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ABSTRACT

Because mouth color is known to be useful for distinguishing hatching-year and adult individuals of several vireo species, I evaluated its utility for ageing and sexing the Black-capped Vireo (Vireo atricapilla). *I examined mouth roof color in 440 individuals of this species from April to September at Fort Hood Military Reservation in central Texas. The mouth color of females remained constant, but that of males changed in late June and early July. Before this change, the sexes differed completely with the upper mandible lining of males being extensively black and that of females being pink and gray. After the color change of males was complete, the sexes differed only in the color of the posterior portion the roof of the mouth. Also, some overlap existed then such that the sex of all individuals could no longer be determined based on mouth color alone. I found no evidence of mouth color differences between second-year and after-second-year birds. However, hatching-year birds differed from adults. The upper mandible linings of the young birds were extensively whitish, whereas those of adults were not. Overlap in color between these ages groups existed so that the age of some individuals could not be determined correctly based on mouth color alone.*

INTRODUCTION

In some passerine birds, variation in the color of the roof of the mouth (upper mandible lining or palate) has been shown to indicate sex, age, or dominance status (Heinrich and Marzluff 1992, Pyle 1997). Because the significance of mouth color has been investigated for relatively few species, this character may provide useful information for many more species. For example, mouth color has been shown to be a useful age character for five *vireo* species and Pyle (1997) suggested that it may be useful for many others, including the Black-capped Vireo (*Vireo atricapilla*). I examined the mouth color of Black-capped Vireos to determine the utility of this character for determining age or sex. Specifically, I addressed four questions: (1) Does mouth color of adults change during the time that the species is on its breeding grounds? (2) Do the mouth colors of males and females differ? (3) Do the mouth colors of second-year (SY) and after-second-year (ASY) individuals differ? and (4) Do the mouth colors of hatching-year (HY) individuals and adults differ?

METHODS

From 2005 to 2009, I examined the mouth colors of 440 Black-capped Vireos that I captured at Fort Hood Military Reservation in Bell and Coryell counties, TX. This total included 283 adult males, 121 adult females, 20 HY males, and 16 HY females. Capture dates ranged from early April to late September and spanned the period from the species' arrival on its breeding grounds to its departure on migration southward. I determined the sex of captured birds based on plumage and the presence of a brood patch (Pyle 1997). I determined the age of birds based on plumage, eye color, contrasts between the primary and greater secondary coverts, or previous capture.

I noted the color of the upper mandible lining of each individual. Although, as a single observer, I avoided the variation in perception and labeling of colors that could occur among different observers, I used a relatively simple color classification that I believe could be applied consistently among observers. I considered any gray color similar to the leg color of the Black-capped Vireo to be "gray." Various shades of pink from medium to dark, I labeled "pink." and called a variety of very pale colors "whitish." These included off-white colors appearing to have weak tints of pink, gray, or yellow.

I found that the colors of the posterior and anterior sections of the roof of the mouth often differed. Consequently, I recorded the color of each area separately. A "V"-shaped ridge on the roof of the mouth marked the boundary between them. In the Black-capped Vireo, the tip of this "V" points forward with each arm trailing posteriorly. When viewed from the side of a bird's bill, the tip of the "V" is approximately even with the external nares. I considered the area of the upper mandible lining anterior of the tip "V" to be the "anterior mouth" and the remaining area to be the "posterior mouth."

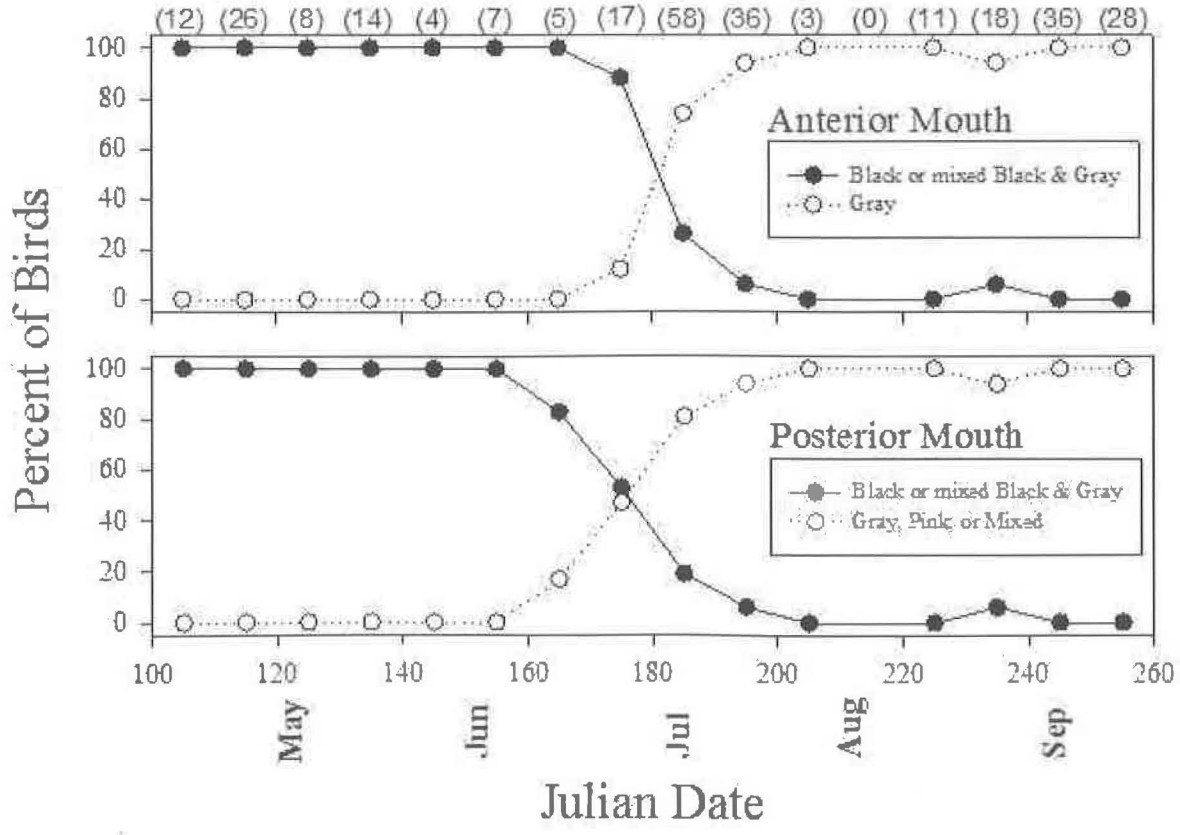
I used z-tests to assess differences in proportions of given mouth colors between age or sex groups (Glantz 2002) and accomplished these analyses using the program SIGMASTAT (SPSS Inc. 2003).

RESULTS

Does mouth color change during the time that the species is on its breeding grounds?

The mouth color of adult males, but not females, changed over the season. From April through mid-June, the color of the entire upper mandible lining of most males was black (Fig. 1). By mid-July, this had changed to gray on the anterior mouth and to gray, pink, or a mixture of the two on the posterior mouth (Fig. 1). Females showed no corresponding color change. Throughout the season, nearly all females (99%) had an anterior mouth color of gray. The posterior color was more variable, but for most females this area was either solidly pink (63%) or a mix of pink and gray (26%). I looked for evidence that the posterior mouth of females changed color over the season by

Fig. 1. The roof of the mouth of the adult male Black-capped Vireo changed color while the birds were on their breeding grounds at Fort Hood, TX. Circles on the graphs indicate the percent of males observed with the initial and final mouth colors during 10-day periods from mid-April to mid-September. Separate graphs show the color change for the anterior and posterior portions of the upper mandible lining. Labels for each month are positioned below the first day of each month and sample sizes for each period are indicated in parentheses along the top of the figure.



comparing birds captured before male mouth color changed (i.e., Julian day 160) to those captured after the change in male mouth color (i.e., Julian day 200). However, I was unable to detect a difference between these time periods in the proportion of females for which the posterior mouth was pink, the most common color (z-test, z = -0.06, P = 0.95).

Do the mouth colors of males and females differ?

Before the color change that occurred in adult males (i.e., Julian day 160), I examined 80 adult males and 30 adult females. The mouth colors of the sexes were distinctly different at that time. Ninety-one percent of the males had an entirely black anterior mouth and the remaining 9% had at least some black in this area. In contrast, no adult females showed any black on the anterior mouth. Instead, this area was completely gray in all but one individual. Adult males and females also differed in the color of the posterior mouth during this time. In most males (99%), this area was entirely or partially black; whereas, in females it was pink (60%) or mixed pink and gray (33%). I never observed a female with black on any area of the upper mandible lining.

After the color change was complete for males (i.e., Julian day 200), I examined 97 adult males and 31 adult females. At this time, the color differences between the sexes were greatly reduced. Most individuals had an anterior mouth color of gray (99% for males and 97% for females). The posterior mouth color was also gray in most (63%) males, but it was pink in most (55%) females. However, this area was pink in a few males (3%) and gray in some females (6%). Furthermore, many individuals of both sexes had a posterior mouth that was a mix of gray and pink (32% of males and 23% of females).

I observed no difference in the mouth color of HY males and females (n = 20 and n = 16, respectively). The predominant color for both the anterior and posterior mouths of this age group was whitish. I failed to detect a difference in the proportion of individuals with this color between the sexes for either the anterior (z = 0.79, P = 0.43) or posterior mouth (z = 0.39, P = 0.70).

Do the mouth colors of SY and ASY differ?

For both male and female Black-capped Vireos, I found no difference in the mouth color of SY and ASY birds. I compared the two age groups of males only before mouth color began to change in mid-June (i.e., 160). During this period, I noted the mouth color of 34 SY males and 45 ASY males. The proportion of males with anterior mouths that were not solidly black was not detectably different between the age groups (z = 0.39, P = 0.70). I obtained the same result with the posterior mouths of the males (z = 1.43, P = 0.15). All females of both age groups (30 SY and 65 ASY) had gray anterior mouths. The proportion with posterior mouths that were not solidly pink did not differ between the age groups (z = 0.85, P = 0.40).

Do the mouth colors of HY and adults differ?

I did not capture HY Black-capped Vireos until late June (Julian day 172) and only compared their mouth color to adults captured on or after this date. Hatching-year birds had whitish color somewhere on the roofs of their mouths more frequently than adults. Only 2% of adults (n = 302) had whitish on the upper mandible lining, whereas 89% of HY vireos (n = 36) had this color (z = 15.09, P < 0.001). When whitish color was present in adults, it was usually present on the posterior mouth.

DISCUSSION

I found that the upper mandible lining of adult male Black-capped Vireos changed color while they were on their breeding grounds. In contrast, the mouth color of females remained constant. During most of the breeding season (April to mid-June), mouth color of males was completely or mostly black. By mid-July, the mouths of most males had turned to gray with no black at all.

The mouth colors of adult male and female Black-capped Vireos differ in a manner similar to that noted between the sexes of the Yellow-breasted Chat (*Icteria virens*; Dennis 1958). During the breeding season, the mouths of males were extensively black, whereas those of females were

gray with some pink on the posterior mouth. After male mouth color changed in July, the sexes were similar in color. However, males usually had a posterior palate that was gray, whereas females were typically pink in this area. Thus, the mouth color change of males did not simply represent color reverting to the same color as the female.

Pyle (1997) distinguished between "reliable" and "useful" age/sex characters. Depending on the date, mouth color can be either for the determining the sex of the Black-capped Vireo. From their arrival on the breeding grounds until mid-June, mouth color is reliable, that is, the sex of greater than 95% of individuals can be determined by this character alone. The presence of black on the upper mandible lining is reliable for indicating a male at any time, as I never observed a female with this color. The latest that I observed a male with some black was 25 Aug, although this was exceptional because the second latest date was 10 Jul. From July through September, there was much overlap in mouth color between the sexes, although posterior mouth color remained a useful character, that is, 50% to 90% of individuals could be separated based upon it.

Because the Black-capped Vireo is sexually dimorphic in plumage color, it may seem that mouth color would have no added utility as a character for sex determination. However, every year I observe a few individuals with intermediate plumage as well as others whose plumage is similar to that of the opposite sex. In such cases, an additional character is valuable. For example, in late March 2009, I captured an individual with just such intermediate plumage. By plumage alone, I could not determine whether it was a male-like female or a female-like male. At that date, it was too early for a female to have developed a brood patch and so that character was useless. However, mouth color easily allowed me to determine that this bird was male.

I found no mouth color differences between SY and ASY vireos, but did find differences between HY vireos and adults. Similar age differences in mouth color have been previously noted for Blue-headed (*V. solitarius*), Cassin's (*V. cassinii*), Plumbeous (*V. plumbeus*), Philadelphia (*V. philadelphicus*), and Red-eyed vireos (*V. olivaceus*; Pyle 1997). Apparently, Black-capped Vireos achieve definitive adult mouth color during their first year of life and this occurs either while they are on their wintering grounds or shortly before. I noted that most HY Black-capped Vireos had extensive whitish color on the roof of their mouths before the end of September. Few adults had this color, but enough HY birds had adult mouth color at that time that this character is useful rather that reliable for ageing this species. It is usually possible to recognize HY Black-capped Vireos based on plumage or eye color. However, a few adults (particularly females in fresh basic plumage) can be similar to HY birds and, having an additional age character like mouth color could occasionally prove valuable.

It is unclear whether mouth color of the Black-capped Vireo across its entire range varies in the same way that it does at Fort Hood. The species ranges from Oklahoma in the north through central and west Texas and south into the Mexican states of Coahuila, Nuevo Leon, and Tamaulipas (Wilkins et al. 2006). The most likely difference among populations could be in the timing of the change of male mouth color. In central Texas, this change began in June and completed by mid-July. During this period most nesting activity ended. If the mouth color change is linked to the cessation of nesting, then populations that differ in the timing of nesting could also differ with respect to the timing of mouth color change.

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An Efficient and Effective Method for Sealing Darvic Color Bands

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ABSTRACT

Five methods to seal Darvic® color bands placed on Tricolored Blackbirds (Agelaius tricolor) *were evaluated. A small electric soldering iron plugged into a voltage inverter attached to an automobile battery was found to more rapidly and reliably seal color bands than the other methods tested and appears to provide an excellent method to seal even large numbers of color bands.*

INTRODUCTION

Colored leg bands are one of the simplest, most effective devices used to mark individuals uniquely to allow their subsequent identification in the field. Several types of plastic colored legs bands have been used for decades on a variety of species (Marion and Shamis 1977); and despite potential problems with storage (Jones 2002) and durability (Minton 2000, Hazlitt 2001), color leg bands of polyvinyl chloride (PVC, trade name Darvic®) have been preferred for long-lived species due to their resistance to fading (Anderson 1980; Ward 2000). However, despite their advantages, the rapid and reliable attachment of Darvic® bands to the bird's legs has been problematic, with some field workers reporting various problems, including band losses and foot injuries (Nisbet 1991).

In 2007, I began to color-band Tricolored Blackbirds (*Agelaius tricolor*) in California as part of a study to document spatial and temporal movements and fidelity to breeding colonies. I utilized Darvic® bands because they are reported to be more durable and color-fast compared to celluloid plastic bands (Anderson 1980; Nisbet 1991). Given the need to trap and band relatively large numbers (thousands) of birds, I required an efficient and effective method to seal the color bands to ensure their long-term attachment to the birds.

I evaluated five methods of sealing the Darvic® color bands and found the most efficient and effective method to be melting the band across the butt-end gap with a small electric soldering iron plugged into a voltage inverter attached to an automobile battery. Preliminary results suggest that bands so attached cannot be removed by the birds and remain attached to the birds' legs.

METHODS

Tricolors were banded at three locations in California's Central Valley in 2007 and 2008 (details of banding locations available in Meese 2007, 2008). Each bird received three bands: one size 2 USGS aluminum butt-end band attached to the left tarsus and two 4-mm inside diameter plastic bands of different colors ("Darvic®" size XBD bands; Avinet, Inc., P.O. Box 1103, Dryden, NY 13053-1103). The plastic bands were sealed in place to prevent their subsequent removal as Tricolored Blackbirds are known to be able to remove plastic leg bands (pers. obs.).