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## ABSTRACT

*I evaluated the information in Pyle (1997a) for determining the age and sex of the Black-capped Vireo* (Vireo atricapilla). *Additionally, I described two new age/sex characters as well as the timing and extent of brood patch development and the range of iris colors in this species. My results agreed with Pyle (1997a) concerning the width of the green edging on the primary coverts, but disagreed to some extent concerning head plumage pattern, rectrix shape, and primary covert shape. As was previously known, age and sex groups differed in their head plumage patterns, but more overlap existed among age groups than has been previously described. For adults, only the extreme patterns were reliable for determining sex, but many patterns were reliable for separating hatching-year males and females. For separating second-year (SY) and after-second-year (ASY) individuals, head pattern was useful for males, but unreliable for females. Head pattern was not reliable for separating hatching-year (HY) and after-hatching-year birds (AHY). Rectrix shape was unreliable for separating SY from ASY but useful for separating HY and AHY. The shape of primary coverts was not reliable for separating any age groups and was sometimes opposite the description in Pyle (1997a). A previously unknown character, breast color, was reliable for separating the sexes of all age groups with females having extensive pale buff color and males white. Another new character, rictus color, was reliable for separating HY and AHY birds. In HY, this color was pale yellow or flesh not matching any color on the bill whereas it was gray or black on adults and matched a bill color. These results reveal that much remains to be learned and I encourage banders to evaluate age and sex characters for species they frequently capture.*

## INTRODUCTION

The guides authored by Pyle (1997a, 2008) currently provide the most complete compilation of information for determining the age and sex of North American birds and represent a major advance in knowledge for banders. Although this information is widely used, much of it has received little critical evaluation. Pyle (1997a) encouraged banders to update information in his guides regardless of whether it is "contradicting, additional, or supporting information". Furthermore, he particularly urged banders to collect data concerning molt and molt limits (Pyle 1997a, 1997b). Banders who handle large numbers of a species or who frequently recapture individuals are particularly well positioned to evaluate the existing information and add new material. My objective in this investigation was to evaluate the information given in Pyle (1997a) for the Black-capped Vireo (*Vireo atricapilla*) as well as to add new age and sex characters for this species.

The Black-capped Vireo was federally listed as endangered in 1987 (Ratzlaff 1987). Because of this status, the species has been monitored and studied extensively at several locations throughout its breeding range in the United States. For example, annual monitoring has been ongoing at Fort Hood Military Installation (hereafter, "Fort Hood") since 1987 (Tazik et al. 1993). At this site, habitat management and the removal of Brown-headed Cowbirds (*Molothrus ater*) resulted in a population increase from less than 200 males in 1988 to over 8,700 in 2018 (Cimprich 2018). Populations have also increased at other sites, prompting the U.S. Fish and Wildlife Service to delist the species in 2018 (U.S. Fish and Wildlife Service 2018a). Delisting removes the requirement for special authorization to capture and band Black-

capped Vireos (B. Peterjohn, pers. comm.) and this, combined with increased populations, makes this species arguably more accessible for study by banders than at any time in the past. Furthermore, there is a continued need to monitor the species. U.S. Fish and Wildlife Service developed a post-delisting monitoring plan for the species that calls for continued monitoring of abundance and nest parasitism until 2030 (U.S. Fish and Wildlife Service 2018b). Such efforts would be aided by banding and individually marking these birds.

## METHODS

I conducted this investigation in Bell and Coryell Counties, Texas, at Fort Hood from 2004 to 2017. I captured Black-capped Vireos by luring them into mist nets with broadcasts of the songs and scolding calls of conspecifics, Eastern Screech-Owls (*Megascops asio*), White-eyed Vireos (*Vireo griseus*), and Black-crested Titmice (*Baeolophus atricrisatus*).

To evaluate the usefulness of sex or age characters, it was necessary to examine individuals of known sex or age. For this, I needed a means to ascertain age or sex other than by using the character being evaluated. Much reliable information was already available for sexing Black-capped Vireos at the start of the investigation. For example, it was well known that the plumage of this species is sexually dimorphic such that males have mostly black heads and females gray (Grzybowski 1995). It was also known that only females fully develop a brood patch (Pyle 1997a). So, initially, I could safely determine the sex of adults showing the extremes of head plumage and brood patch development and consider these to be known-sex birds. I could determine the sex of others by observing behavior because I marked many of the birds individually with colored leg bands. Thus, I considered individuals that sang to be males and those that paired with presumed males to be females. Initially, these methods allowed me to accumulate a sample of known-sex birds. Later, after I had determined that breast color reliably indicated sex (details in Results section), I was also able to use this character to recognize known-sex birds.

I used several means to identify known-age birds. For example, many were recaptured in a calendar year after the one in which they were originally banded. Thus, I could consider any bird that was banded as an adult in a previous year to be age after-second-year (ASY) and any that was banded as a nestling the previous year to be age second-year (SY). To determine the age of adults captured for the first time, I used a character described by Pyle (1997a), namely the presence or absence of a molt limit between the outer greater coverts and the inner primary coverts. At the beginning of this investigation, I examined the reliability of this character using 206 known-age adults (i.e., recaptured birds). For all of these birds, the presence or absence of this molt limit correctly indicated age and so I considered it to be a reliable age character.

I needed other characters to recognize known hatching-year (HY) birds. Iris color was previously known to be reliable for separating HY from adults (Pyle 1997a) as was mouth color (Cimprich 2009). The combination of these characters provided the basis for identifying known HY in my sample.

***Head Pattern***. Pyle (1997a) described differences between male and female Black-capped Vireos in their nape and crown color (hereafter, "head pattern"). Early in my experience with the species, I observed that intermediate birds existed whose sex was not apparent from their head pattern. In this investigation, I sought to clarify the range of variation by describing the head pattern of a large sample of birds of known sex and age. I also describe head pattern as a character to determine the sex of HY.

The forehead, crown, nape, and auricular region of Black-capped Vireos can be either black or gray. The extent of black versus gray varies among age and sex groups (Grzybowski 1995). I categorized these into six head patterns as shown in Figure 1. Sometimes, the black feathers of the head have gray edges or tips which abrade away over time. I considered these partially gray feathers to be equivalent to completely black feathers. Not all individuals exactly matched the patterns as depicted in Figure 1, but I classified each as the

most similar pattern. Patterns 3 and 4 showed the most variation. For pattern 3, birds varied in how much of the light colored area of the lores and around the eyes was bordered by black, but all had some black border present. For pattern 4, birds varied in the amount of black across the anterior portion of the crown, but all had some black in this area. Birds showing the other four patterns varied only slightly (pattern 5) or not at all (patterns 1, 2, and 6).

***Brood Patch***. Pyle (1997a) listed the presence of a brood patch (hereafter, "BP") as a character to identify females. I sought to further clarify this information by describing the timing of female BP development. Although I did not intentionally target females for capture during the time they were laying eggs, I captured a few inadvertently. There were 13 females whose nests I was monitoring and that I also captured around the time they began laying their first clutch of the season. These females provided information about brood patch development in relation to the laying of the first egg of the breeding season.

Male Black-capped Vireos develop a partial brood patch (Pyle 1997a). Early in my experience with this species, I noted individuals whose sex was not readily apparent because of their intermediate head patterns. For this reason, I began to check for a brood patch on every bird I handled, even those with obvious male plumage. Although I seldom recorded these observations, I nonetheless comment here on the range of male brood patch development I saw.

***Breast Color***. This is a new character for determining sex. When banding known-sex Black-capped Vireos, I noticed that breast color seemed to depend on sex. Later I learned that Ragsdale (1880) had also noted the same color difference in nine adults he had collected. To determine the reliability of this character, I noted breast color on 291 females and 451 males from 2010 to 2017.

***Feather Shape***. Pyle (1997a) indicated that the shapes of outer rectrices and primary coverts are useful for determining the age of Black-capped Vireos. To test the value of these characters, I asked the assistance of nine experienced banders. Four of these banders had considerable experience banding Black-capped Vireos having banded an average of 353 each (range = 111 to 648). The remaining five banders had no experience with this species but had banded for several decades and three held certification at the Trainer level by the North American Banding Council. I asked these people to view images of rectrices and coverts and to determine the ages of the birds depicted based on the information in Pyle (1997a). All images depicted known-age birds. I could then judge the value of these characters by the percentage of images that the banders' correctly aged. I used a one-sample Wilcoxon signed rank test (Zar 1999) to determine if the banders scores differed from 10 answers correct (50%), the expected score if they had randomly guessed each age. I used the program, SigmaPlot (Systat Software 2011) to calculate the results of this test. If the banders exceeded 50% correct to a degree that was statistically significant (i.e., $P \leq 0.05$), then I would conclude that the character had value for determining age.

I asked the nine banders to view four sets of 20 images. Two sets were digital photographs of the outer two rectrices, one showing SY and ASY birds in the spring (April and May) and the other showing HY and after-hatching-year (AHY) birds in the late summer (August and September). The remaining two sets were images of primary coverts from each of these same two time periods. For all sets, I randomly chose 10 images of each age group from the hundreds that I have photographed during this study to make up each set of 20 images and presented them in random order. I did not inform the banders that half of images represented each age group.

In addition to feather shape, the photographs of primary coverts showed other characters relevant to age including the contrast in color and wear with adjacent feathers and the amount of green edging on feathers. I wanted to isolate covert shape from these other characters and so I made an image of the feather outlines by tracing the photographs. To do this, I first printed enlarged photographs so that the primary covert group would be 8-12 cm

wide on the paper. I then traced the outlines of the coverts from each photograph using tracing paper, then photographed the tracings and presented the resulting images to the banders (see Fig. 2 for an example).

I asked the banders to make an age determination for every image (i.e., either SY or ASY for the spring images or HY or AHY for the late summer images). In cases where they felt uncertain, I asked that they make the best determination they could and also record that they were uncertain about the answer.

***Width of Green Edge on Primary Coverts***. Pyle (1997a) indicates that Black-capped Vireos in their first plumage cycle have narrower yellow-olive (hereafter, "green") edgings on their primary coverts than older individuals. I checked the value of this character for determining age by measuring the green edges on these feathers. The apparent width of this green edging depends on how strongly the barbs of each covert curve toward the feather's tip and this can change moment by moment as one opens or closes the wing. The stronger the curve, the narrower the apparent green edge. Thus, it was necessary to obtain measurements that did not depend on this curve.

I focused on individual barbs, the feather elements that extend obliquely from both sides of a feather's central shaft. I measured the total length of barbs as well as the amount of that length that was green, then expressed the amount of green as the percentage of total barb length. To accomplish this, I began with digital photographs of the primary coverts (Fig. 2). I then enlarged these on the screen of a computer so that individual barbs would be 30-90 mm long on the images. I next used dial calipers to measure the image on the screen. Because I used percentages, data were comparable regardless of the exact degree of enlargement on the computer screen. I measured five barbs for each bird on coverts 3-5 (counted from the innermost covert), usually 2 barbs each on coverts 3 and 4 and one on covert 5. I chose barbs that appeared to have the greatest extent of green and whose endpoints were clearly visible in the image. Finally, I used the mean from these five measurements to represent that individual bird.

Two comparisons of covert edge width were of interest, namely SY vs. ASY in the spring (April and May) and HY vs. AHY in the late summer (August and September). I used Mann-Whitney tests (Zar 1999) to make comparisons between ages and the ranges to assess overlap between groups and again used the program, SigmaPlot (Systat Software 2011), to calculate the test results.

***Iris Color***. I noted that eye color was more variable than described in Pyle (1997a). I recorded iris color for most HY. However, I seldom recorded it for adults, but did examine the iris of most and so am able to comment on the range of adult iris colors.

***Rictus Color***. I recorded the rictus (gape flange) color of 33 HY and 38 adults (SY, ASY, and AHY). I noted only the color of the external area that is visible when the bill was closed.

## RESULTS

***Head Pattern***. Age and sex groups differed in their range of head patterns (Fig. 1). As expected, males tended to have more extensive black than females and older birds tended to have more black than younger ones. However, considerable overlap existed among groups. For example, among adults (i.e., SY and ASY), the amount of black on some females was as extensive as that of many males. Also, a small number of adult males showed relatively little black like most females. Overlap also existed between SY and ASY birds within each sex. For example, 87% (99 of 114) of SY males showed a pattern in which the nape was the only gray area (pattern number 5 in Fig. 1), but so did 11% (17 of 158) of ASY males. The overlap in head patterns between SY and ASY females was almost total. The greatest variation was shown by HY males with some individuals showing each of the six patterns. In contrast, HY females were the least variable group showing only two patterns.

***Brood Patch***. The latest that I observed a female with no BP development was on the day she laid the second egg of her first clutch. I also observed

three more with no BP development on the day before they laid their first egg. I observed none with a complete BP before they initiated egg laying but on two individuals the skin had started to wrinkle 2 and 3 days before they laid their first egg. On both of these birds, however, the area that would eventually become the BP was still covered with down.

Females developed a brood patch in April and early May. The earliest I have observed a fully developed brood patch was 14 April. The area of the brood patch remains featherless and thus recognizable until early in the prebasic molt when down starts to grow again in the ventral apterium although the edema and vascularization disappear well beforehand. The latest that I have observed this remnant brood patch was 11 August.

To date, I have never handled a male that entirely lacked down in the ventral apterium in the area where the brood patch would develop. Furthermore, I have not observed males with other than smooth, transparent skin in this area with the purple color of the underlying muscle showing clearly through. No males had any detectable edema, wrinkling, increased vascularization, or opaqueness as is characteristic of the skin of females with full brood patch development.

***Breast Color***. I noted the breast color of 291 adult females and 521 adult males from 2010 to 2017. The breast color of all of the males was white whereas it was light buff on all of the females. On one female, the buff color was limited to the center of the breast, but it extended completely across the breasts of all others. I noted that the buff color was especially pale on 19 females. This occurred mainly (16 of 19 birds) in mid-June to late July immediately before and during the early stages of the prebasic molt when these feathers would be in their most worn and faded state. When the breast feathers are new in August and September (48 females observed), the buff color was very distinct and never pale.

From 2007 to 2107, I noted the breast color of 85 HY males and 92 HY females. For most males, this area was white, but 11 (13%) had some buff color. On these males, the buff was pale and usually limited to a small area of the breast. On one, however, the buff color extended in a narrow band across the breast leaving most of the breast white. All HY females had buff colored breasts. The color on these birds was very distinct, covering the entire breast and often extending into the throat. Although I did not note its frequency, the lores and light areas surrounding the eyes was also buff on many of these HY females.

***Feather Shape***. The median number of correct age determinations for the 20 images of outer rectrices in the spring was 9. The highest scoring bander got only 12 correct. This result was not statistically different from a score of 50% correct ($T+ = 12$, $T- = 24$, $P = 0.46$). This was accompanied by an apparent high level of confidence in the answers. The median number of images for which the banders felt uncertain about age was one. Banders were more successful with the late summer images of rectrices. For these, the median number correctly aged was 17 and the maximum 18. This result did exceed a 50% correct score ($T+ = 45$, $T- = 0$, $P < 0.01$). The median number uncertain for this group was zero.

The nine banders did poorly at determining age based on the shape of primary coverts regardless of season. For the spring images, the median number of correct age determinations was 8 and the maximum 12. For the late summer images, the median was 11 correct and the maximum 12. In both cases, the scores did not differ from 50% correct (for spring and late summer respectively, $T+ = 8$, $T- = 20$, $P = 0.38$ and $T+ = 19.5$, $T- = 16.5$, $P = 0.84$). Despite the low scores, banders appeared confident in their determinations with medians of one and zero uncertain answers for spring and late summer, respectively.

***Width of Green Edge on Primary Coverts***. SY and ASY birds ($n = 23$ and 20, respectively) differed in covert edge width ($U = 3.0$, $P < 0.01$). Also, their ranges showed only limited overlap, 29–52% for SY and 48–63% for ASY. Similarly, HY and AHY birds differed ($U = 18.0$, $P = 0.02$), but the degree of overlap was greater (39-55% for HY and 47-66% for AHY).

***Iris Color***. Although I did not record data on adult iris color, I have observed that it differed from that of HY Black-capped Vireos. I have seen red, orange, and red-brown adult irides. In contrast, HY eyes usually lack reddish tones at least as late as 16 September, the last date on which I examined an HY. Of 149 HYs, 136 (91%) had brown irides similar to the color of milk chocolate. Nine (6%) had gray-brown eyes. The remaining 4 (3%) were red-brown. The birds with the red tones were relatively late in the season, one on 20 July and the three others in August.

***Rictus Color***. On 32 of 33 HYs, rictus color was pale yellow or pale flesh, not matching any of the colors on the bill. The remaining HY had a gray rictus and was captured relatively late, 21 August, but none of six others captured from 18 August to 16 September showed this color.

The rictus color of 37 of 38 adults was entirely black or gray, colors that matched that of at least part of their bills. Only males during the peak breeding season, April to mid-June, had black rictuses although some males were gray at this time. After mid-June, all males had gray rictuses as did all females. One adult female had a rictus that was mostly the typical gray but was also partially flesh-colored.

**DISCUSSION**

Pyle (1997a) distinguished between "reliable" and "useful" age or sex characters. Reliable characters are those that, alone, correctly indicate age or sex in >95% of individuals. Useful characters correctly indicate age or sex of 50-95% and, consequently, must be used in concert with other characters. I classified characters in these same terms. Additionally, I refer to characters that separate <50% of individuals as "unreliable".

***Head Pattern***. I found this character to be useful overall for determining the sex of Black-capped Vireos, but reliable in some instances. Among adults, pattern six was only shown by males whereas patterns 1-3 were only shown by females. The sex of adults with these patterns can thus be determined accurately based on this character alone. Nonetheless, enough individuals of both sexes showed patterns 4 and 5 to render this character, by itself, insufficient for determining the sex of birds showing those two patterns. Similarly, I found head pattern to be useful overall for determining the sex of HY Black-capped Vireos, but reliable for recognizing most males.

Despite the overlap in their head patterns, male and female HY Black-capped Vireos differed in the shade of gray on their heads. For males, this color was slate gray, like that of adult females. On HY females, this color was green-gray, distinct from males and contrasting less with the color of their green backs. Color differences among HY were also noted by Grzybowski (1995) who wrote that presumed males have "distinctive gray caps" whereas presumed females have "indistinctly gray caps with some green feathering". Pyle (1997a) notes that HY Black-capped Vireos in formative plumage have a nape color that has "little or no contrast" with the back color. However, I found that this minimal contrast applies only for HY females. HY males show as much contrast as any adult. No previous author mentioned that HY males have any black at all on their heads. However, 69% in my sample showed substantial black (i.e., patterns 4-6) (Fig. 1).

For separating SY and ASY birds, head plumage was useful for males, but unreliable for females. Although most ASY males showed no gray, 12% of SYs also had this same pattern. Similarly, most SY males had gray only on the nape, but so did 12% of ASYs. These percentages indicate that the chance of misclassifying an adult male's age based on head plumage alone is too great for this character to be considered reliable. This result contradicts Pyle (1997a) who indicated that ASY males have a crown and nape that is "uniformly glossy black". My results more closely match Grzybowski (1995) who wrote that <10% of SY males can have a "complete to almost completely black caps" (similar to pattern 6) and that <5% may even have gray extending to the forehead (like pattern 4). Head pattern should not be used as the sole basis for judging the age of males.

Although SY and ASY females showed a near complete overlap in patterns, it was evident that

the older birds had a greater tendency to show more extensive black. Others have reported that older females of other passerine species sometimes have plumages that are more male-like (e.g., Lynch et al. 1985, Stutchbury and Robertson 1987).

Grzybowski (1995) noted that some males have a gray nape until their second breeding season (i.e., age third-year). I observed gray-naped males that were even older than their third-year with gray napes, including a fourth-year and a seventh-year. The nape feathers of these individuals were not merely gray tipped or edged, but completely gray. Apparently, the definitive plumage of some individuals features a gray nape that never becomes black with increasing age.

***Brood Patch***. Knowing the maximum extent of BP development in male Black-capped Vireos can help banders separate male and female Black-capped Vireos. My observations, though not systematic, indicate the males at most lose some, but not all, of the down in the ventral apterium. The skin maintains the smooth, transparent quality it has at other times of the year. This is easily distinguished from the full BP that females develop. It is worth noting that females apparently fail to develop a BP on rare occasion. I have observed two SY females with no evidence of a BP in late May. It is possible that these individuals had laid no eggs that year at the time of their capture.

***Breast Color***. This character is reliable for determining the sex of adult and HY Black-capped Vireos. The pale buff breast color on females is usually apparent and is especially obvious in direct comparison to males. This buff color sometimes extends to the throat, lores, and the light areas around the eyes, especially on HYs. Although the buff breast color of the female is noticeable in-hand, it is not always apparent when viewed from a distance through binoculars.

The combination of breast color and head pattern was reliable for determining the sex of HYs. This was apparent when I recaptured adults that I had previously banded (and determined their sex) as HY. For 34 such birds (27 males and 7 females), the sex I determined when each was age HY agreed with the sex I determined when they were adults.

***Feather Shape***. The shape of the outer rectrices is useful for separating HY and AHY Black-capped Vireos in the late summer and probably for some time afterward. Banders in this study still incorrectly aged 2-4 late summer birds out of 20 based on rectrix shape alone and so I recommend combining this character with others when attempting to separate HY and AHY. Difficulties with HY rectrix shape may arise from feather replacement. I have observed that HY often are growing one to several rectrices in a random pattern that suggests regrowth of accidentally lost feathers. The replaced feathers have truncate tips like adult feathers rather than tapering to a point like juvenile feathers. It is best to examine several rectrices to avoid confusion.

Rectrix shape proved unreliable for separating SY and ASY Black-capped Vireos in the spring. HY Black-capped Vireos depart from the breeding grounds with pointed rectrices yet return the following spring with ones that are rounded at the tip. It is unclear whether this change is brought about by wear, molt, or a combination of both.

My results indicate that primary covert shape is unreliable for determining the age of Black-capped Vireos at any time. The shapes of these feathers seem to vary little among individuals. One exception is that a few individuals have distinctly pointed coverts (Fig. 3). I have not collected data to indicate how frequently such birds occur, but these individuals are typically ASYs in the spring or AHYs in the late summer and early fall. This is opposite Pyle's (1997a) description of covert shape for this species and, indeed, for many passerine species.

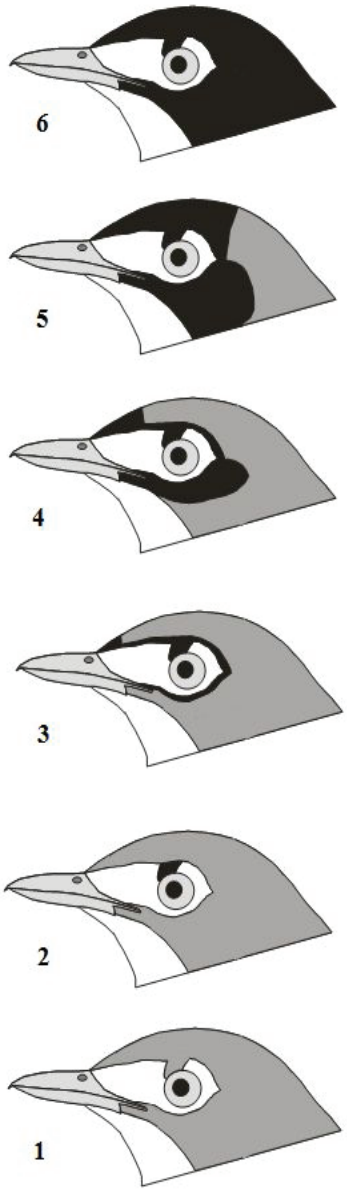
***Width of Green Edge on Primary Coverts***. The width of the covert edging provides a useful character for determining the age of Black-capped Vireos, especially when they are in alternate plumage during the breeding season. However, one must view it as a percent of barb length that is green and examine the middle coverts (numbers 3-5). A good rule of thumb is that those birds with clearly greater than 50% green tend to be ASY

whereas those less than 50% green are usually SY. This rule relies on a simple visual judgement and thus eliminates the need for actual measurement.

***Iris Color***. Although iris color is variable in the Black-capped Vireo, my results agree with Pyle (1997a) that it is a reliable indicator of age. Although I did note that 3% of HYs had reddish brown eyes like some adults, it appears that most begin to turn red sometime after the birds leave the breeding grounds in June and before they return in March and April.

***Rictus Color***. This character is reliable for separating HY from adult Black-capped Vireos. Like the iris, the rictus acquires adult color after the young birds depart the breeding grounds in southward migration.

**Figure 1**. The pattern of gray and black plumage on the heads of Black-capped Vireos varied among age and sex groups. Each row in the table lists information for one of the six head patterns depicted to the left of that row. Each column lists the percentages of a sample that showed each pattern for one age/sex group.




| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | ASY (n=158) | SY (n=114) | HY (n=66) | ASY (n=102) | SY (n=63) | HY (n=36) |
| 6 | 89% | 12% | 2% | 0% | 0% | 0% |
| 5 | 11% | 87% | 11% | 6% | 2% | 0% |
| 4 | 1% | 1% | 56% | 20% | 10% | 0% |
| 3 | 0% | 0% | 23% | 46% | 27% | 0% |
| 2 | 0% | 0% | 5% | 28% | 60% | 67% |
| 1 | 0% | 0% | 5% | 0% | 2% | 33% |

**Figure 2.** I used tracings (A) made from photographs (B) to test the usefulness of primary covert shape alone for determining the age of Black-capped Vireos. The use of tracings rather than photographs served to conceal other age characters that were visible in the photographs such as molt limits and the width of feather edgings. An SY male captured 20 Apr 2011 is depicted. A color version of this figure can be viewed on the Inland Bird Banding Association website, www.ibbainfo.org.

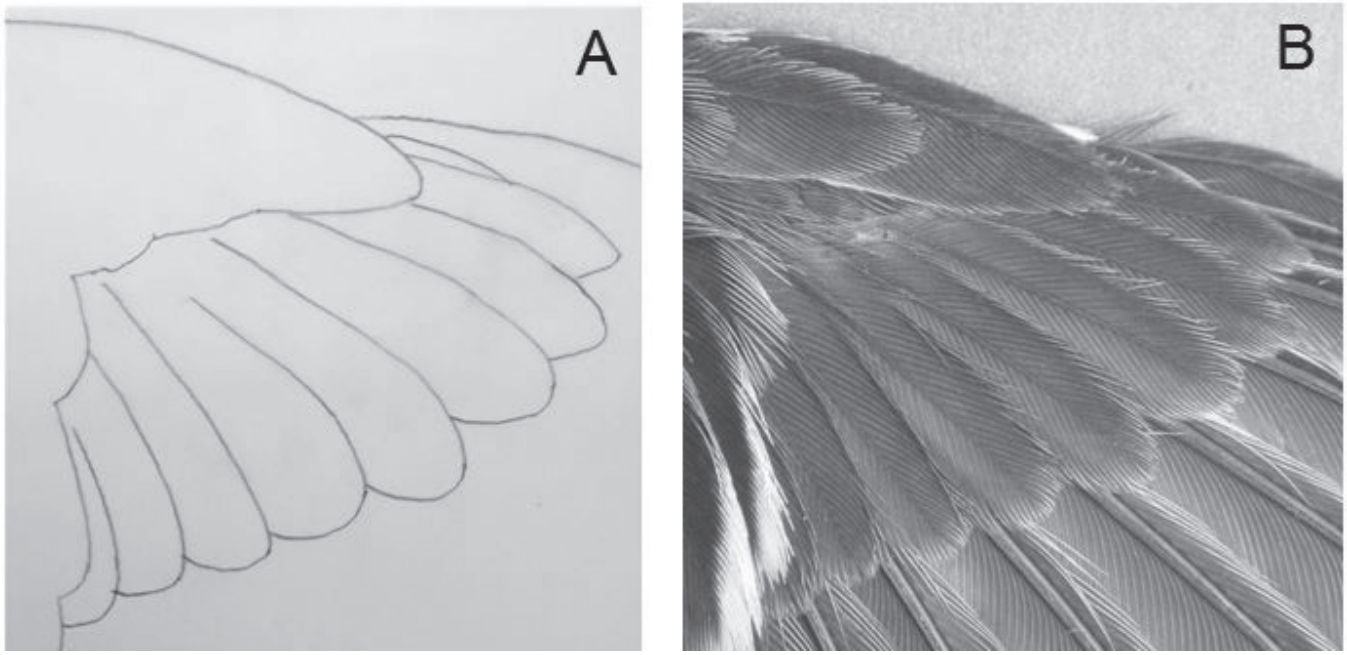
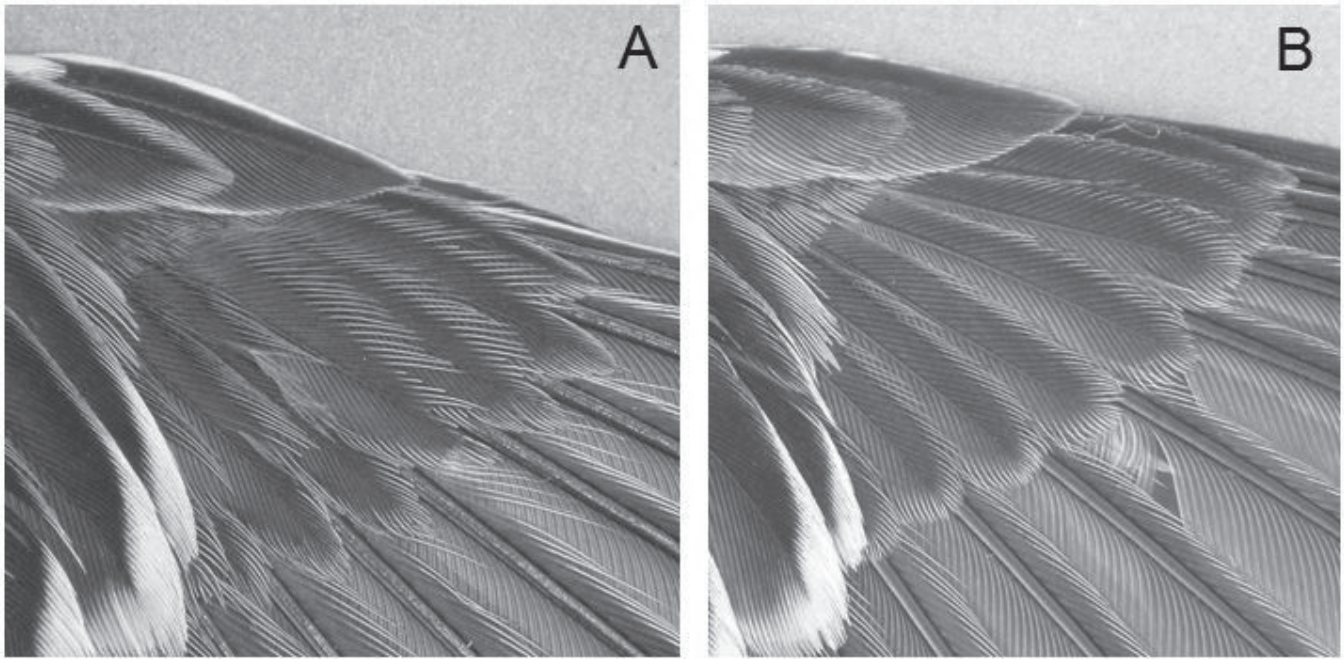



**Figure 3.** Primary covert shape is an unreliable indicator of age in the Black-capped Vireo. Many individuals have covert shapes opposite of the descriptions in Pyle (1997). For example, "A" shows a known fourth-year male with tapered, pointed coverts whereas "B" shows a known SY male (originally banded as a nestling) with relatively truncate coverts. These birds were recaptured and photographed on 17 May 2010 and 12 May 2009, respectively. A color version of this figure can be viewed on the Inland Bird Banding Association website, www.ibbainfo.org.



***Additional Reliable Sex and Age Characters***. Other characters for determining the age and sex of Black-capped Vireos on their breeding grounds have been described elsewhere. Cimprich (2018) explained how the presence of molt limits within the tertials and secondaries are useful for separating SY and ASY Black-capped Vireos. Cimprich (2018) also described how the presence of molt limits in the primaries, primary coverts, and alula reliably indicate age SY. The sexes can be separated reliably based on differences in the color of the roof of the mouth and this same character can be used to recognize HY (Cimprich 2009). Because so many reliable characters are available, the sex and age of virtually every Black-capped Vireos can be correctly determined. The most likely individuals to prove difficult to age are females. The dark centers of their remiges, primary coverts, and alula are dark gray rather than black as in most males. Because of this, the contrast between retained and replaced feathers is not as great as in males and less experienced banders may have difficulty discerning molt limits in the wing.

Pyle (1997a) suggested that another possible age character for Black-capped Vireos may be the length of the tenth primary. As in Catharus thrushes, this feather may be longer in HY and SY birds than in AHY and ASY birds. Cimprich (2005) investigated this character and found broad overlap between age groups, evidence that it is unreliable for ageing this species.

Although this investigation focused on age and sex characters on the breeding grounds, most should have utility elsewhere. The only uncertainty stems from lack of knowledge about when first-cycle Black-capped Vireos complete their preformative replacement of tertials and secondaries and transition from the HY to the SY head pattern during their first prealternate molt. They may also replace rectrices. These molts complete while the birds are away from their breeding grounds (Pyle 1997a, Cimprich 2018) and it is currently unknown when this occurs with respect to the start of a new calendar year.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Black-**capped-Vireo by Comstock Studios (George West)**