Incomplete Flight Feather Molt and Age in Certain North American Non-passerines

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ABSTRACT

Based on specimen examination, information is presented on incomplete or arrested prebasic flight-feather molts, and differences between juvenal and adult flight feathers, in North American pigeons, doves (Columbidae), cuckoos, roadrunners, anis (Cuculidae), nightjars (Caprimulgidae), swifts (Apodidae), trogons (Trogonidae), and kingfishers (Alcedinidae). Individuals of most of these families regularly (but not always) retain flight-feathers for one or more annual cycles, until a subsequent prebasic molt. Retained flight feathers most often include the outer secondaries, although in some families or species, primaries, primary coverts and/or rectrices may also be retained. In certain families or species (group A) flight feathers are typically replaced during the first prebasic molt, juvenal feathers being retained until the second prebasic molt, whereas in others (group B) flight feathers are not typically replaced until the second prebasic molt, juvenal feathers being retained until the third prebasic molt. In both of these groups adult feathers can also be (but are not always) retained during subsequent prebasic molts. Four flight-feather patterns are thus found in non-molting birds: uniform juvenal, uniform adult, mixed adult and juvenal, and mixed replaced and retained adult feathers. Assuming that retained juvenal and adult feathers can be distinguished, many birds of group A (pigeons, doves, cuckoos, roadrunners and anis) can be reliably aged through at least their second year, and many birds of group B (nightjars, trogons and the larger kingfishers) can be aged though at least their third year.

INTRODUCTION

The timing, location and extent of molts in North American birds are remarkably understudied, given their basic importance to avian biology (Rohwer and Manning 1990, Thompson and Leu 1994). This especially seems true of the "near-passerines" (doves through woodpeckers in the sequence of the American Ornithologist's Union checklist [1983]). Generally it has been assumed that replacement of flight feathers (here defined as the primaries, primary coverts, secondaries, and rectrices) in these families, whether it occurs during the first or the adult prebasic molt, is complete (Forbush 1927, Bent 1932-1940, Roberts 1955, Wood 1969, Oberholser 1974). But in many near-passerines these molts are incomplete, with one to many flight feathers, especially among the secondaries and primary coverts, typically retained through one or more molt cycles (Test 1945, Rohwer 1971, Forsman 1981, Cramp 1985, Evans and Rosenfield 1987, Baker 1993). While sporadic information exists on retained flight feathers in a few species, especially in Europe, molt in most North American near-passerines has received little or no attention since that of the earlier, general works.

While examining museum specimens for information on molt and ageing criteria, I found that individuals of most near-passerine species retained flight feathers regularly for more than one year, and that retention patterns and differences between juvenal and "adult" (definitive or non-juvenal) feathers could be used to reliably age these individuals, in some cases up to their third or fourth year of life.

The variable molts and complex ageing criteria of owls, hummingbirds, and woodpeckers will be detailed elsewhere. Here I summarize findings in the other North American near-passerine families.

METHODS

Specimens housed at the California Academy of Sciences (CAS), San Francisco, Museum of Vertebrate Zoology (MVZ), University of California, Berkeley, and Point Reyes Bird Observatory (PRBO), Stinson Beach, California, were examined. On each specimen the flight feathers were carefully studied (see Rohwer 1971) for evidence of incomplete replacement or for differences in color pattern, shape and/or wear between juvenal and adult feathers. Birds that were collected in active molt were noted, and for other specimens all retained flight feathers were recorded by position in the wing or tail.

Specimens were assigned age codes following the calendar-based system of the Bird Banding Laboratory (Canadian Wildlife Service [CWS] and U.S. Fish and Wildlife Service [FWS] 1991). Codes included: U/AHY for a bird of unknown age; HY/SY and AHY/ASY for birds in and beyond their first basic plumage, respectively; and SY/TY and ASY/ATY for birds in and beyond their 2nd basic plumage. In each case the codes represent birds in the one-year period between completion of molts (often October to September); the code before the slash applies until the end of the calendar year (31 December) and the code after the slash applies between the beginning of the year (1 January) and the next molt. Primaries (p1-p10) and rectrices (r1-r6) were numbered distally (outward or away from the body) and secondaries (s1-s12) proximally (inward or toward the body).

Terminology of molt, plumages and feather generations follows Humphrey and Parkes (1959; see also Thompson and Leu 1994). Generations of feathers and plumages subsequent to fledging are termed juvenal, 1st basic, 2nd basic, etc., while adult feathers, plumages and birds refer to those that are at least 1st basic in age (i.e., are not juvenal), but otherwise are of unknown age.

RESULTS AND DISCUSSION

Near-passerines appear to have a single annual molt that can occur on the summer grounds, the winter grounds, or both. Individuals of most species follow the same general sequence of flight-feather replacement. Except in hummingbirds (Pyle et al. manuscript), and cuckoos and kingfishers (see below), molt of the primaries starts with the innermost, p1, and continues distally to the outermost, p10. Primary-covert replacement in all families except woodpeckers (see Pyle and Howell in press) and kingfishers (see below) usually corresponds with that of the primaries. Replacement of the secondaries typically proceeds both distally from the innermost ("tertials") and, a bit later, proximally from the outermost (s1) such that the last secondaries replaced are often among s2-s7 (typically, s3-s4). Replacement of the rectrices can be variable and often proceeds irregularly, finishing with feathers among r2-r4. In many species the sequence of replacement can be protracted and/or suspended (see below) during migration or winter, not being completed until spring.

Retention of flight feathers results when the molt sequence does not complete before the next annual cycle, unmolted feathers being held at least until commencement of the next prebasic molt. This has been termed an "arrested" or "abridged" molt (see Ginn and Melville 1983, Norman 1991); as opposed to "suspended" molt, in which replacement resumes after migration or winter but before the next molt cycle. Thus, during the first flight-feather molt, retained juvenal feathers often include the outermost primaries, secondaries among s2-s7, and/or rectrices among r2-r4. Juvenal feathers are usually retained symmetrically in both wings and both sides of the tail, or at most differ by one or two feathers. These juvenal feathers may or may not be the first replaced during the next molt (see Baker 1993: 23-24); as a consequence, molt sequences in adults can be irregular and retained feathers are less-often symmetrical. Both juvenal and adult flight feathers may or may not be retained, hence four molt-retention pattern categories can be defined: uniform juvenal feathers, mixed juvenal and adult feathers, uniform adult feathers, and mixed replaced and retained definitive feathers (Figure 1).

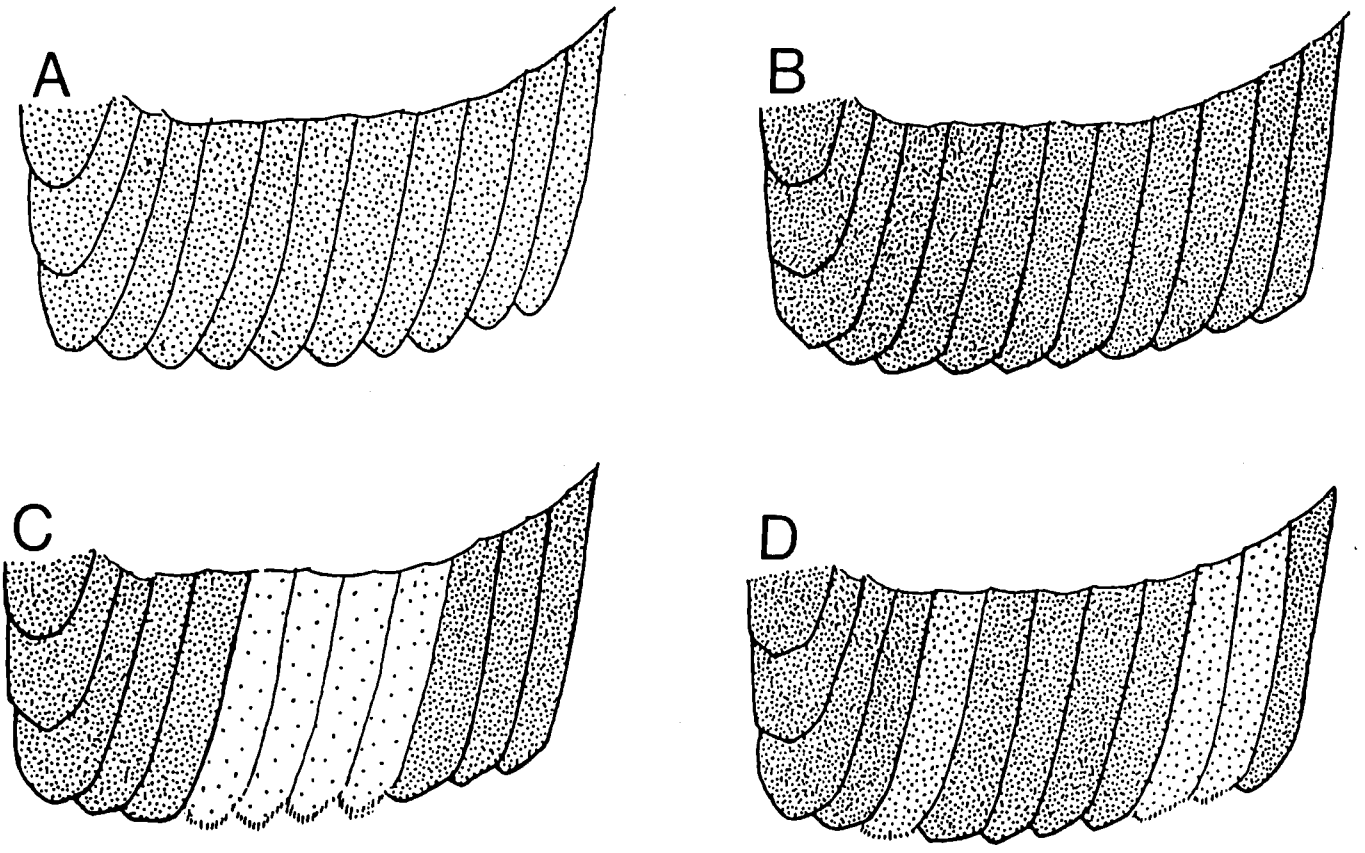


Figure 1. Generalized representation of four retention patterns found in secondaries of near-passerines uniform juvenal feathers (A), uniform adult feathers (B), mixed adult and juvenal feathers (C), and mixed replaced and retained adult feathers (D). Note that juvenal secondaries usually differ from those of adults in being narrower, more tapered at the tip, and contrasting more markedly in color and wear with replaced feathers, while retained adult feathers contrast less with replaced feathers. Retained juvenal feathers usually occur among s2-s7 and are often consecutive and symmetrical in both wings, whereas retained adult secondaries can occur throughout the wing, are often not consecutive, and are less frequently symmetrical in both wings. North American pigeons, doves, cuckoos, roadrunners, and anis can be aged HY/SY (patterns A and C), U/AHY (B), or AHY/ASY (D); while North American nightjars, trogons and Belted and Ringed kingfishers can be aged HY/SY (A), AHY/ASY (B), SY/TY (C), or ASY/ATY (D). See text for more details.

Assuming that juvenal and adult feathers can be distinguished, and depending on when replacement of juvenal flight feathers typically commences (i.e., during the first or second prebasic molt), birds with retained flight feathers can be aged more accurately or to a later age category than those with uniform adult flight feathers (see Figure 1). Molt patterns within each near-passerine family are summarized as follows:

COLUMBIDAE

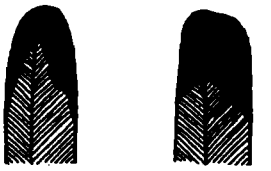
In pigeons and doves, flight-feather replacement occurs during both the first and the adult prebasic molts. In North America it is protracted, can be suspended and, due to year-round breeding in some southern populations, can occur in at least a small proportion of birds at almost any time of year (CWS and FWS 1991, and references therein). These factors make it difficult to separate retained feathers from those that are about to be molted or that were replaced before a suspension of molt occurred. Nevertheless, individuals of most species appear to retain flight feathers until the second prebasic molt, especially among the middle secondaries. Unless as noted below, retention of primaries and/or rectrices was less common or more difficult to detect.

A small-to-moderate proportion of non-molting, spring-summer Red-billed *(Columba flavirostris)* and Band-tailed *(C. fasciata)* pigeons were found that had apparently retained juvenal secondaries, either s6 only, s5-s6, or s4-s6. Examples include Red-billed Pigeon MVZ98186 collected in August with juvenal s5 and s6 of both wings retained and very worn, and Band-tailed Pigeon CAS39090 collected in July also having retained s5 and s6 on both wings as juvenal feathers. These were assigned age code SY. Apparent retained adult feathers also were found in specimens of *Columba*, for example, Red-billed Pigeon MVZ101592, collected in Texas in May, had retained what appeared to be adult secondaries s2-s3 and s6 in the right wing and s2 and s6 in the left wing, and was tentatively aged ASY (see Figure 1). Because of year-round breeding and suspension of molts in these species, however, more study is warranted before age code ASY can be reliably assigned, based solely on retention patterns.

Non-molting *Zenaida* doves with retained juvenal secondaries were less frequent in the collections (9% of White-winged Doves, *Z. asiatica,* and 6% of Mourning Doves, *Z. macroura),* and no specimens were found with retained adult secondaries. As in *Columba*, retained juvenal secondaries were among s4-s6 (e.g., April specimen White-winged Dove CAS31444 and May specimen Mourning Dove CAS32158), and specimens with these were assigned age code SY.

I could not confirm age-specific differences in the emargination of p6-p8 in the Inca Dove *(Columbina inca)*, as mentioned by Tweit (1986) and Mueller (1993). Emargination on p6-p9 appears to average deeper on adult than on juvenal feathers, but overlap between the age groups in this feature probably renders it difficult to use for ageing single birds. I found, however, that juvenal and adult primary coverts in this species and in Common Ground-Dove *(C. passerina)* differed in color pattern (Figure 2), and that this was much more helpful in ageing.

Figure 2. Juvenal and adult primary covert patterns in *Columbina* doves. Note that the rufous color of the base of these feathers averages paler in juvenals than than in adults.



Juvenal inner secondaries (s5-s11) also had white tips or corners whereas these feathers were uniformly brown in adults. Many, if not all, HY/SY *Columbina* specimens had suspended flight feather molt into winter and spring (see Tweit 1986), and some HY/SYs (e.g. June specimens Inca Dove MVZ135416 and Common Ground-Dove CAS39110) appeared to have arrested the molt, retaining juvenal flight feathers until the second prebasic molt. Typically, HY/SYs from October through at least March or April still retained the outer 2-5 juvenal primaries (among p6-p10), their

corresponding, juvenal primary coverts (Figure 2), and 1-6 secondaries among s2-s8. Adult prebasic molts seemed more often complete and confined to fall/early winter; however, birds with apparent retained adult secondaries (e.g., March Inca Dove CAS34915 with older adult s2 and s4-s7) were also found. Based on molt patterns and the above-mentioned differences between juvenal and adult flight feathers, most HY/SYs and, tentatively, some AHY/ASYs could be aged through March, with at least some SYs and possibly some ASYs reliably aged through June or later. Birds with uniform adult feathers could probably be aged AHY/ASY through at least February, but this needs confirmation, especially in populations with a prolonged breeding season. More study on skull pneumatization patterns in *Columbina* doves (see Johnston 1962) may assist in our understanding of molt patterns and ageing in this genus.

Molt retention patterns and ageing criteria in White-tipped Dove *(Leptotila verrauxi)* appear similar to those of *Columba*, except that juvenal primary coverts are washed rufous whereas adult coverts are brown, and this assisted with ageing.

CUCULIDAE

Flight feathers in North American Cuculidae are typically replaced during both the first and subsequent prebasic molts and, in migratory species, replacement occurs on the winter grounds. Unlike other near-passerines, the sequence of replacement of primaries and secondaries in cuckoos can be irregular, with two or more series of feathers being molted alternately or in both directions from one center (see Baker 1993 and references therein).

Specimen examination revealed that both Black-billed *(Coccyzus erythopthalmus)* and Yellow-billed *(C. americanus)* cuckoos can retain secondaries and rectrices during the first and subsequent molts. Four of 30 adult Black-billed Cuckoos collected on the breeding grounds (e.g., CAS34955 and MVZ127378) had retained 2-5 secondaries among s1-s6; two of these had also retained 1-2 rectrices among r2-r3. All four of these birds were aged SY, as determined by the presence of pale tips to retained juvenal secondaries and/or retained juvenal rectrices that were narrower, more tapered, and with less distinct pale tips than are found on adult rectrices (see National Geographic Society 1987: 237). The pale tips on the juvenal secondaries, found in Black-billed and Mangrove *(C. minor)* cuckoos but not in Yellow-billed Cuckoo (Nolan 1975, this study) had worn off by the first summer in two of the four specimens; thus, retained secondaries without pale tips were not necessarily adult feathers.

Nine of 125 Yellow-billed Cuckoos had retained flight feathers, including roughly equal proportions from eastern and western populations. Seven of these (e.g., CAS45001 and MVZ169435), which had retained 1-4 secondaries among s2-s8, could not be confidently aged due to the difficulty in distinguishing retained juvenal from retained adult secondaries in this species (see below). The two other specimens (MVZ106985 and MVZ124369) had also retained 4 rectrices each (among r2-r5). These worn feathers which contrasted with the rest of the tail, were broad, truncate and showed the distinct white tips of definitive feathers (see National Geographic Society 1987: 237). These birds could be aged ASY. A comparison of retained juvenal secondaries on the Black-billed Cuckoos with retained adult secondaries on the Yellow-billed Cuckoos revealed that the adult feathers were slightly broader and contrasted less in wear with replaced secondaries than did the retained juvenal feathers. But these distinctions were slight, hence, ageing spring-summer birds by retained secondaries only is not recommended unless (in some SY Black-billed and Mangrove cuckoos) the secondaries have pale tips still remaining. It is possible that SYs and ASYs show different retention patterns, but more study is needed to establish whether or not this is the case. Based on a small sample of Mangrove Cuckoo specimens it appears that molt patterns and ageing criteria parallel those in Black-billed Cuckoo, at least in northern populations.

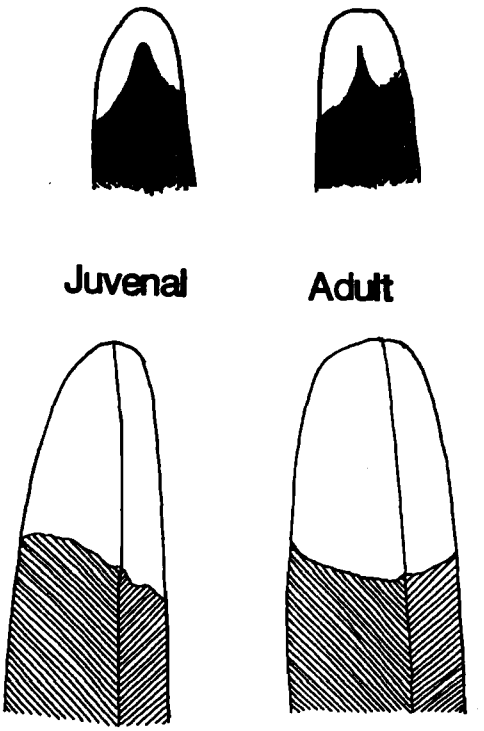
Molts in Greater Roadrunner *(Geococcyx californianus)*, Smooth-billed Ani *(Crotophaga ani)* and Groove-billed Ani *(C. sulcirostris)* were found to be highly irregular. Flight-feather replacement occurred slowly and, generally, very asymmetrically throughout the non-breeding seasons. A few specimens showed patterns suggesting that both juvenal and adult flight feathers could be retained,

but due to frequent suspension of molting, adventitious or irregular feather replacement, and prolonged if not year-round breeding, this was difficult to confirm.

In the roadrunner, juvenal primary coverts and rectrices could be distinguished by differences in shape and color patterns (Figure 3), and juvenal secondaries averaged slightly narrower, browner, and less glossy than those of adults. These clues allowed confident separation of HY/SYs from AHY/ASYs in most birds through spring or summer, at which time molting typically had completed in both age groups. Birds in winter or spring with uniform, fresh, adult flight feathers were rare, and were tentatively aged AHY/ASY. Some birds (e.g., CAS75518 collected in April) had one or two very worn feathers, apparently juvenal, among two generations of adult feathers; these were probably TYs but more study is needed.

In the anis, all juvenal feathers were brown or dull blackish vs. glossy bluish or black in adults, and the rectrices differed in shape (see Figure 3). As in the roadrunner these differences allowed separation of many HY/SYs and a few AHY/ASYs (with two generations of adult feathers) through the first summer. Some HYs (e.g., Groove-billed Ani CAS63648) had almost completed the first prebasic molt in December; thus, birds with uniform adult feathers should probably be aged U/AHY (December-November), if based on plumage alone. Arrested molt appeared to be rare in anis.

Figure 3. Juvenal and adult primary covert (upper) and rectrix (lower) patterns in Greater Roadrunner. Note also the difference in shape of the rectrices. A similar difference in shape can be found in cuckoos, anis and trogons.



CAPRIMULGIDAE

Molt and its application to ageing in the Chuck-will's-widow *(Caprimulgus carolinensis)* were detailed by Rohwer (1971); similar molt patterns and ageing criteria were found during this study in most North American nightjar species. Except as noted below, North American nightjars retain all flight feathers during the first prebasic molt, and the adult prebasic molt occurs on the summer grounds. Rohwer noted that the juvenal rectrices in Chuck-will's-widow were narrower and more tapered than in adults, and that secondaries could occasionally be retained during adult prebasic molts. During this study I confirmed that both differences in rectrix shape and retention of secondaries occurred in most North American nightjar species, and further found that juvenal secondaries and primary coverts differed in color pattern from those of adults (Figures 4-5). By combining these differences with flight-feather retention patterns (especially among the secondaries; Figure 1), many North American nightjars could be aged through SY/TY or ASY/ATY.

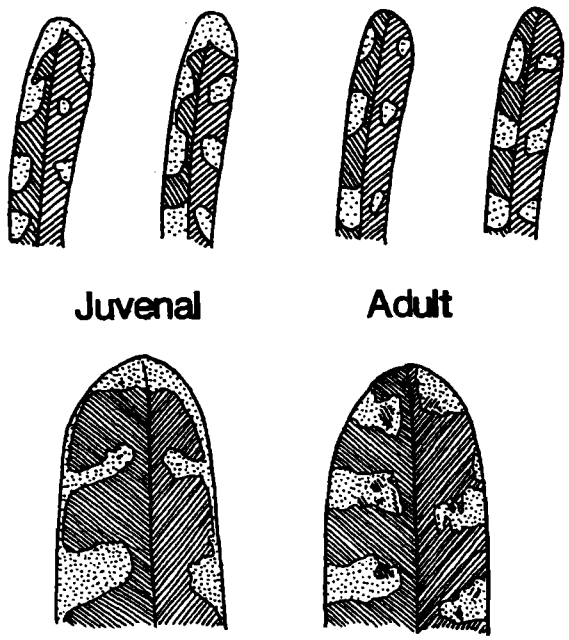


Figure 4. Juvenal and adult primary covert (upper) and secondary (lower) patterns in nightjars. The light buff or cinnamon tips to the primary coverts are diagnostic of juvenal feathers; however, there can be some overlap in pattern between juvenal and adult secondaries, which can make distinctions between SY/TY and ASY/ATY (see Figure 1) difficult. Adults can also have pale gray (as opposed to buffy) tips to the secondaries (e.g., see Figure 5).

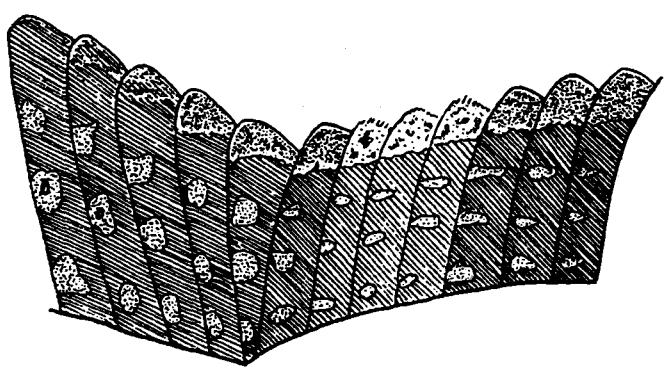


Figure 5. Secondaries of an SY/TY Lesser Nighthawk. Note the retained juvenal feathers, that have buffier or more cinnamon tips than adjacent adult feathers. Similar patterns of retention can be found among other nightjars, although differences between juvenal and adult feathers are not as striking in the other species.

Molt in Lesser *(Chordeiles acutipennis)* and Common *(C. minor)* nighthawks was discussed by Selander (1954). Common Nighthawks differ from Lesser Nighthawks and the other North American nightjars in that most flight-feather replacement occurs on the winter grounds, and that the first prebasic molt typically includes the rectrices (but not other flight feathers). Selander noted that many nighthawk specimens retained juvenal secondaries, but he assumed that this resulted from an incomplete first prebasic molt when, according to this study, it results from an incomplete second prebasic molt. Of 55 non-molting, spring Lesser Nighthawk specimens examined, 18 (32.7%) had uniform juvenal flight feathers and were aged SY. Eight specimens (14.5%) had uniform adult feathers except 1-4 retained juvenal secondaries, usually in a block among s2-s6, and were aged TY (Figure 5). Nine nighthawk specimens (16.4%) had uniform adult flight feathers and were aged ASY; and 20 (36.4%) had 1-6 retained adult secondaries among s1-s8, usually not in a block and often asymmetrical in the wings, and were aged ATY (see Figures 1 and 5). Similar proportions were found among 60 spring and summer Common Nighthawks, except that a higher percentage of birds (38.3%) had uniform adult feathers and the number of retained feathers averaged fewer, suggesting that the molt is more often complete in Common than in Lesser Nighthawk. Differences in color pattern between juvenal and adult secondaries (Figure 5) were greater in Lesser than in Common Nighthawk; retained secondaries in some Commons could not be aged and, like birds with fully-replaced secondaries, these individuals were assigned code ASY.

Molt patterns in the Pauraque *(Nyctidromus albicollis)*, Common Poorwill *(Phalaenoptilus nuttallii)*, Buff-collared Nightjar *(Caprimulgus ridgwayi)* and Whip-poor-will *(C. vociferus)* paralleled those of Chuck-will's-widow, allowing ageing of some birds to SY/TY or ASY/ATY. The proportion of birds with retained secondaries varied among these species, from 47.6% of 21 AHY/ASY Chuck-will's-widows examined to 7.1% of 28 AHY/ASY poorwills examined. As in Common Nighthawk, distinguishing juvenal from adult secondaries can be difficult, and some birds with retained feathers could only be aged AHY/ASY (see Figure 5). One TY poorwill (CAS26746 collected in

May) had retained the outer two juvenal primaries and primary coverts (Figure 4) in addition to juvenal secondaries (s1-s2 and s7). Retention of primaries was also noted to occur occasionally in Common Nighthawks (Selander 1954) and Chuck-will's-widows (Rohwer 1971).

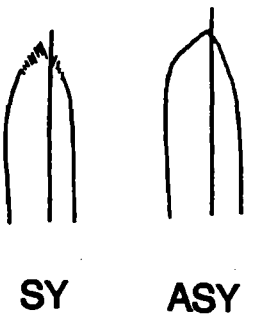
APODIDAE

Little has been published on molt in North American swifts (see Johnston 1958, Marin and Stiles 1992, Bull and Collins 1993). Based on specimen examination, both first and adult prebasic flight-feather molts in the Black Swift *(Cypseloides niger)* appear to occur on the winter grounds and are complete. In the other three species, Chimney *(Chaetura pelagica)*, Vaux's *(C. vauxi)*, and White-throated *(Aeronautes saxatalis)* swifts, only the adult molt includes the flight feathers, this occurring on the summer grounds. No specimens were found with unquestionably retained flight feathers. A few Black Swifts (e.g., CAS45097 and CAS71832) may have retained some secondaries and greater coverts, but contrasts in feather wear among these specimens may also have resulted from suspended molt or from relative differences in exposure. Little is known of molt in the Black Swift or even where North American breeders winter (Stiles and Negret 1994).

In Black and White-throated swifts, juvenal and female primaries and rectrices averaged broader and blunter than those of adults and males, and this could be used to help distinguish HY from AHY Black Swifts in fall (along with the scalloped juvenal body plumage; see Drew 1882, Swarth 1912), and HY/SY from AHY/ASY White-throated Swifts in both fall and spring. The tail fork was also found to be deeper in adult males than in juvenile or first-basic males and all females, especially in Black Swifts. In *Chaetura* sp., the best way to separate SY from ASY birds in winter-spring was by the comparatively abraded tertials, and narrower more tapered and more abraded rectrices (Figure 6) of SYs.

SY birds, perhaps non-breeders, also seemed to molt flight-feathers earlier in the spring-summer than ASYs, as early as 12 June in Chimney Swift

Figure 6. Shape and amount of abrasion in rectrices of SY vs. ASY *Chaetura* swifts in winter and spring. Distinctions are not as apparent on fresher feathers during fall.



(CAS24721 with p1-p4 being replaced on each wing) and 4 May in Vaux's Swift (CAS83744 with p1-p3 being replaced on each wing). The relative timing of flight-feather molt could prove useful for separating SYs from ASYs through summer, but more study based on known-age birds is needed.

TROGONIDAE

Based on specimen examination, both Elegant *(Trogon elegans)* and Eared *(Euptilotus neoxenus)* trogons retain most to all flight-feathers during the first prebasic molt. This molt is protracted through the first spring, and some but not all HY/SYs of each species replace the tertials. The adult prebasic molts are complete or nearly complete, and occur in July to October. Juvenal and adult rectrices are easy to distinguish based on differences in shape in both species (see Figure 3) and color pattern in Elegant Trogons, juvenal outer rectrices having narrower bars and juvenal central rectrices having a narrower black tip than are found in adults (see Howell and Webb 1995). The color pattern of the secondaries also differs between juvenal and adult feathers. In Elegant Trogon, the juvenal inner secondaries (s6-s10) have large white corners that the adult feathers lack. The outer webs of all secondaries are white, coarsely peppered black in juvenal feathers vs. finely speckled olive (female) or gray (male) in adult feathers. In Eared Trogons the juvenal secondaries are brownish, with little or no green tinge whereas the adult secondaries are dusky and strongly tinged green.

Thus, the separation of HY/SY from AHY/ASY trogons through summer is straightforward.

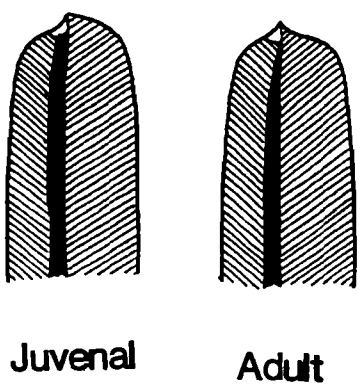
A small proportion of trogons could be aged SY/TY or ASY/ATY based on retained juvenal or adult secondaries, respectively. Of 39 AHY/ASY Elegant Trogons examined only two had retained secondaries; one (MVZ110142 collected in February) had retained the juvenal s5 on the right wing and was aged TY, and another (MVZ110146 collected in December) had retained the adult s4 and s5 on the right wing and was aged ASY. Most of the eleven Eared Trogons examined had been collected during active molt, so that retained secondaries would have been difficult or impossible to detect. However, one specimen (MVZ139436 collected in July), that was just beginning molt, had retained the juvenal s7 on the right wing and was aged TY. The shape of the rectrices on this bird was intermediate between that of juvenal and adult feathers (see Figure 3), which might be typical in SY/TYs. Interestingly, higher proportions of birds with retained secondaries were found in other trogon species, e.g., four of 18 Mountain Trogon *(Trogon mexicanus)* specimens at CAS had retained one or two feathers.

ALCEDINIDAE

Molt in the Belted Kingfisher *(Ceryle alcyon)* was discussed by Stone (1896), Stresemann and Stresemann (1966), Cramp (1985), and Hamas (1994). The first prebasic molt is extended throughout the non-breeding season (December to April) and can include some or all rectrices and apparently some outer primaries and secondaries as well, at least in certain eastern migratory populations. The adult prebasic molt occurs from June to January (most are finished by November) and includes all or most flight feathers. Unlike other near-passerines, the primaries molt distally and proximally from two centers (often distally from p1 and in both directions from p 7), such that the last primaries replaced are usually among p2-p5.

Specimen examination confirmed most of this, although no winter-spring SYs in the California collections (n=66) were found with symmetrically replaced primaries or secondaries (except, perhaps, the tertials in a few specimens). This contrast in molt extent with eastern populations is interesting and should be confirmed; it is possible that information on replacement of primaries and outer secondaries during the first prebasic molt was erroneously based on birds in second prebasic molt, as apparently occurred with sapsuckers (see Cramp 1985, Pyle and Howell in press). Also, retention of either juvenal or adult flight feathers was found during this examination in most adult specimens. Of only 20 AHY/ASY Belted Kingfishers examined (83% of sample specimens were HY/SYs!), six were aged SY/TY, eleven ASY/ATY, and three had completely uniform flight feathers or ambiguous retention patterns and were aged AHY/ASY. Juvenal secondaries differed from adult secondaries, on average, in color pattern (Figure 7) and this assisted with ageing retained feathers. The blackish center to the central rectrices also averaged wider in juveniles and females than in adults and males, although this was only useful in ageing some HY/SYs as many apparently had replaced these feathers during the first fall or winter. From 1-3 juvenal primaries among p2-p5 were retained in four SY/TYs (e.g., CAS31830 collected in May), and one late June specimen (CAS17717) had begun molt of the primaries with p2 and p3, suggesting that this was a TY that had retained these feathers during the preceding molt.

Figure 7. Juvenal and adult secondary patterns in Belted Kingfisher; the figure illustrates a typical s6. Note the shape of the black shaft streak near the tip. A similar difference can be found in Ringed Kingfisher.



Molt of the primary coverts appeared to parallel that in woodpeckers (Pyle and Howell in press), where the outer 1-4 feathers (and probably some innermost ones) are replaced during the second prebasic molt, and an irregular number are replaced during subsequent molts. Atypically, these

feathers do not appear to be replaced with corresponding primaries. If consistent in Belted Kingfisher this would provide the best clue to ageing, with SY/TYs having 1-4 consecutive, outer primary coverts black and fresh, contrasting with consecutive inner primary coverts brown and abraded (see Pyle and Howell in press). Several specimens had this pattern (e.g., CAS31830 mentioned above and MVZ23674 collected in June), and, along with retained juvenal secondaries, were aged TY. More study is needed on retention patterns of flight feathers in Belted Kingfisher, based on a larger series of AHY/ASY birds. Examination of twelve Ringed Kingfisher *(C. torquata)* specimens suggests that the same molt patterns and ageing criteria apply in this species, possibly with more feathers retained, on average.

Flight-feather molt in Green Kingfisher *(Chloroceryle americana)* differed from that of Belted Kingfisher in that up to six outer primaries and 3-5 secondaries (among s6-s13) are replaced during an extended first prebasic molt, and that subsequent prebasic molts appeared most often to be complete. Thus, HY/SYs could be separated from AHY/ASYs during winter and spring by contrasting new and old primaries and secondaries. A few AHY/ASY birds may have had one or two retained primaries and secondaries (e.g., MVZ82240, collected in Texas in January, with p5 and s11-s12 on each wing retained and apparently having completed molting), but juvenal and adult secondaries were difficult to distinguish and such birds were aged AHY/ASY. The primary coverts typically appeared to be retained completely in HY/SYs, being uniformly greenish-brown when worn, and completely molted in most AHY/ASYs, being uniformly dark glossy green. Some AHY/ASY specimens may have had mixed generations of primary coverts but, again, separation of SY/TY from ASY/ATY based on retention patterns appeared to be difficult at best. Possible extended or year-round breeding, especially in tropical American populations, may complicate molt patterns and ageing in this species.

CONCLUSIONS

Knowledge of flight-feather retention patterns and timing, along with differences between juvenal and adult flight feathers, can be used to confidently place individuals of many North American near-passerines in older age categories than are currently being assigned. In many species the retention of juvenal or adult flight feathers, especially among the secondaries, can be used to age birds through SY/TY or ASY/ATY. Reliable ageing of near-passerines, however, requires caution and/or experience in many cases. In many birds, molt patterns may not be easily distinguished without practice, or may conflict with what would be expected given the above information. Responsible ageing always includes the willingness to place a bird in a less-precise age group should any uncertainty exist. While it is expected that the above criteria will assist in the more accurate ageing of near-passerines in North America, confirmation and/or further information is needed based on study of known-age captive or marked individuals.

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News, Notes, Comments

Live Recovery of a Venerable Raptor
A Longevity Record for the Red-tailed Hawk

On 12 November 1994, a banded Red-tailed Hawk *(Buteo jamaicensis)*, USFWS #877-17127, was captured at the Kittatinny Mountains Raptor Banding Station, Sussex County, New Jersey, by Chris Lanna. This bird had been banded by Chet Robertson as an AHY, near Kempton, Pennsylvania, on 21 October 1972. Using the Bird Banding Laboratory's (BBL) assumed hatching date of 1 June (Clapp, R.B.; M.K. Klimkiewicz; and J.H. Kennard. 1982. Longevity records of North American Birds: Gaviidae through Alcidae. *J. Field Ornithol.* 53:81-124), this bird had lived a minimum of 23 years, 5 months--a longevity record for the species. Lanna reported the bird was in good condition, was alert and strong, and appeared to be healthy in every way.

I think it's noteworthy that the USFWS lock-on band, which also had endured for over 22 years, was still in good condition. Although the lock-on flange was slightly loose and needed tightening, the band was legible and showed only minimal wear. The bird was photographed and released.

BBL records indicate that as of 31 August 1994, there have been 101,548 Red-tailed Hawks banded, and 5,194 (5.1%) have been recovered. The recovery data clearly shows that although these raptors are capable of living long lives, very few actually do. Of the 5,194 recovered birds, only 31 survived 17 years or more, and just 11 survived 20 years or more. The longevity record for the Red-tailed Hawk (2 individuals) was 22 years, 7 months (Klimkiewicz, M.K. and A.G. Futcher. 1989. Longevity records of North American birds: supplement 1. *J. Field Ornithol.* 60:469-494.). The bird described here surpasses that record by nearly one full year.

Clapp, et al. (1982) and Klimkiewicz and Futcher (1989) provided a list of longevity records of North American birds. Of the 24 species of diurnal raptors included in the list, only the following four were shown to have survived 20 years or longer in the wild:

Black Vulture *(Coragyps atratus)*. . . . . 25 years, 6 months

Osprey *(Pandion haliaetus)*. . . . . 23 years, 0 months

Red-tailed Hawk *(Buteo jamaicensis)*. . . . . 22 years, 7 months

Bald Eagle *(Haliaeetus leucocephalus)* . . . 21 years, 11 months

Thus, the 23 year, 5 month old bird described here is the oldest Red-tailed Hawk and the second oldest diurnal North American raptor known--a venerable bird, indeed.

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