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Eye Coloration in Common Yellowthroat (*Geothlypis trichas*) to Determine Age

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ABSTRACT

We present a study on age determination of the Common Yellowthroat (Geothlypis trichas) *through the use of eye coloration, which is compared with other known aging criteria: skull ossification, preformative molt and shape of rectrices. From a sample of 300 birds, it has been determined that the use of eye color is one of the most reliable criteria to determine the age of this species during fall. It is recommended that one gains experience observing captured birds to establish the characteristic.*

INTRODUCTION

Although the change of eye color in the iris of several species of birds in relation to their age has been known for some time (Wood 1969, Rosenfield and Bielefeldt 1997, Geupel and Ballard. 2002, Ash 2004, Guallar et al 2009), the use of this criterion has been generally underutilized for passerine birds. Guallar et al. (2009) document the possibility of using eye color as a method of "aging through semi-quantitative variables". In many passeriformes species, such as Brown Thrasher (*Toxostoma rufum*) (Nichols 1953), Dark-eyed Junco (*Junco hyemalis),* White-throated Sparrow (*Zonotrichia albicollis*) (Yunick 1977), and Green-tailed Towhee *Pipilo chlorurus* (Leukering 2000), the eye coloration criterion can be used readily to differentiate young birds from adults, at least during fall when the iris color difference between young and adult birds is evident. Techniques used to determine eye color go from empirical techniques (Guallar et al. 2009) to the use of references such as Munsell Book of Color (1973) or, more recently, the use of a digital technique (Garrod 2014).

From a total of the 73 passeriforme species treated in their publication, Guallar et al. (2009) reported 25 species in which the use of iris color to determine age of individuals is reliable. Guallar et al. (2009) reported 48 species in which iris color to determine age was not recommended, including the Common Yellowthroat.

Previous observations of specific characteristics of Common Yellowthroats *(Geothlypis trichas)* allowed us to note prominent age-related differences in eye coloration: dark gray in young birds and light brown in adults. Based on this observation, we determined and compared the age of individuals by using different characteristics independently, among these, eye color. The goal of this study is to corroborate that eye color in Common Yellowthroat is not only a valid but also a complementary characteristic to determine age in this particular species.

Study Area - Santa Alejandrina Swamp Monitoring and Banding Station (OAPSA) is located in Minatitlan, Veracruz, Mexico (17°59'27" N, 94°30'38" W) (7 m above sea level), in the coastal plains of the Gulf of Mexico. This site is characterized by wetlands with reed marshes and

savannah. The area corresponds to the narrowest part of the country, which could represent the neck of the funnel for the migration routes of birds. Large numbers of Common Yellowthroats are captured (1393 individuals in 2011 and 1604 in 2012) at OAPSA, an excellent location to conduct this study.

METHODS

From 17 Sep to 23 Oct 2011, an extensive analysis of the characteristics that allow for age determination (Pyle 1997) of Common Yellowthroats was carried out. Both 10 standard mist nets (Ralph et al. 1996) and nocturnal sound lures played from 02:00 to 10:00 (Grahbauer et al. unplubished ms) were used to capture birds. The nets were opened for four hours, starting at sunrise. All individuals were marked with an aluminum band with a unique number that allows for individual identification. Each banded bird was aged, sexed and a number of morphometric measurements were taken (wing chord, weight). Three characteristics were used to determine age: a) degree of pneumatization or skull ossification, b) molt of the primary coverts, greater coverts, and flight feathers, and c) rectrice shape, as tapered or truncate (Pyle 1997), molt, wear, and presence of growth bars. Independently, eye color was recorded for each bird. The determination of eye color was done through direct observation, by the same bander in charge to avoid potential bias1 of interpretation; however, on more than half of the samples, a second and even third reviewer on the part of other banders and assistants that extract the birds from the nets, were made, with the same results. This was done in order to corroborate whether the observed coloration of the eyes of the Common Yellowthroat on the part of the bander in charge could be noted by someone else. Due to the scarcity of references on the subject and considering that the few published studies are based on relatively small sample sizes, compared to the number of captured birds in this field station (OAPSA), we did not rely on any studies to classify the color of the bird's eye, but rather based it on our own personal knowledge and experience on the color of the eye of birds of a known age, on the part of the bander.

The birds were classified as Hatching Year (HY) when they showed a) partial cranial ossification, b) partial wing feather molt (Pyle 1997, and c) first generation tapered rectrices and/or presence of typical young growth bars (Pyle 1997). Independently, individuals were classified as young when they showed dark gray eye color.

Birds were classified as After Hatching Year (AHY) when they showed: a) complete skull ossification, b) complete wing feather molt, and/or c) basic generation (truncate) rectrices. Birds which showed light brown irises were classified as adult. Every ageing characteristic was determined independently by the same bander and checked with at least half of sample by one or two other banders confirming the age determination and ultimately compared among them to judge which of these criteria was the most reliable to age this species. It is important to note that in order to avoid the tendency to favor the age determination technique through eye coloration, this information was the first characteristic registered, after which wings, tail, and skull were examined and noted, thus preventing data bias. Ageing through skull ossification was used as the basis of comparison, since this is the most reliable characteristic during the fall to separate young birds from adults, before complete skull ossification. It is known that skull ossification can be completed as of early October; however, during the period of this study, ossification windows were visible in the skulls of most of the young birds, which made this a good characteristic for comparison, as well as the plumage of individual males, which most of them already presented an incomplete mask. There was a small probability that a HY bird may have completed ossification of the skull during the study period if it had hatched from the earlier brood.

Differences of explanatory variables between aging criterion and bird groups was evaluated with the Chi-test (Zar 2010).

RESULTS

A total of 340 individuals were captured (303 new captures and 37 recaptures). In order to do the comparative analysis of the aging criteria, a sample of 300 individuals, including new birds and recaptures, of Common Yellowthroat was used. The other 40 birds that were not included were individuals captured during busy waves of capture. Thus, there was no time to record all aging criteria.

Table 1 shows how the 300 individuals were classified based on the other three different aging criteria. As a result of the analyses of skull ossification of 300 individuals, 151 were classified as AHY birds and 149 as HY birds.

whose skull was not ossified, that was classified as an adult. As for the other two characteristics, the margin of error was greater, mainly when using tail shape, molt and wear. The error rate for eye color was 0.7%, 3.5% for wing, and 18.2% for tail (Table 2). With regard to tail shape and wear, there were two individuals (1.4% of total) which did not show definite characteristics that could allow the bander to age them as either young or adult birds.

The six missing individuals that are shown as young birds in Table 2 were excluded because

Table 1. Results obtained through each of three criteria used to determine age in Common Yellowthroat.

Skull Ossification		Eye Color		Wing Molt	Rectrices
Adult (AHY)	151	Adult	145	139	119
		Young	6	11	20
		Unknown	0	1	12
Young (HY)	149	Adult	1	5	26
		Young	148	144	115
		Unknown	0	0	2
		Without Date	0	0	6
Total	300		300	300	300

Table 2. Individuals with incomplete skull ossification and complete data set on age criterion. Ageing by skull ossification of HY birds compared to eye color, wing feather molt, and rectrices shape.

Skull		Eye			Wing		Rectrices	
Young (HY)	143	**Age**	**No.**	**%**	**No.**	**%**	**No.**	**%**
		Adult	1	0.7	5	3.5	26	18.2
		Young	142	99.3	138	96.5	115	80.4
		Unknown	0	0	0	0	2	1.4
Total	143		143	100	143	100	143	100

Taking just the birds classified as HY based on incomplete skull ossification, we found the following results compared to the other characteristics (Table 2): The characteristic used for ageing, which most closely matched the results of skull ossification, was the use of eye color. Consequently, eye coloration, in contrast with wing feather molt and shape and molt of rectrices, is reliable for ageing. There was a single bird, some of the data for aging characteristics for these birds are not complete. In Table 2 it is evident that between eye color, wing feather molt, and rectrices, the most reliable aging characteristic according to this study is eye color which was significantly different when compared to the other two characteristics (chi-square test. $x^2=280.04$, df=3) to the other two characteristics.

However, the wing feather molt (chi-square test, x^2=257.04, df=3) and rectrices shape characteristic (chi-test, x^2=148.71, df=3) were also significantly different.

DISCUSSION

In a demographic analysis, it is estimated that, with a margin of error below 5% of the population, a single characteristic can be used for that purpose (Pyle 1997). Eye coloration and wing feather molt are within this interval. Both techniques are not only comparable but also complementary. It is clear and recommended that retrix shape, molt and wear alone should not be used as a reliable characteristic (18% error) when aging Common Yellowthroats, but it can be used as an complementary characteristic.

Guallar et al. (2009) do not recommend the use of eye color for this species; however, their sample size was composed of only 39 birds. In the particular case of OASPA, the large number of individuals that were captured permitted us to better observe the intra-specific variations. It also allowed us to gain more experience and facilitate the interpretation of eye coloration. In this regard, we consider that in some species, such as vireos, the change in eye-color is more evident (Pyle 1997, Guallar et al. 2009), while in other species, such as Fox Sparrows (*Passerella iliaca*) (Garrod 2014) or Common Yellowthroats, these variations tend to be less obvious, thus requiring the bander to know the species' morphology. We propose that the eye color is a reliable characteristic for ageing Common Yellowthroat and, at the same time, we recommend that banding teams should carefully observe the changes in eye coloration in different species within the different age categories, before using this characteristic in a general manner.

Due to the high number of captured birds at this station, the differences noted by the bander in charge, which were reviewed by the other banders and assistants, was simpler, since it allowed the comparison of two or more individuals at the same time. Just as age determination by molt or skull ossification, the use of this characteristic for ageing birds, requires a certain basic knowledge and experience in ageing for more accuracy, on the part of the bander. It is important to stress the fact that this eye color ageing technique is most effective during the fall season, when this study was carried out, since it gets more complicated at other times of the year, like during spring migration. Keeping this in mind, eye coloration ageing characteristics can be applied in a reliable way, with sufficient experience, using other characteristics as well to determine the age of a bird. One final note on the way climatic conditions might influence the observation of eye color: just as in other ageing characteristics, when there is insufficient light, or in the opposite case, when there is an excess of light, this may change color perception, so the bander must keep this in mind under such conditions when analyzing what he sees in order to determine the age of a bird.

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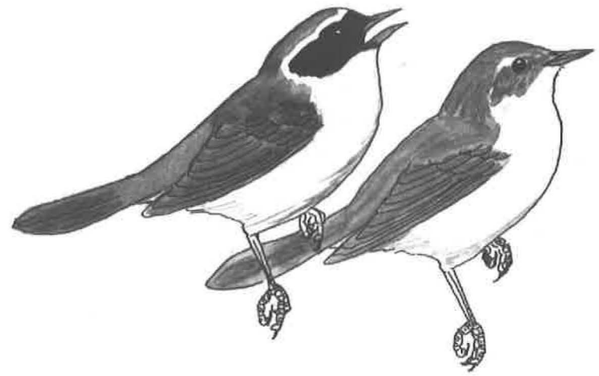

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