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Using Wing Plumage to Determine Age of Mountain Quail

David J. Delehanty* and Nichole C. Turek
Department of Biological Sciences
8007 Idaho State University
Pocatello, ID 83209
*Corresponding author
Phone: (208) 282-4532
E-mail: deledavi@isu.edu

ABSTRACT

We analyzed the occurrence of mottled versus solid-colored upper greater primary coverts on the wings of Mountain Quail *(Oreortyx pictus)* to evaluate the use of wing plumage as an indicator of Mountain Quail age. Mountain Quail retain their juvenal primary coverts through the first prebasic molt and subsequently enter their first breeding season with juvenal coverts still intact. Juvenal primary coverts #1-7 are mottled, and juvenal primary coverts #8 (usually) and #9 are solid-colored. At the end of their first breeding season, quail shed their juvenal primary coverts during the second (definitive) prebasic molt and replace them with solid-colored adult primary coverts. All primary coverts of quail >15 mo age consistently are solid-colored. Thus, color pattern of primary coverts provides a reliable means for aging Mountain Quail. Individuals that possess one or more mottled coverts are < approximately 15 mo old, while individuals with only solid-colored coverts are > approximately 15 mo old. Solid-colored coverts #8 and #9 are not informative for aging quail.

INTRODUCTION

The last decade has seen substantial progress in using subtle plumage characteristics to determine age in North American birds (Pyle 1997). The ability to determine the age of birds through plumage characteristics is especially helpful to the study of small or declining populations (e.g., White et al. 2002) because it adds a demographic dimension to data on reproduction and survivorship. Mountain Quail *(Oreortyx pictus)* have declined significantly in distribution and abundance across their historic range (Brennan 1994). Field studies of Mountain Quail breeding biology and population dynamics could be enhanced by the ability to determine age of individuals with confidence (Gutiérrez and Delehanty 1999). Very young Mountain Quail (0-2 mo) are recognized easily as juveniles based on their small size and substantial mottling throughout their plumage. However, following the first prebasic molt, aging adult-sized Mountain Quail can be difficult.

For more than a century, ornithologists have known that juvenile New World quail (Odontophoridae) retain certain wing feathers through the first prebasic molt, which occurs during the first summer of life (age 2-5 mo), and hold these feathers until the second (definitive) prebasic molt the following summer (age 12-14 mo). Normally, the two outermost primary remiges (p9 and p10) are retained (Dwight 1900) and the presence of relatively pointed, worn, or faded outer primaries has been used to judge the age of quail (Dwight 1900, Leopold 1939, Larson and Tabor 1980). New World quail also retain juvenal upper primary coverts through the first prebasic molt and carry these feathers through the first breeding season (Leopold 1939). Using primary covert retention to determine the age of New World quail may be less subjective than using outer primaries because adult primary coverts are uniformly solid-colored whereas juvenal primary coverts can be mottled with pale flecks and spots.

The observation that New World quail retain juvenal coverts often has been attributed incorrectly to a study by Dwight (1900), although this publication does not address juvenal covert retention. However, van Rossem (1925: 420) reported a communication from Dwight stating, "The spotted juvenal primary-coverts, which accompany the inner eight juvenal primaries, are retained a full year, and are lost at the second fall moult." Sumner (1935), using California Quail *(Callipepla californica)*, was the first to report in detail that the presence of mottled primary coverts can be used to age quail. This was followed by a prominent paper by Leopold (1939) in which mottled coverts among presumed yearling quail were observed for nine New World species including Mountain Quail.

Leopold (1939) remains the principal reference for the use of mottled juvenal primary coverts as indicators of age among New World quail. However, for several reasons it presents ambiguities when applied to determining age of Mountain Quail. The age of the Mountain Quail used to correlate age and covert color was not known independently, but rather was inferred by comparing their covert color to an unstated number of museum specimens. Mountain Quail bearing juvenal-like primary coverts were assumed to be less than approximately one year old, while those with solid-colored primary coverts were assumed to be more than a year old (Leopold 1939). Hence, the study was circular and does not appear to have been open to alternative explanations. Secondly, the details of Mountain Quail covert color and retention were not provided and the general pattern for juvenal primary coverts, illustrated with a Northern Bobwhite (*Colinus virginianus)* wing in which all nine coverts are buffy-tipped (Leopold 1939), does not reflect the covert pattern seen in Mountain Quail. Among young Mountain Quail, some coverts are mottled with pale or buff spots and flecks at the tips, while other coverts are solid-colored (Gutiérrez and Delehanty 1999). Lastly, among New World quail, the second prebasic molt follows a quail's first breeding season and the primary coverts molt sequentially from innermost to outermost slightly ahead of the sequentially molting primaries (Leopold 1939). Because some Mountain Quail exhibit solid-colored innermost and outermost primary coverts with mottled coverts in between, it would be helpful to understand if this pattern reflects the general replacement sequence described by Leopold (1939).

We measured the frequency and location of mottled and solid-colored primary coverts of

Mountain Quail of known age. Our goal was to clarify the pattern of retention of mottled primary coverts among Mountain Quail and to describe the use of primary coverts to determine the age of Mountain Quail.

METHODS

We analyzed the left wing of 69 Mountain Quail that had been frozen for 1-9 years following their deaths and for which age was known independently of any plumage characteristics. Quail came from two sources: a wild population in the Mojave Desert of southern California, and a captive research population. The captive population consisted of individuals taken from the Mojave population, commercially purchased quail (R. Tybie, Doyle, CA), and the progeny of wild and commercial quail. Both groups of quail were the subjects of long-term study (Delehanty 1997, Gutiérrez and Delehanty 1999) unrelated to plumage morphology, and we used quail that were collected or salvaged during the course of that research.

Like other New World quail, Mountain Quail have 10 primary flight feathers. One upper primary covert overlays the gap formed between each pair of adjacent primaries. We numbered primary coverts starting with the small, innermost primary covert (#1) covering the gap between p1 and p2 through the outermost primary covert (#9) covering the gap between p9 and p10. For analysis, we removed the left wing and recorded the color of all nine coverts. Covert color was recorded as being either solid olive-brown (color 28, Smithe 1975-1981) or mottled with buffy or cream (colors 124, 54, respectively, Smithe 1975-1981) tips and fine buffy or cream speckling on an olive-brown background.

We compared the presence or absence of mottled primary coverts to the age of quail and looked for consistent patterns between plumage and age of Mountain Quail. In our analysis, we focused on the ability to detect age at life-stages important to describing Mountain Quail population dynamics. In particular, we looked for the ability to detect hatch-year quail among autumn populations of adult-sized animals. This would provide a means for measuring autumn age ratios and annual reproductive success. We also looked for the ability to discern between yearling breeders versus older individuals to better understand Mountain Quail breeding biology.

RESULTS

Mountain Quail exhibited a consistent and interpretable pattern of solid-colored versus mottled primary coverts (Table 1). All coverts on all quail >15 mo age (n = 22) were solid-colored and matched the olive-brown plumage of the rest of the upper wing. Similarly, all quail <10 mo age (n = 38) had 1-8 mottled coverts. Typically, coverts #1 through #7 were mottled on these young quail. In all but two cases, covert #8 was solid-colored, and #9 was always solid-colored. Quail 11-14 mon old (n = 9), i.e., yearling breeders in the latter stages of their first breeding season, were in transitional plumage that accurately reflected the onset of the prebasic molt that follows each breeding season. One of the nine yearling breeders had not yet molted its juvenal coverts. Six individuals had from two to six new, solid-colored coverts appearing sequentially in the #1 - #6 positions. Two individuals from June and July, respectively, and approximately 14-15 mo age, had replaced all nine primary coverts.

Table 1. Percent frequency of mottled primary coverts from the left wing of Mountain Quail. Quail are divided into ages that reflect important life stages: adult-sized quail that have not reached their first breeding season (ages 2-10 months), yearling breeders (ages 11-14 months), and individuals that have completed at least one prebasic molt following a breeding season (ages > 15 months). Every quail ages 2-10 months had at least one mottled covert (mean = 6.3 ± 1.45 SD, min. = 1, max, = 8). Yearling breeders had from 0-6 mottled coverts (mean = 2.4 ± 2.13 SD). Coverts that were not mottled were solid colored.

		Primary Coverts								
Age	**N**	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**
2-10 mos.	38	84.2	89.5	94.7	94.7	92.1	89.5	81.6	5.3	0
11-14 mos.	9	11.1	11.1	33.3	33.3	55.5	44.4	55.5	0	0
≥15 mos.	22	0	0	0	0	0	0	0	0	0

DISCUSSION

In our study, the presence of even one mottled primary covert indicated that the Mountain Quail in question was less than approximately 15 mo of age. This suggests that researchers can identify hatch-year individuals reliably among adult-sized quail captured during autumn or winter. Similarly, any breeding bird with one or more mottled primary covert is a yearling breeder. Primary coverts #5 - #7 might be useful especially in detecting yearling breeders, as these are the last mottled coverts to be replaced. The exclusive presence of solid-colored coverts indicated that the Mountain Quail was 15 mo old or older. These quail had experienced at least one breeding season and had undergone at least one prebasic molt at the end of the breeding season.

The patterns of mottled and solid-colored primary coverts that we observed are explained readily by Mountain Quail molt sequence. Mountain Quail retain their juvenal primary coverts through the first prebasic molt, which occurs during their first summer of life, and enter their first breeding season with juvenal coverts still intact. Although several species of New World quail undergo a very limited prealternate molt during early spring involving the replacement of some head and neck feathers (Dwight 1900), a prealternate molt has not been documented for Mountain Quail. If present, a prealternate molt does not appear to include primary coverts. Mottled juvenal coverts are not replaced with solid-colored adult coverts until the second prebasic molt.

Because juvenal primary coverts #8 and #9 are solid-colored like adult primary coverts, the presence of solid-colored coverts #8 and #9 is not informative for indicating Mountain Quail age. The presence of adult-like, solid-colored coverts #8 and #9 in juvenile quail probably results from the highly compressed molt sequence typical of New World quail. In New World quail, juvenal plumage is held very briefly. The molt from juvenal plumage into adult plumage can begin before the molt from natal down into juvenal plumage is completed (Dwight 1900). Primary coverts #8 and #9 are among the last juvenal feathers to erupt (DJD, pers. obs.). They erupt in concert with start of the first prebasic molt into adult plumage and are adult-like in appearance even though they represent the first generation of coverts. Coverts #8 and #9 are adult-like juvenal coverts that are retained along with the mottled juvenal coverts #1-#7. A similar pattern of retained, mottled juvenal coverts #1-#7 and solid-colored coverts #8-#9 in yearling birds has been described for Scaled Quail *(Callipepla squamata;* Wallmo 1956, Smith and Cain 1984).

Our findings confirm the astute general observation made by Dwight more than a century ago (van Rossem 1925) that all primary coverts are retained during the first prebasic molt. We modify the details of using primary coverts to age New World quail (Leopold 1939) specifically for use on Mountain Quail. We emphasize that solid-colored primary coverts #8 and #9 are not informative in revealing the age of Mountain Quail. Also, because the primary covert molt sequence progresses from innermost to outermost, it is possible to observe yearling breeders late in the breeding season with confusing transitional plumage. As yearling breeders initiate their post-breeding prebasic molt, they will exhibit with solid-colored innermost primary coverts (due to the onset of the prebasic molt), mottled middle primary coverts (due to retention of juvenal coverts), and solid-colored outermost primary coverts (due to retention of adult-like juvenal coverts). Presence of mottled primary coverts on a nesting adult reliably indicates a yearling breeder. If all the primary coverts of a breeding quail are solid-colored and are also newly molted, then the quail is ≥approximately 15 mo age. When all primary coverts on a nesting adult are solid-colored, faded, and worn, this should reliably indicate that the quail is in its second or more breeding season.

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News, Notes, Comments

Erratum: Vol.28 No. 2, Inside Front Cover

Misidentification of Species

As many *NABB* readers pointed out (a list too long to print here), the inside cover of *NABB* 28(2) incorrectly labeled the cover illustration as a Black-and-white Warbler. The caption should have indicated that the bird illustrated was a Blackburnian Warbler. The Production Manager apologizes to the artist and readers, and thanks Dr. George West for providing a graphic of a Black-and-white Warbler for the cover of this issue.

Readers may be interested to know that Dr. West's drawings and sketches are available for purchase at: **birch@birchsidestudios.com**

Robert Pantle Prod. Mgr.

Erratum: Vol.27 No. 4, pages 127-129

Recommended Band Size for Spotted Towhees: A Suggested Revision by Rita R. Colwell

Seventeen females are shown in the Tables on p.128, but, in error, only 16 were used for calculations. The missing individual was the bird whose wing length was 81 mm and weight was 33.7 g. Corrected calculations, including all 17 females, are: wing length range = 75-81 mm, mean = 77.5 mm; weight range = 33.7-41.4 g, mean = 37.75 g. The author thanks Walter Sakai for pointing out this oversight.