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Test of the Plumage Characteristics Used to Sex Golden-cheeked Warblers in the First Basic Plumage

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ABSTRACT

While the Golden-cheeked Warbler (Setophaga chrysoparia) *is sexually dimorphic in adult plumage, a large degree of overlap exists within the plumage characteristics used to determine sex for hatching-year Golden-cheeked Warblers in first basic plumage. During the 2009 breeding season, we collected blood samples from 10 hatching-year Golden-cheeked Warblers and compared their actual sex as determined by DNA analysis to their presumed sex as determined by plumage characteristics described in Pyle (1997). For all samples, the DNA analysis confirmed the sex determination based on plumage characteristics. These results provide strong evidence that plumage characteristics alone can be used to reliably determine the sex of Golden-cheeked Warblers in first basic plumage.*

INTRODUCTION

The Golden-cheeked Warbler *(Setophaga chrysoparia) is* a federally endangered migratory passerine. Currently, it is known to breed in the juniper-oak *(Juniperus ashei - Quercus spp.)* woodlands of 25 counties in central Texas (Pulich 1988, Ladd and Gass 1999). In the non-breeding season, this species migrates along the Sierra Madre Oriental of eastern Mexico (Ladd and Gass 1999). It overwinters in the Central American pine-oak *(Pinus* spp.- *Quercus* spp.*)* forest region, which is located throughout the highlands of the Sierra Madre and extends from southern Mexico to northwestern Nicaragua (Ladd and Gass 1999).

The first prebasic, or preformative (Howell et al. 2003), molt of Golden-cheeked Warblers begins within two to three weeks after the young leave the nest and occurs on the breeding grounds (Gass 1996). This molt includes the median and greater secondary coverts (hereafter "greater coverts") and the body feathers (Pyle 1997). While Golden-cheeked Warblers in juvenal plumage cannot be sexed reliably by plumage characteristics, Pyle (1997) describes variation in the amount of black mottling in the chin and throat, the amount of black

in the centers of the back feathers and upper tail coverts, and the presence of black shaft streaks in the median coverts as sexing criteria for individuals of this species in subsequent plumages. However, a large degree of overlap exists within these characteristics for hatching-year (HY) Golden-cheeked Warblers in first basic, or formative, plumage; approximately 5 - 75% of this group can be sexed reliably using these characteristics. It has proven difficult to examine the reliability of these sexing criteria because HY Golden-cheeked Warblers are difficult to capture before migration, as well as at stopover sites and on wintering grounds. Our objective was to further examine the reliability of these criteria for this group by comparing the presumed sex of HY Golden-cheeked Warblers in first basic plumage as determined by the plumage characteristics given in Pyle (1997) to their actual sex as determined by DNA analysis.

METHODS

We collected blood samples from ten HY Golden-cheeked Warblers on Fort Hood Military Reservation in central Texas in June and July 2009 (for detailed descriptions of Fort Hood see Eckrich et al. 1999). We used recorded vocalizations of Golden-cheeked Warblers, Black-capped Virèos (*Vireo atricapilla),* and Eastern Screech-Owls *(Megascops asio)* to aid in capturing these birds in mist nets. After capture, we banded each bird and determined the presumed sex using plumage characteristics described in Pyle (1997). Seven of these birds had completed their first prebasic molt. The remaining three individuals were in the last stages of this molt with only a small patch of juvenal plumage remaining on the nape. We used isopropyl alcohol to clean the middle toe nail of the bird, our hands, and the cutting surface of a fingernail clipper. Using the fingernail clipper, we removed approximately 50% of the length of the toe nail to induce bleeding. We transferred the blood to a 12-mm diameter circle that was printed on a paper sample card and covered 75% of the circle with the blood sample. This task took approximately two and a half minutes. We recorded the band number on the card. After the sample dried, we stored it in a transparent zip-loc plastic bag. We applied pressure to the clipped toe nail to stop the bleeding. Each bird flew away normally.

Because of the chromosomal differences between the two sexes of birds, males being monogametic and females being heterogametic, sex can be determined using molecular techniques. Avian Biotech International (1336 Timberlane Road, Tallahassee, FL 32312) determined the sex of the birds that we sampled using a method described by Fridolfsson and Ellegren (1999) to amplify DNA samples using polymerase chain reaction and examine them using agarose electrophoresis.

RESULTS

Based on plumage characteristics, we presumed the sex of five of the ten HY Golden-cheeked Warblers to be male and the other five to be females. Sex determination by DNA analysis agreed with sex determination by plumage characteristics in all cases. Differences in plumage between the sexes of the ten birds that we sampled included the amount of black in the centers of the back feathers and upper tail coverts, the amount of black mottling in the chin and throat, and the presence of black shaft streaks in the median coverts. The back feathers and upper tail coverts of males had relatively distinct, moderately large black centers; whereas, the back feathers and upper tail coverts of females had indistinct, small black centers. The median coverts of males had black shaft streaks; whereas, the median coverts of females had black triangular centers. The chin and throat of males were white or yellow with black mottling; whereas, the chin and throat of females were white or yellow with little to no black mottling.

DISCUSSION

The perfect correspondence between the presumed sex determined by plumage and actual sex determined by DNA analysis demonstrate that the sex of HY Golden-cheeked Warblers in first basic plumage can be determined reliably using the plumage characteristics described in Pyle (1997). Males in first basic plumage have relatively

distinct, moderately large amounts of black in the centers of their back feathers and upper tail coverts, black shaft streaks on their median coverts, and white or yellow in the chin and throat with black mottling. Females in first basic plumage have an indistinct, small amount of black in the centers of their back feathers and upper tail coverts, black triangular centers on their median coverts, and white or yellow chins and throats, with little or no black mottling.

Our study demonstrates that it is possible to determine the sex of Golden-cheeked Warblers using plumage characteristics at nearly all times of their life cycle as they complete their first prebasic molt within a month of fledging (Gass 1996). This is important information for studies that take place on the wintering grounds or along the migration route, especially if males and females demonstrate different migratory behaviors. For example, results of studies examining the ratio of male to female Golden-cheeked Warblers at winter sites have been mixed (Vidal et al. 1994, Rappole et al. 1999). If sex ratios of this species vary among winter sites, then its continued existence depends upon protecting specific sites where each sex overwinters. Hence, further studies using plumage characteristics to determine the sex of Golden-cheeked Warblers at different sites across the wintering range are needed.

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