as extent of skull pneumatization, plumage characters, and molt patterns. However, seasonality and natural variation within species, subspecies, or age classes can complicate our ability to accurately assess age (Pyle 1997). In addition, many species are in need of more study, including Black-capped Chickadee *(Poecile atricapillus)*. Chickadees can be difficult to age accurately for several reasons, including the inability to determine skull condition because of thick and/or dark skin, cryptic or pseudo molt limits, and similar plumages among age classes (including juvenal).

There are several reliable ageing characteristics for Black-capped Chickadees, including extent of skull pneumatization (when visible), feather texture, or a sootier cap coloration in juveniles (Pyle 1997). These characteristics primarily divide Hatching-Year birds from After-Hatching Year birds in the summer and early fall, while the presence of retained windows and/or molt limits can assist with ageing birds as Second Year or After Second Year in the spring and summer. It is also possible to age chickadees by the amount of white in the outer rectrices. However, this plumage character should not be used alone, as birds with juvenal rectrices can opportunistically drop and replace tail feathers at any time that may appear more adult-like. Finally, upper mandible lining color may change as chickadees age, as in other species of the Paridae family. Upper mandible lining in Tufted Titmice *Baeolophus bicolor* darkens from grayish-pinkish or grayish-blackish in young birds to black in adult birds (Woodward 1975). Mountain Chickadee *Poecile gambeli* follow the opposite pattern where upper mandible lining changes from dark gray in young birds to white in adults (Pyle 1997). A study investigating Black-capped Chickadees in Montreal resulted in only weak evidence that mouth lining color may be related to age (Renaud et al. 2007).

Refining our ability to age Black-capped Chickadees could provide considerable potential for more precise estimates of survival as well as more power to determine threats to Black-capped Chickadees during their life cycle. Our study objective was to gather data on whether mandible lining color would serve as a reliable ageing characteristic.

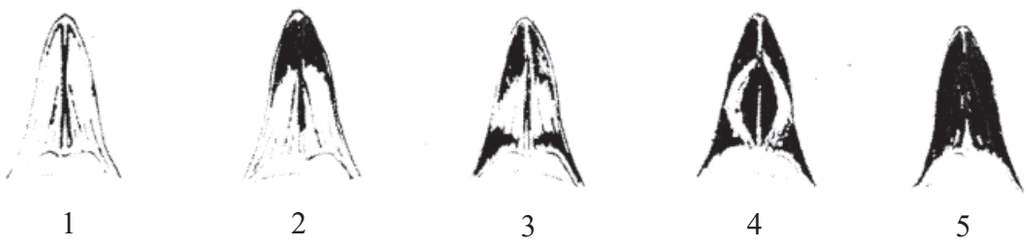


**Figure 1. Illustrative scale of mandible lining color scale from 1-5.**

**Figure 2. Upper mandible lining (scored as "3") of a Black-capped Chickadee.**

**Mouth Lining of Juvenile and Adult Chickadees**

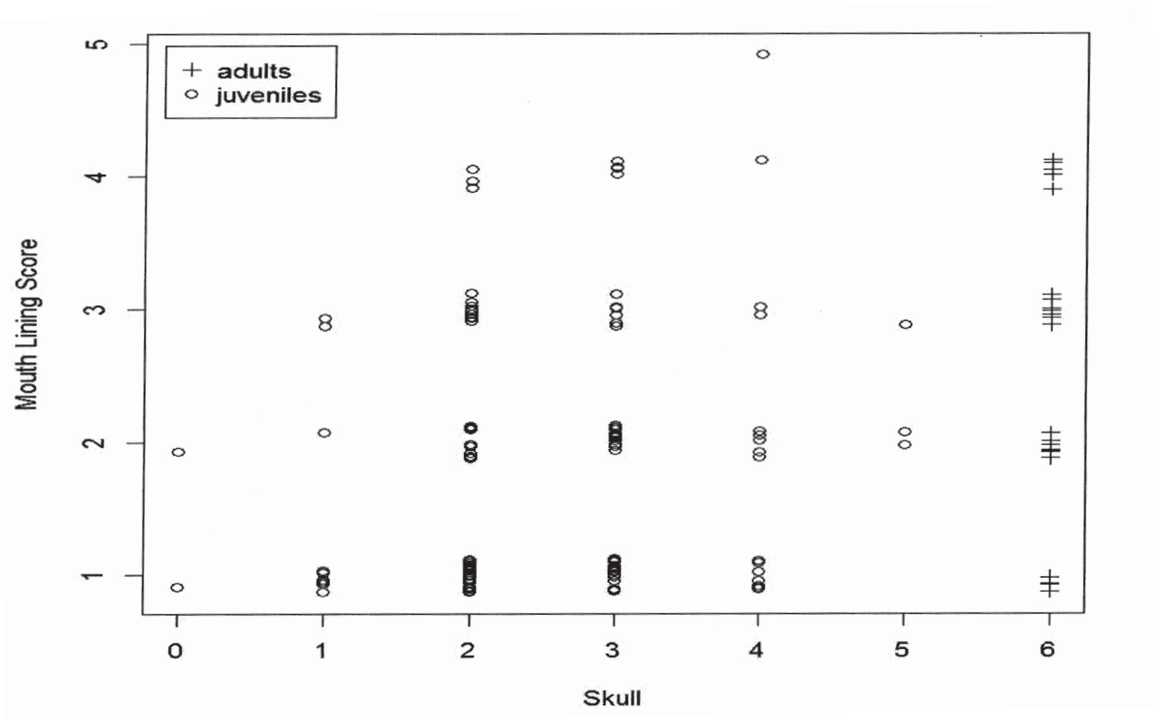


**Figure 3. Level of skull pneumatization and corresponding mouth lining color in adult and juvenile Black-capped Chickadees at western Montana banding sites.**

## METHODS

**Study area.** The University of Montana Bird Ecology Lab conducted migration bird banding during the fall season in the Bitterroot Valley, Missoula County, MT (46.7040N, -114.0416W). One site is located on the Bitterroot River floodplain, while two sites were located in vegetated upland woody draws. Although vegetative communities were dominated by different species and differed structurally, the most common tree species at banding sites included black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), aspen (*Populus tremuloides*), and occasionally ponderosa pine (*Pinus ponderosa*). The understory included a mix of grasses, forbs, and shrubs including willow (*Salix* spp.), rose (*Rosa* spp.), snowberry (*Symphoricarpos albus*), chokecherry (*Prunus virginiana*), red-osier dogwood (*Cornus stolonifera*), serviceberry (*Amelanchier alnifolia*), alder (*Alnus incana*), mock orange (*Philadelphus lewisii*), black hawthorn (*Crataegus douglasii*), and elderberry (*Sambucus nigra* ssp. *cerulea*). Elevation ranged from 968 m to 1174 m.

**Data collection.** We used standard mist-nets (12m x 2.6m, 30mm mesh) to capture and band both migrants and residents mid-August through mid-October, 2015 – 2017. We opened mist-nets 20 minutes before sunrise, closed five hours after opening, and checked nets approximately every 30 minutes, depending on conditions. We did not operate stations during adverse weather. We fitted all birds with a U.S. Geological Survey serially numbered aluminum band and collected age, sex, and other morphometric information. We collected additional data on mandible lining color of Black-capped Chickadees (n = 185). We used a categorical method of scoring the amount of silver vs. black coloration on the non-fleshy portion of the upper mandible. We used the following criteria for our scores: 1 (entirely light); 2(>50% light); 3(50/50); 4 (>50% dark); 5 (entirely dark) (Figure 1 and 2).

**Statistical analysis.** We used known-age Black-capped Chickadees for analyses using R program version 3.3.0. We calculated group means and standard errors, and conducted a Welch's two-sample t-test (Welch 1938) on adults vs. juveniles to detect any significant difference.

## RESULTS

We found that adults tended to have a darker mouth (color score $2.64 \pm 0.15$, $n = 44$) than juvenile birds (color score $1.82 \pm 0.08$, $n = 141$). Using a Welch's two sample t-test, we detected a significant difference in mouth lining color between adults and juvenile birds ($p < 0.001$), but variation within these age groups is relatively high (Figure 3). Birds in all age classes with known levels of skull ossification also presented mouth lining scores from nearly every category. For example, we found that 17.4% of adult birds had a mostly light mandible lining, and 8.0% of juvenile birds had a mostly or entirely dark mandible lining.

## DISCUSSION

Mandible lining color can be used to age birds within several families, including corvids, thrushes, and vireos, as well as some parids. While we found an association between age and mouth lining color in Black-capped Chickadees, we do not recommend using this characteristic alone. The high variability and significant overlap in mouth lining color between adults and juveniles demonstrate that this characteristic should not be used as an independent measure.

It is possible that sex may influence mouth lining color as well. However, we captured our birds in the post-breeding period and were rarely able to determine sex due to the lack of a cloacal protuberance or brood patch in this monomorphic species. Banding during the breeding season could result in a stronger association between mouth color and sex. Desrochers (1990) conducted a discriminant function analysis using wing, outer rectrix length, and weight to help determine sex of live Black-capped Chickadees with >90% accuracy, but did not use mouth lining color in his analysis. Confirmation of sex using genetic materials (e.g., feathers or blood) could most accurately fill in knowledge gaps as well.

There are other factors which could impact the timing and extent of mouth coloration change in Black-capped Chickadees, including differences

across populations, resource abundance, diet, condition of the bird, and other environmental or genetic factors. Again, we would likely benefit from examining mouth lining color at times outside of the post-breeding season to gain a more thorough understanding across seasons. We would both be able to track changes across time with known marked birds and potentially gain a better understanding of influences we have not tested. In the absence of a diagnostic age characteristic, such as extent of skull pneumatization, we believe that a univariate approach will not accurately separate young birds from older birds and that multiple measures must be considered. We recommend additional data collection on the upper mandible lining color in Black-capped Chickadees throughout the year to further refine this ageing technique.

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**Black-capped Chickadee by George West**