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RELIABILITY OF AGING CRITERIA BY FEATHER CHARACTERISTICS OF EASTERN BLUEBIRDS

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Abstract.—Using criteria described by Pitts (1985), three observers used shape and color of the tenth primary wing coverts of 328 Eastern Bluebirds, *Sialia sialis,* to assess the accuracy and inter-observer consistency of these aging criteria. Independent scores were identical for 73.5% of all birds from which coverts were collected, with significantly higher concordance for males than for females. Collective discussion of each feature in dispute resulted in agreement on 92.1% of the individuals. Independent scoring of coverts from 28 known-age females and 27 known-age males resulted in mean accuracy rates of 78.6% and 86.4%, respectively. Following discussion of contested scores, observers arrived at a consensus evaluation on all but one individual. For consensus scores, observers correctly aged 96.3% of males and 89.3% of females. These results indicate that aging criteria are accurate for male Eastern Bluebirds with the standard required for recommendation by the Canadian Wildlife Service and U.S. Fish and Wildlife Service (1977), but aging of females using these criteria is not as reliable. For studies in which accurate determination of the age of female Eastern Bluebirds is critical and in which independent estimates of age from banding data are not available, it is suggested that researchers collect coverts for aging and have multiple observers assign the individuals to age categories.

LA CONFIABILIDAD DE LOS CRITERIOS PARA SEÑALAR EDAD EN BASE A CARACTERÍSTICAS DE LAS PLUMAS EN *SIALIA SIALIS*

Sinopsis.—Usando los criterios descritos por Pitts (1985), tres observadores usaron la forma y el color de las plumas de la décima cubierta primaria del ala en 328 *Sialia sialis* para comparar la exactitud y la consistencia entre los observadores al usar estos criterios. Las notas independientes fueron idénticos en 73.5% de todas las aves de las cuales se coleccionaron las cubiertas, coincidiendo significativamente más al evaluar los machos que las hembras. Discusiones colectivas sobre cada pluma en disputa resultaron en acuerdos sobre 92.1% de los casos. Notas independientes de cubiertas de 28 hembras y 27 machos de edad conocida resultó en tasas de exactitud de 78.6% y de 86.4% respectivamente. Después de discutir las notas sobre las plumas en desacuerdo, los observadores llegaron a un concenso en todos menos un ave. En notas de concenso, los observadores correctamente llevaron un 96.3% de las plumas de los machos y un 89.3% de las plumas de las hembras a la edad correcta. Estos resultados indican que los criterios de edad son exactos para machos de *Sialia sialis* con las pautas requeridas por recomendación del Servicio de Vida Silvestre Canadiense y del Servicio de Pesca y Vida Silvestre de los E.E.U.U. (1977), pero el estimar la edad de las hembras usando estos criterios no es tán confiable. Se sugiere que los investigadores coleccionen cubiertas para analizar edad y que tengan varios observadores que lleven las aves a categorías de edad estimadas en estudios donde la determinación de edades de *Sialis sialis* sea crítica y en los cuales estimados de edad independientes provenientes del análisis de anillas no estén accesibles.

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Eastern Bluebirds, *Sialia sialis,* can be assigned to age categories using the shape and color of tenth primary wing coverts, which are apparently not molted with the remainder of the juvenal plumage (Pitts 1985). After-second-year (ASY) individuals of both sexes are identified by distinctly pointed tenth primary coverts that show some blue in the pigmented areas surrounding the rachises. Coverts of second-year (SY) birds have frayed edges and blunt or uneven tips. The coverts of most SY birds lack any blue coloration, although in some SY males they may appear indistinctly blue upon careful inspection. An accuracy of ≥95% is required for recommendation of an aging technique (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977). The purpose of this study was to evaluate independently the reliability of this aging technique on another population of Eastern Bluebirds.

STUDY SPECIES AND METHODS

Eastern Bluebirds are sexually dichromatic thrushes (Family Muscicapidae) easily assigned to sex by reference to plumage variation (Pinkowski 1974 and pers. observ.). They are secondary cavity nesters, breeding on our South Carolina study sites in nesting boxes that we provide for them. We have monitored these breeding populations continuously since 1985, and PAG monitored the populations previously from 1977 to 1982.

During three breeding seasons (1986–1988) we collected the tenth primary coverts from the right wings of 153 male and 175 female adult Eastern Bluebirds as part of our routine sampling, which included banding for other studies (e.g., Gowaty and Bridges 1991). After collection, we mounted each feather on a microscope slide with a label indicating the USDI number of the individual from which the covert was collected, its sex, and the date and location of collection. Each author then independently assigned each individual to a second-year (SY) or after-second-year (ASY) age class using the aging criteria described in Pitts (1985). All three authors had extensive previous experience with bluebird specimens but did not have prior experience with the aging methodology used in this study. After scoring, we compared our evaluations and discussed nonmatching results, attempting to reach consensus on all individuals.

We had captured and banded 28 females and 27 males in previous years, allowing us to categorize them as known SY or ASY individuals. We then compared our individual and composite evaluations of age with the known age of each bird.

RESULTS AND DISCUSSION

All three observers concurred on the age class assignments of 73.5% of the coverts collected. The level of concordance was significantly higher ($G = 8.58$, df = 1, $P < 0.005$) for males (81.0%) than for females (66.9%). Following discussion of initial observations, we attempted collectively to age each contested individual by further consideration of the aging criteria. We reached a consensus on assignments of 92.1% of the individuals, with no difference between males and females ($G = 0.21$, df

= 1, $P > 0.5$). From our composite scores, we recorded 100 SY (62.5%) and 60 ASY (37.5%) females and 82 (57.7%) SY and 60 (42.3%) ASY males.

To check the likely accuracy of the scores for our entire sample, we applied the aging criteria to a subset of known-age birds. Our subset of known-age birds consisted of 19 ASY and nine SY females and 16 ASY and 11 SY males. We independently agreed on the same age classifications of 21 known-age males (77.8%) and 17 known-age females (60.7%). Individual observer accuracy ranged from 81.5 to 88.9% (mean = 86.4%) for males and 67.9–89.3% (mean = 78.6%) for females; however, our consensus scores were correct for all except one ASY male (96.2%) and three females (89.3%; two ASY and one SY), with no consensus reached for the age of one male.

SY birds that lose and replace coverts between molt periods may be expected to be mis-identified as ASY the following year, whereas ASY feathers may deteriorate and be erroneously classified as a result of excessive wear, fading or ectoparasitic load. As wearing of feathers may be associated with age, our errors may have been correlated with the timing of collection of the coverts. Of the four incorrectly assigned and one unassigned coverts, however, two were collected in May and one each in April, June, and July, thus failing to suggest any seasonal effect. Furthermore, we did not find any overall association between the month that coverts were collected and the concordance of ages recorded by each observer ($G = 0.01$, df = 1, $n = 328$, $P > 0.9$).

All observers identically scored three of the four coverts that were classified incorrectly. Three of the feathers contained features that suggested conflicting classifications. The mis-classified male covert was distinctly blue in its pigmented region and had a narrow white border but was clearly frayed at the tip. The SY female was incorrectly classified because the tip of the covert was clearly pointed, although the feather lacked any discernible blue pigment. One ASY female was originally identified correctly by two observers based upon the presence of blue pigmentation in the feather but was later given a composite classification of SY because the tip was distinctly rounded. The other ASY female covert, mis-classified by all three observers, was slightly frayed at the tip and did not exhibit any blue coloration. In cases of conflicting evidence, we generally used the shape of the covert tip as the principle indicator of age (Pitts 1985), unless the shape was considered ambiguous.

Our consensus scores are more accurate than our individual scores. This suggests the possibility that even though the criteria are simple, observer reliability increases with experience. We also believe that this indicates the differential abilities of some observers to see all the appropriate variation at once; in particular, individuals with ground/background perceptual difficulties probably will apply the criteria less well than individuals without such perceptual anomalies.

The results lead to the following conclusions for application of the aging criteria offered by Pitts (1985). Male Eastern Bluebirds can be re-

liably assigned to age class using the shape and color variation of the tenth primary wing covert, although acceptable reliability of this technique (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977) is variable among observers and may require consensus scoring by multiple observers. As female Eastern Bluebirds are apparently more difficult to age using these criteria, observers should evaluate the effect of potential error in aging on any results that depend upon the criteria in Pitts (1985). Specifically, we recommend scoring by multiple observers, which generally will be facilitated by collection of coverts, to increase the reliability of this method of age classification.

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