

AGEING NORTH AMERICAN LANDBIRDS BY MOLT LIMITS AND PLUMAGE CRITERIA

*A PHOTOGRAPHIC COMPANION TO THE
IDENTIFICATION GUIDE TO
NORTH AMERICAN BIRDS, PART I*

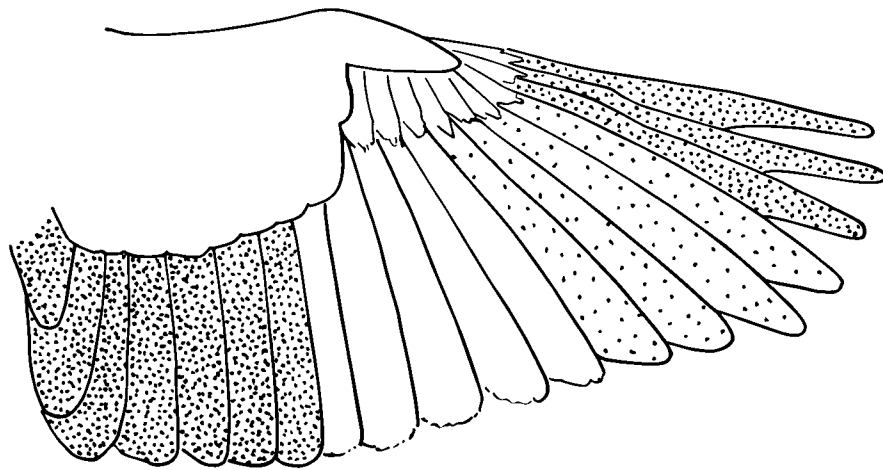


Dan Froehlich

Slate Creek Press

AGEING NORTH AMERICAN LANDBIRDS BY MOLT LIMITS AND PLUMAGE CRITERIA

A PHOTOGRAPHIC COMPANION TO THE IDENTIFICATION GUIDE TO NORTH AMERICAN BIRDS, PART I



Dan Froehlich

Slate Creek Press
Bolinas, California

Ageing North American Landbirds by Molt Limits and Plumage Criteria.
A Photographic Companion to the Identification Guide to North American Birds, Part I.
Copyright ©2003 by Dan Froehlich. All rights reserved.
Second Revised Edition Copyright ©2009 by Dan Froehlich

ISBN: 0-9618940-2-4
Library of Congress Control Number: 2003104679

Printed in the United States of America by Government Printing Office.

Designed and produced by David F. DeSante, Peter Pyle, and Nicole Michel for
Slate Creek Press, P.O. Box 219, Bolinas, California 94924.

A product of:



The Institute for Bird Populations
P.O. Box 1346
Point Reyes Station, CA 94956



U.S. Department of the Interior
Bureau of Reclamation
Lower Colorado Region
Boulder City, NV

TABLE OF CONTENTS

INTRODUCTION	1
AGEING LANDBIRDS BY MOLT LIMITS AND PLUMAGE PATTERNS	4
Prejuvenal (First Prebasic) Molt	4
Juvenal feathers	5
Preformative Molt	11
Where to look for molt limits	19
How to look for molt limits	25
Confounding Effects	39
Feather wear	39
Prealternate molts	45
Pseudolimits	46
Timing of molt	46
SUMMARY	47
REFERENCES	49
ACKNOWLEDGEMENTS	50

LIST OF FIGURES

Figure 1: Terminology for a generalized feather	2
Figure 2: House Wren, HY. June in MI.	6-7
Figure 3: House Wren, HY. August in CA.	6-7
Figure 4: Gray Catbird, SY. March in NC.	8-9
Figure 5: Hermit Thrush, HY. October in CA.	8-9
Figure 6: Comparison between juvenal and formative feathers	10
Figure 7: Acadian Flycatcher, SY. May in VA.	12-13
Figure 8: Audubon's Warblers, ASY male, left; SY male, right. March on Farallon Islands, CA.	12-13
Figure 9: Audubon's Warblers, ASY female, left; SY male, right. July in CA. .	14-15

Figure 10: Prothonotary Warblers, ASY female, above. Jul, loc. unknown; SY male, below. May in NC.	14-15
Figure 11: Philadelphia Vireo, HY. September in CA.	16-17
Figure 12: Audubon's Warblers, SY males. April in CA.	16-17
Figure 13: Wood Thrush, HY. September in NC.	18-19
Figure 14: Yellow Warbler, HY (female?). September in CA.	18-19
Figure 15: Vesper Sparrow, HY. July in CA.	20-21
Figure 16: Rose-breasted Grosbeak, SY male. April, loc. unknown.	20-21
Figure 17: Indigo Bunting, SY male. June in NC.	22-23
Figure 18: Northern Cardinal, SY male. May in VA.	22-23
Figure 19: Summer Tanager, ASY male. May in VA.	26-27
Figure 20: Prothonotary Warbler, ASY male. May in VA.	26-27
Figure 21: White-eyed Vireo, SY. April in NC.	28-29
Figure 22: "Traill's" Flycatcher, probably Alder, SY. May in VA.	28-29
Figure 23: Song Sparrows, HY left; SY, right. June in CA.	30-31
Figure 24: Black-and-white Warblers, AHY male, left; HY female, right. October in Cuba.	30-31
Figure 25: Red-breasted Sapsucker, TY. August in CA.	32-33
Figure 26: Downy Woodpecker, TY, male. April in NC.	32-33
Figure 27: Downy Woodpecker, ATY (4Y?), female. May in VA.	34-35
Figure 28: Carolina Chickadee, entering 2nd PB. May in VA.	34-35
Figure 29: Red-eyed Vireos, ASY, left; SY, right. May in VA.	36-37
Figure 30: Chipping Sparrow, SY. April in NC.	36-37
Figure 31: Indigo Bunting, ASY male. April in NC.	40-41
Figure 32: Indigo Bunting, ASY male. May in VA.	40-41
Figure 33: Myrtle Warbler, SY female. April in NC.	42-43
Figure 34: Blue Grosbeak, age ??, sex ??. May in VA.	42-43

INTRODUCTION

With the publication of the *Identification Guide to North American Birds, Part I* by Peter Pyle (1997a), hereafter "ID Guide," the most current information available on ageing North American passerines and near-passerines became available to the general banding public in a single volume. The detail presented, species by species, greatly expanded the opportunities for field ornithologists to discriminate, in particular, post-juvenal age classes of birds captured. The detail presented, however, also proved daunting to many banders used to relying simply on skulling and relatively obvious plumage criteria (e.g., for male American Redstarts) for ageing their captures. Several factors exacerbated the difficulties many banders experienced in applying the new criteria in the field.

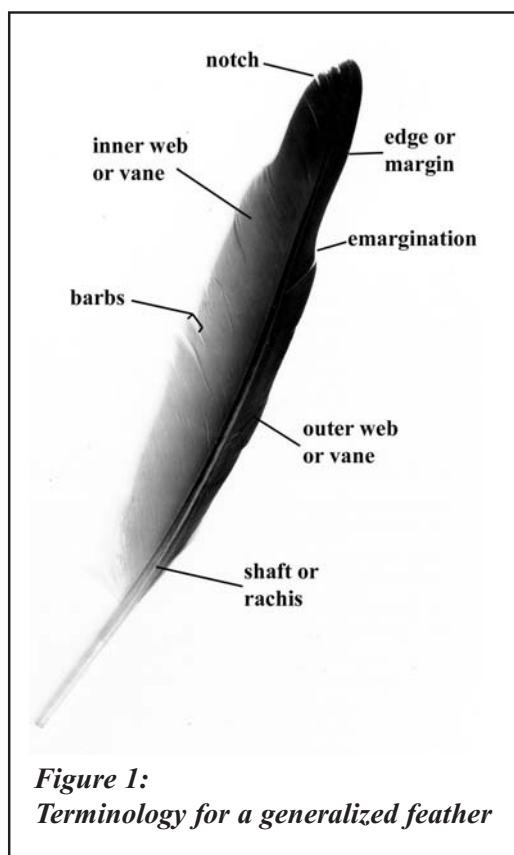
First, the main technique employed – close examination of wings for subtle contrasts in feather shape, length, wear, and hue – while in general use in Europe since the 1970s, was previously rarely applied in North America, except to the limited extent detailed in the initial edition of the ID Guide (Pyle *et al.* 1987) and for ducks (e.g., see Carney 1992), even though the significance of feather differences in recognizing plumage sequences was described by Dwight as early as the turn of the century (Dwight 1900). The general unfamiliarity with the technique left many banders at a loss as to what, exactly, they were looking for. The illustrations and descriptions in the ID Guide demonstrate the general principles important in distinguishing different generations of feathers, but the degree of complexity and the subtlety inherent in the plumage contrasts warrant further guidance.

Second, many of the criteria were developed by examining specimen series in museum collections. Both lack of experience with dozens to hundreds of specimens in direct comparison and lack of opportunity for direct comparison of different age classes in typical field settings made it particularly challenging for banders to match birds captured in the field to individual plumage descriptions in the ID Guide, particularly when the plumage descriptions appear similar.

Finally, the dense presentation of the information in the ID Guide – with abbreviations, complex punctuation, and a need to understand molt strategies and plumage patterns – discouraged some banders from attempting to apply the new techniques, particularly when faced with a stressed bird in the hand and a full page of plumage descriptions to read.

The idea for this visual aid came from experiences while teaching The Institute for Bird Populations' bird-banding classes and intern-training sessions. Frustration with the ID Guide, expressed in phrases such as "It always says the same thing for each species" and "What's the difference between 'bluish gray' and 'deep bluish gray'?" dissolved into exclamations of "Aha!" when in-hand captures illustrated molt limits and retention patterns particularly well. Good photographs, I thought, could provide the same experience. Indeed, *Moult and Ageing of European Passerines* by L. Jenni and R. Winkler (1994), a monumental photographic guide to molt patterns in 58 European species, provides extensive information on molt strategies and exquisite photographs of plumage patterns for the species covered, of which only Barn Swallow, Winter Wren, Common Redpoll, and Red Crossbill (see Index for scientific names of species) are regularly captured in North America outside of Alaska.

The goals of this guide are much more modest than those of Jenni & Winkler (1994). Rather than serve as a guide to molt strategies and the resulting plumage patterns in individual species, I only intend to demonstrate, with selected photographs of North American birds, the most common patterns of differential feather replacement among juvenile and adult birds that result in age-specific plumages identifiable in the hand. I do not dwell on the distinction between juvenile birds in full juvenal plumage and adults, as, for the most part, juveniles are easily distinguished (by skull, soft parts, and the plumage itself). Armed with a distinct image of the feather shapes and hues important for distinguishing post-juvenal age classes among a variety of species, banders will have a better search image for finding molt limits – or ascertaining their absence – in their subsequent banding. A discussion of how to look for molt limits should assist in this challenge.



To keep this guide short and to avoid unnecessary repetition, I have adopted most of the terminological conventions used in Part I of the ID Guide. One major exception is adoption of the terms "preformative molt" and "formative plumage" following Howell et al. (2003). These were termed "first prebasic molt" and "first basic plumage," respectively, in the ID Guide. Full familiarity with plumage and feather terminology (see Fig. 1, adjacent) as well as with the molt classification given in the ID Guide (as modified by Howell et al. 2003) is presupposed. To review this material, I recommend consulting the following pages in the ID Guide: p. 2 for plumage terminology; the inside back cover for a summary of abbreviations and molt strategies; and pp. 12-40 for details on molt strategies and plumage sequences as well as ageing techniques and using the Guide (see also Pyle 1997b). Also, the introductions to the bird families in the ID Guide are very helpful, particularly for woodpeckers (pp. 163-166) and passerines (pp. 207-211). Finally, in keeping with standard banding terminology, I age birds in terms of calendar year: HY – hatching year, AHY – after hatching year, SY – second year, ASY – after-second year, TY – third year, ATY – after third year, etc.

Here I concentrate exclusively on the relationship between molt and our ability to age birds. While this examination impinges on the functions of molt and its ecological adaptations, these aspects of molt are only addressed insofar as they can help us find molt limits. For a more thorough discussion of the function and consequences of molt, as well as more exhaustive discussions of the range of variation in molt strategies, see Jenni & Winkler (1994).

While this guide deals with the identification of post-juvenal age classes as an end in itself, it is worthwhile keeping two things in mind: first, distinguishing post-juvenal age classes is important not

so much because of its inherent value, but because evidence suggests that there are fundamental ecological differences between these age classes in migration phenology and routes, survivorship, site fidelity, breeding success, etc. The ability to distinguish these age classes provides scientists an opportunity to examine the ecological significance of these differences with much finer resolution.

Second, while the opportunity to differentiate post-juvenal age classes presents an exciting intellectual challenge, it is important to remember that many individuals show criteria that fall in overlap zones between the age classes and cannot be assigned accurately to a specific age class after the preformative molt. Learning where the limits of overlap lie for each species – and for each bander's powers of discrimination – is part of the intellectual challenge. In the meantime, it is important not to sacrifice accuracy for the sake of precision: i.e., an SY bird aged ASY based on tenuous familiarity with the salient criteria does much more harm to a data set than assigning an accurate yet imprecise age of AHY to the individual due to unfamiliarity with the criteria. Each capture, whether aged precisely or not, represents an opportunity for refining our ability to demarcate that discriminatory fine line for ourselves; recording suspected age as a note, when uncertainty prevails, can help solidify our discriminatory ability by offering a chance to compare suspected ages among recaptures. In the same vein, recaptures and birds ageable by other means represent particularly valuable opportunities for learning, for example, what "dusky" really looks like and how worn "relatively worn" is. In ageing by molt patterns, confidence grows with experience.

A final caveat: much of what is briefly presented here applies *generally*, but is not necessarily true in all cases. Feathers, molt strategies and plumage patterns are highly variable among and within species, the very reason the ID Guide has over 700 pages! Molt details for each species must be gleaned from the ID Guide.

AGEING LANDBIRDS BY MOLT LIMITS AND PLUMAGE PATTERNS

There is a simple reason why banders are able to distinguish various age classes of landbirds by plumage. It is that a bird's plumage always consists of those feathers replaced during the most recent molt and those retained from previous plumages. Among North American passerines, there are three molts with unique characteristics that produce age-specific plumage patterns: the prejuvenal molt, which produces the juvenal plumage, the preformative molt during the bird's first fall, and all subsequent prebasic molts. It is the differences among these molts that produce many of the differences in plumage which allow us to separate HY/SY's from AHY/ASY's. Prealternate molts tend to be more variable among all age classes often with less distinguishable results.

The unique features of these three molts are as follows:

The **prejuvenal molt** occurs prior to fledging and produces the bird's first set of non-downy feathers. **These feathers all grow in simultaneously and, probably as a result of the extreme energetic requirements of growing so many feathers at once, are of poor quality.**

The **preformative molt** proceeds sequentially, not simultaneously. However, typically during this molt, **not all of the feathers are replaced, particularly among the wing feathers: usually, the primary coverts and at least some primaries, secondaries, tertials, rectrices, and greater coverts are retained from the juvenal plumage.** Thus, after this molt, birds generally carry two generations of feathers: poor-quality juvenal flight feathers and coverts, and high-quality formative feathers.

During **prebasic molts in every subsequent fall, all feathers on a passerine are generally replaced.** Thus, after such molts, only one generation of feathers is present on the bird; the feathers are of a high quality and appear more or less uniform.

Thus, the trick to ageing birds by plumage is to identify what characteristics the previous molt had by assessing clues in the plumage: were all feathers replaced, resulting in a uniform plumage, or were some feathers retained from a previous plumage? When you combine that assessment with what is known about the molt strategies of that species – the information presented in the ID Guide – you can deduce the current age of the bird from the age it had when it underwent that previous molt. What are these plumage clues? To identify the clues, we must consider more thoroughly the nature of juvenal feathers in comparison to formative feathers, and the nature of the preformative molt. A number of confounding effects – feather wear in relation to feather exposure, feather replacement during prealternate molts, inherent differences between adjacent feathers ("pseudolimits"), and timing of molts – must also be considered when using these clues.

Prejuvenal Molt

The fact that juvenal feathers are all grown simultaneously and not sequentially as in all subsequent molts has important consequences for ageing birds. As feathers grow, feather material is synthesized both day and night; however, diurnal and nocturnal metabolic differences result in variation in the

pigment deposited during the day vs. that deposited at night. Often these differences can be detected in good light, especially on the flight feathers, as growth bars, subtle bars of color crossing a feather perpendicular to the shaft.

When nutritional changes or stress affect feather synthesis, such bars may become more apparent, with the feathers showing substantial pigment variation (Jenni & Winkler 1994, p. 51). When variation in the deposition of feather material results in structural variation in feather quality, the bars are termed fault bars.

Further, in some species groups which show barring on the flight feathers such as wrens (see Fig. 2, p. 7), the barring appears to be deposited similarly, perhaps through differences in nocturnal vs. diurnal deposition of feather material (pers. obs.). This may hold true for owls as well (Pyle, 1997c). In other groups, however, the location of bar patterns on the flight feathers, such as the white spots on woodpecker wings, appears to be preprogrammed regardless of the time of day feather growth occurs. And finally, aberrations in pigmentation occasionally appear in birds (Fig. 3, p. 7).

In each of these cases, the bars or colors will line up across all feathers that were produced simultaneously, since the factor influencing feather deposition is likely to have affected all follicles equally. Since the prejuvenal molt is the only programmed molt in passerines during which all flight feathers molt simultaneously, the presence of such patterns can indicate that those feathers originally appeared during the prejuvenal molt.

This criterion should be applied judiciously, however, for a number of reasons. Feathers that fall out accidentally will regrow simultaneously and may well show growth or other bars without indicating that they were produced during the prejuvenal molt. Tail feathers, in particular, are prone to accidental loss, often several or all of them together, and thus extra caution must be applied in ascribing tail feathers with bars that line up to the prejuvenal molt. In the Gray Catbird example (Fig. 4, p. 8), the presence of the growth bars on the outer three greater secondary coverts and their absence on the inner coverts indicates that two generations of coverts are present, but need not necessarily indicate that they were grown during the prejuvenal molt, since replacement of greater coverts tends to occur more or less simultaneously in many species.

In conclusion, feathers with bars that line up (proportionally to the relative lengths of the feathers) indicate that those feathers grew in simultaneously, while feathers that show staggered barring (again proportional to the relative lengths of the feathers) grew in sequentially. These bars may indicate a preceding prejuvenal molt (e.g., when bars on all flight feathers line up), an incomplete preformative molt (e.g., when bars on retained juvenal feathers line up while those on adjacent replaced feathers are staggered), or indicate accidental loss (e.g., when the feathers with bars that line up are not symmetrically distributed on both sides of the bird).

Juvenal feathers

In general, the feathers grown during the prejuvenal molt – the first set grown in the nest – differ fundamentally in a number of ways from all feathers grown subsequently. The main difference, common to every one of the juvenal feathers, is that they are structurally weaker than feathers grown

Figure 2: House Wren, HY. June in MI.

Figure 3: House Wren, HY. August in CA.

Both Figure 2 and 3 show lines of light brown and blackish crossing the outer vanes of each flight feather forming a bar extending across all feathers of similar length, indicating that these feathers may have grown in simultaneously (on the outer three primaries, the bars become more condensed as the feathers get shorter, progressively skewing the bar). Similarly, growth bars and fault bars, which are unprogrammed differences in color or material deposition, will form even bars across all feathers that grew in simultaneously. Occasionally, color aberrations will become part of the pattern of color deposition as well, again detectable on all feathers that grew in simultaneously. In the example in Figure 3, the unusual pale cinnamon tips to the primaries, secondaries and tertials can also be seen in the rectrices, the greater coverts, the flight feathers of the folded wing, and perhaps even the body plumage as well. The only programmed molt in passerines during which all flight feathers are grown simultaneously is the "prejuvinal" molt, produced in the nest. During all subsequent molts, flight feather replacement is sequential, and such bars may be slightly displaced from feather to feather, failing to form a perfectly straight line across the wing. By being aware of such overall patterns as you examine flight feathers, you can possibly deduce whether or not feathers sharing the bars grew in simultaneously. If this pattern is symmetrical on both sides of the bird's body, as in Figure 3, it is probably not the result of an accidental molt, but evidence of a preceding, simultaneous, prejuvinal molt (though caution is advised in making such determinations based on tail feathers alone, as these are the feathers most often lost accidentally). In House Wrens, flight feathers may be replaced during an incomplete, eccentric preformative molt (see Pyle 1997a, pp. 208-209), in which case only a block of retained, juvenal, outer secondaries and inner primaries in the middle of the wing might show bars lining up. For the most part, though, juvenal flight feathers are retained for over a year and replaced during the second prebasic molt. Thus, these two wrens are likely in their first year of life, and, based on the freshness of their flight feathers, in their hatching season. Neither appears yet to have undergone a preformative molt involving any flight feathers. In fact, from below, the primaries, secondaries, and tertials on the wing in Figure 2 are all still in sheath, i.e., growing in, indicative of a simultaneous "prejuvinal" molt.

Caution is advised in applying this criterion to other groups showing bars in the wings. In woodpeckers, for example, white bars in wings line up whether or not the feathers molted simultaneously. Wrens and owls are the only species currently suspected of showing bars whose distribution on the feathers may be partially sensitive to simultaneous versus sequential growth; however, a critical study is needed to verify these patterns and their utility in ageing.

subsequently. Often identified as "loosely textured" or "poor-quality" feathers, they show two main characteristics that are visible to the trained but naked eye and can serve to distinguish them from formative and basic feathers grown subsequently from the same follicle: (1) around the base of the shaft they are more downy and toward the tip show a reduced area in which the barbs are linked by hamulus-barbicel hooks to form an interlocking vane, and (2) the barbs are spaced more widely apart along the shaft giving the juvenal vane a coarser look. Conversely, formative and basic feathers grown later show a denser, finer appearance by comparison.

Both of these features are readily apparent in the comparisons shown in Figure 6 (p. 10). Of course, it is virtually impossible to collect feathers sequentially from the very same follicle; generally, however, adjacent follicles in the same feather tract will produce similar feathers during the course of a given molt. It is important not to compare feathers from different tracts, since some tracts are

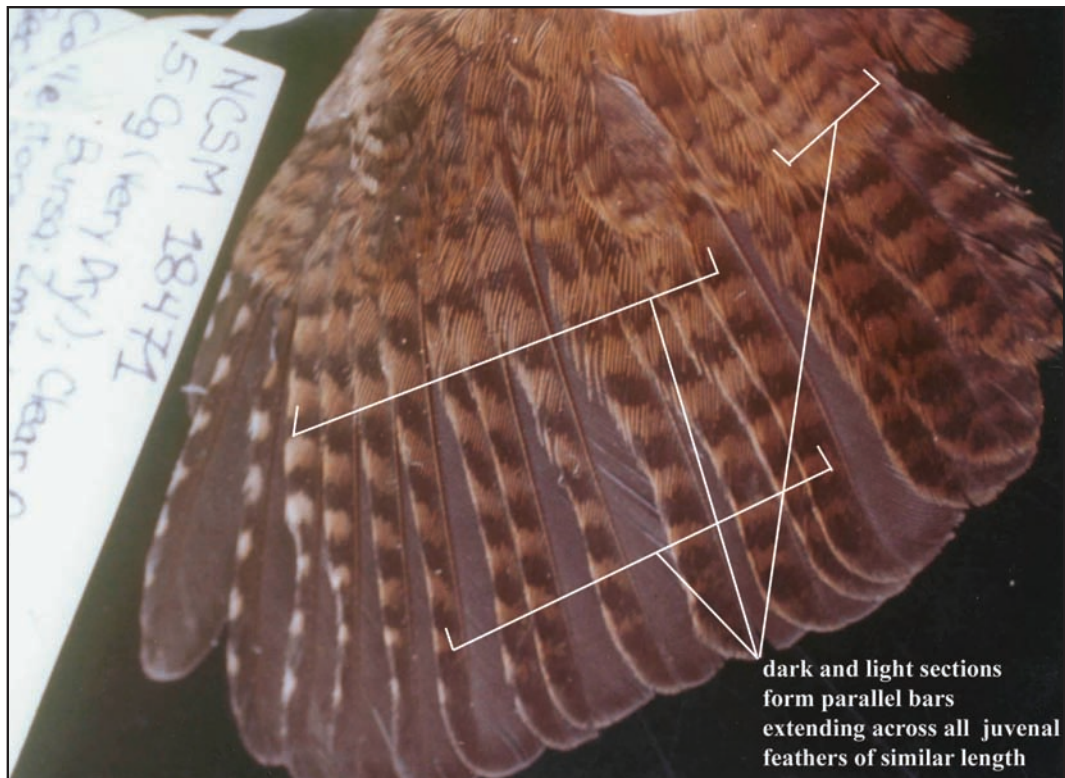


Figure 2

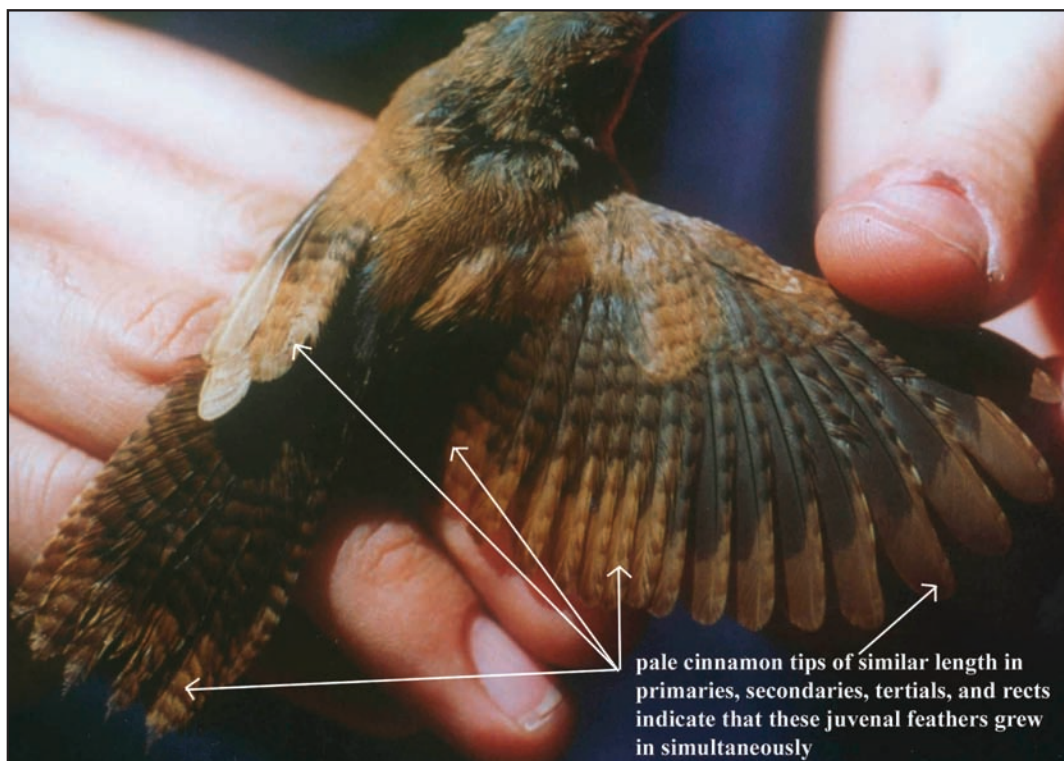


Figure 3



Figure 4



Figure 5

Figure 4: Gray Catbird, SY. March in NC.

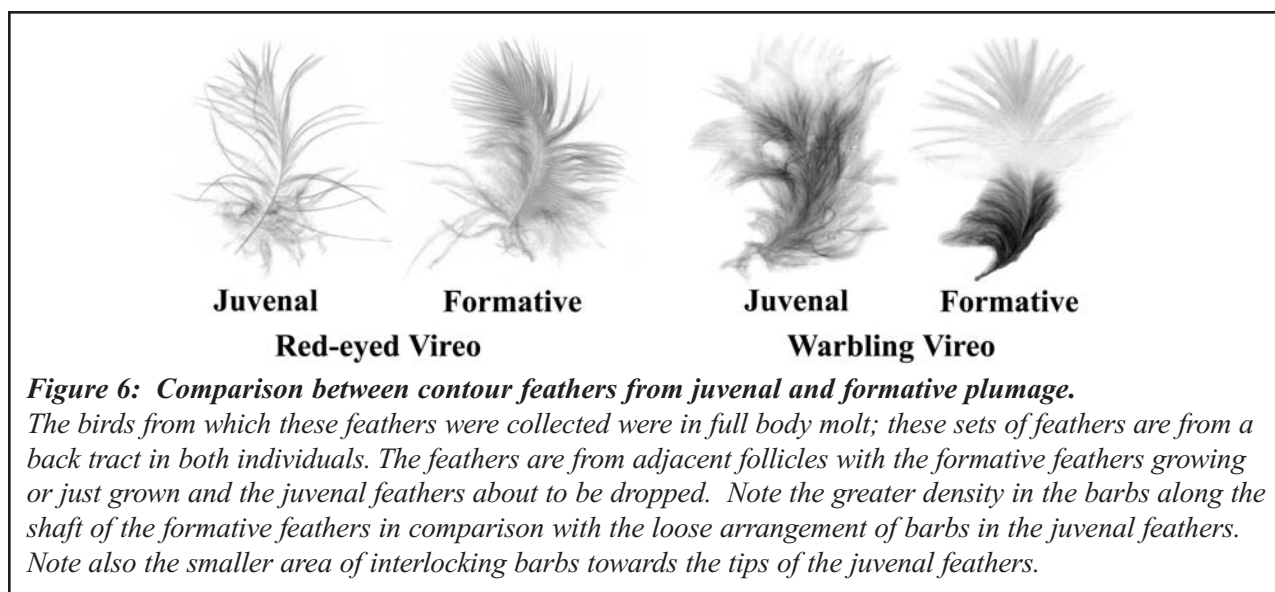
In catbirds, the differences between replaced juvenal and retained formative feathers are generally obvious, with the replaced feathers a bluish slate-gray while the retained feathers always maintain a brownish wash. Often, the retained feathers – which generally include the primary coverts, remiges, and some outer greater coverts – also show a slight brownish edging (unfortunately, the browns in this picture were underdeveloped). These color contrasts on the wing can often be seen at a distance, even when the wing is closed; sometimes the differences are so strong that the molt limit within the greater coverts appears to separate two different feather tracts. Other differences between the two feather generations are also apparent in this picture: first, the replaced feathers are slightly longer than the retained feathers, highlighting the difference between the two groups. Second, and more subtly, the barbs in the replaced feathers are denser along the shaft, or, conversely, the spacing between the barbs emanating from the shaft is wider in the retained juvenal feathers than in the replaced formative feathers. This is most apparent when you contrast the outer web of the two feathers defining the molt limit. Apparently, the median and lesser coverts were also replaced during the preceding preformative molt, since they match the color of the replaced greater coverts most closely. Finally, the barring pattern – a broad, light terminal band with a narrower band above it – uniform across all of the retained greater coverts, probably represents growth or even fault bars; however, the fact that those feathers grew in simultaneously may not positively indicate that they were produced during prejuvenal molt, since those greater coverts that are grown during any molt may often molt more or less simultaneously. In this case, the growth bars do indicate that the three feathers showing them grew in together, while the others grew in at another time, lending further support to the already obvious molt limit.

inherently wispier or downier than others; thus flank feathers in adult birds often look similar to the juvenal breast feathers depicted in Figure 6 (p. 10). While all juvenal feathers are relatively wispier than their formative and basic counterparts, tracts of contour feathers that display juvenal features particularly reliably are the feathers of the nape and the upper- or undertail coverts. Furthermore, the nape feathers are among the last to molt and are thus among those feathers that will retain their juvenal characteristics the longest during a preformative molt that includes all body feathers.

The feathers shown in Figure 6 (p. 10) are indeed comparable: a juvenal feather about to molt and a formative feather still in sheath from an adjacent follicle in the same tract. In general, the first characteristic, the downiness and the restricted vane, is readily apparent only in contour feathers; it is not apparent in flight feathers or wing coverts. The lower density of barbs along the shaft, however, is common to all juvenal feathers and can be discerned among the feathers of the wing – with training and practice – particularly in individuals that show mixed juvenal and formative feathers within one feather tract in HY/SY plumage, such as the greater coverts (see Gray Catbird (Fig. 4, p. 8) and Hermit Thrush (Fig. 5, p. 8)).

Figure 5: Hermit Thrush, HY. October in CA.

In this Hermit Thrush wing, the molt limit among the greater coverts is subtle: only the innermost large greater covert has been replaced (excluding the shorter, innermost tenth which covers the basal right half of the short, innermost tertial). It shows three very subtle differences from the adjacent, retained feather: it is slightly grayer, less brown; it shows denser barbs (compare the barb density at the tip of the inner web); and, as is also seen in the Wood Thrush (Fig. 13, p. 19), the pale tip is less concentrated and does not coalesce into a shaft streak.



The enormous energetic cost incurred by growing a full set of feathers all at once probably prevents substantial investment of resources into any individual feather. While rapid growth of the juvenal plumage allows the young birds to leave the nest quickly – the nestling stage is the most vulnerable period in their life – it also produces feathers that are weak in structure. This has profound implications for their relative durability. They simply do not withstand the elements as well as feathers grown subsequently. The supreme importance of this in ageing birds will be elaborated under "Feather Wear," p. 39.

Before we consider preformative and prebasic molts, though, two other unique features of juvenal feathers should be mentioned. These are length and shape. Juvenal feathers tend to be shorter than subsequent feathers. This is particularly noticeable in wing measurements: HY birds that retain their juvenal flight feathers tend to show wing-length distributions that average lower than AHY birds with basic flight feathers, especially when broken down by sex. This contrast in length is often detectable by the naked eye in birds that undergo an incomplete preformative molt, replacing some primaries. Instead of an even increase in length outwards from one primary to the next, a small step can often be detected between the remaining juvenal inner primaries and the replaced formative outer primaries. While the distinctness of the step can be highlighted by wear, it is not merely an artifact of wear; even fresh wings can show it. While this step has long been described in Yellow-breasted Chat (Phillips 1974), it can also be found in White-eyed Vireo (Fig. 21, p. 28), Song Sparrow, Indigo Bunting, and Bewick's Wren, among others (see Pyle 1997b). The same pattern is followed by most other feathers as well, e.g., the greater coverts in the Gray Catbird (Fig. 4, p. 8) and Acadian Flycatcher (Fig. 7, p. 13).

Finally, shape is an important distinguishing feature of juvenal feathers, particularly flight feathers. While the contrast between tapered and narrow juvenal feathers and truncate (squared-off) and broad formative and basic feathers has been adequately illustrated in the ID Guide (on pp. 210-211, as well as in many species accounts), it is worth discussing briefly and illustrating with some photographic

examples. Comparative shape of rectrices (Audubon's Warblers (Fig. 8, p. 13)), primary coverts (Audubon's Warblers (Fig. 9, p. 14) and Prothonotary Warblers (Fig. 10, p. 14)), and primaries (Prothonotary Warblers (Fig. 10, p. 14)) can be very helpful as ageing criteria.

The ID Guide often specifies which particular feathers in each tract are worth looking at. If it does not, I recommend rectrices 4-5, the two primary coverts in from the outermost one, and generally the outer primaries; these seem to show shape differences most reliably, as put into evidence by the examples. However, always make sure the age of the feathers you are looking at match the age of the homologous feathers on the other side of the bird. In particular, relying on tail shape is risky, as the tail feathers are those most likely to be lost and replaced adventitiously, outside of a programmed molt. Accidentally lost juvenal feathers generally are replaced by definitive feathers (a good example is the Philadelphia Vireo, Figure 11 (p. 17), which has replaced the second visible primary covert from the outer side of the wing; the contrast between the truncate feather and the tapered ones is striking). Thus, while the *presence* of juvenal feathers can be used as proof that a bird is in HY/SY plumage, their *absence* may not necessarily prove that the bird is *not* in HY/SY plumage, especially if the tail is the sole criterion under consideration.

Shape can be a very subtle feature; ageing using shape is best learned by comparison. Generally, it is not easy to tell tapered from truncate feathers on examination of your first captures of a species. Consult with others who have more experience with that species; better yet, examine several and see if they start to fall into two groups; or, best of all, try to use other criteria to age the bird, *then* study – and imprint in your mind – the shape of the feathers of the known-age bird. Some warnings: first, shape is species-specific. Compare the primary coverts of an ASY Prothonotary Warbler (Fig. 20, p. 27) to those of an ASY Summer Tanager (Fig. 19, p. 27), for example. In direct comparison the tanager's coverts appear pointed and narrow. Second, there is a fairly wide range in shape that even birds of the same age may show. For example, on the Audubon's Warblers' wings in Figure 12 (p. 17), the primary coverts of the bird on the right appear more truncate, but both wings are from SY males on April 12. Third, in some species and/or individuals, differences in shape may not be apparent between juvenal and adult-type feathers. On the Northern Cardinal in Figure 18 (p. 22), the outer two primary coverts are retained juvenal feathers but are not distinctly tapered or narrow in comparison with the replaced formative coverts. On the basis of shape alone, many birds may have to be left unaged, especially as you are learning.

Preformative Molt

Unlike the prejuvenal molt, which is unique in involving all feathers at once, the preformative molt is unique among post-juvenal molts in that it is generally not complete and, further, is quite variable in extent. There are, of course, exceptions: some species can show complete preformative molts; these include many columbids, cuculids, Black Swift, hummingbirds, some flycatchers, larks, swallows, Bushtit, many Wrentits, European Starling, Phainopepla, some *Aimophila* and *Ammodramus* sparrows, Northern Cardinal, some blackbirds, and weavers. These species are generally best aged, when possible, by differences in the actual plumages of the various age classes or by non-feather characteristics (skull pneumaticization, bill color, iris color, etc.). Other species can show incomplete **adult** prebasic molts; these include most columbids, most cuculids, most owls, nightjars, trogons, kingfishers, and woodpeckers. Ageing in these groups can often be accomplished

Figure 7: Acadian Flycatcher, SY. May in VA.

In this Acadian Flycatcher wing, the difference between the four, inner, replaced greater coverts (long and blackish with broad, clean, lemon to whitish tips) and the outer retained coverts (short and brownish with more worn off-white edging) is relatively apparent. What is visible of the median coverts appears to match the new greater coverts in freshness. Even the difference between the inner two tertials, which are blackish, broadly and freshly edged in pale yellow, and the outer tertial and remaining secondaries, which are browner with narrower edging and show more wear, is not difficult to detect. In this species, preformative molts generally include hardly any wing feathers; first prealternate molts, on the other hand, frequently include secondary coverts and tertials, while subsequent prealternate molts generally include at most two greater coverts and tertials (ID Guide, p. 223). Thus, although this wing shows a molt limit that stems from a recent prealternate molt, the differences between the first prealternate and subsequent prealternate molts may well allow a specific age class distinction based on the extent of the prealternate molt. Finally, the dull brown primary coverts lacking green edging corroborate the age of this individual as an SY.

by careful consideration of the specific differences in feather replacement pattern during the preformative and prebasic molts of each age class.

This guide focuses on providing assistance in assigning age classes to birds in those species in which differences between the extent of the preformative molt and subsequent prebasic molts are the main criteria on which such distinctions are based – basically most passerine birds. In these species, it is

Figure 8: Audubon's Warblers, ASY male, left; SY male, right. March on Farallon Islands, CA.

The two birds in Figure 8 show significant contrast in the shape of the rectrices: those on the bird on the left are squared off, "truncate," typical of spring ASY's, while, by contrast, those on the bird on the right are clearly narrower and tapered at the tip, typical of spring SY's. Although in this classic comparison, each of the tail feathers demonstrates the contrast, the characteristic shape is generally most reliable in rectrices 4 or 5. Generally, the contrast becomes most apparent by assessing the overall width of the feathers and the angle and/or rounding formed by the shape of the inner vane coming off the central shaft at the tip of the feather: relatively acute in juvenal-grown feathers and closer to squared-off in subsequently-grown feathers. These contrasts are apparent in any of the rectrices in the picture.

Other age-related contrasts shown in the picture include the duller color of all of the SY's flight feathers; the narrower, more pointed primaries in the SY; and the SY's more worn and less brightly edged flight feathers (e.g., note the central rectrices).

The brilliant white edging on the ASY's greater coverts are typical of alternate feathers; the SY, lacking such feathers entirely, apparently has not yet undergone its prealternate molt or skipped these feathers: perhaps it is a female? Knowing, however, that the bird is an SY, based on the contrasts discussed above, we can exclude the possibility that it is a female; this bird shows white on R3 and even a spot on R2, more typical of males than females; the bluish-gray edging of the uppertail coverts corroborates the sex. It is an SY male that probably has yet to undergo his partial prealternate molt, during which he will acquire more bluish-gray in his body plumage as well as probably at least a few brilliant white-edged inner greater coverts. All of the flight-feather characteristics discussed for ageing, however, will remain unaffected.

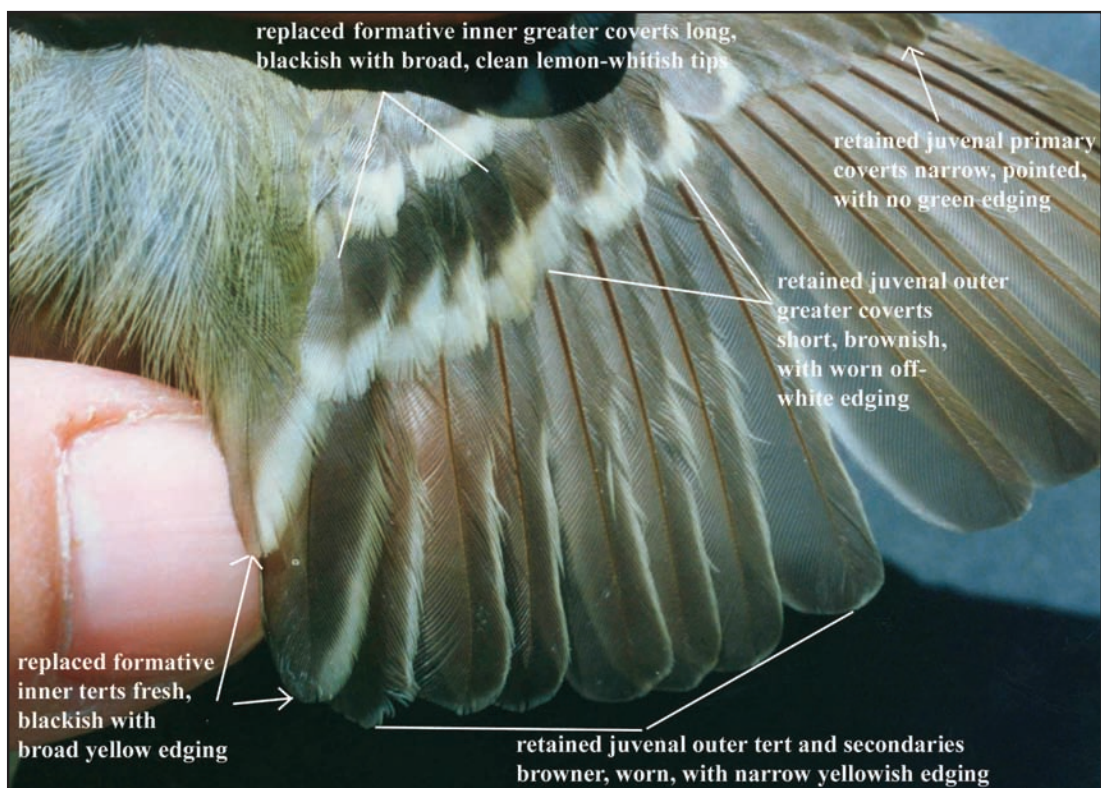


Figure 7

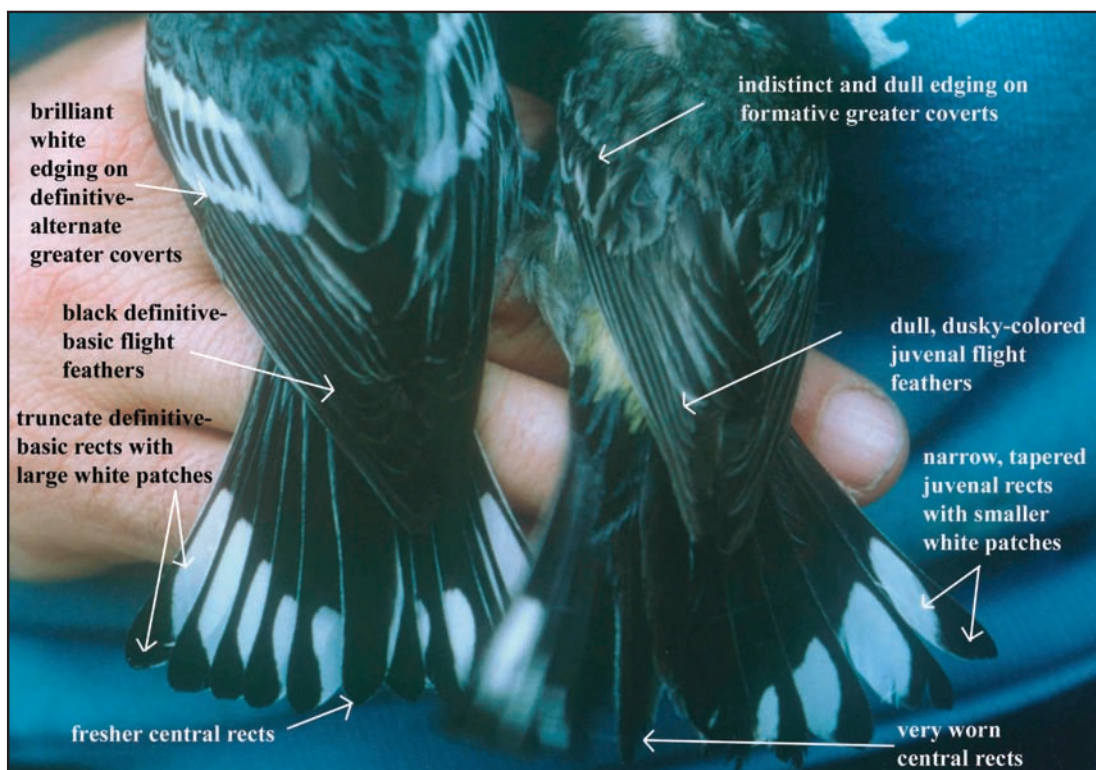


Figure 8

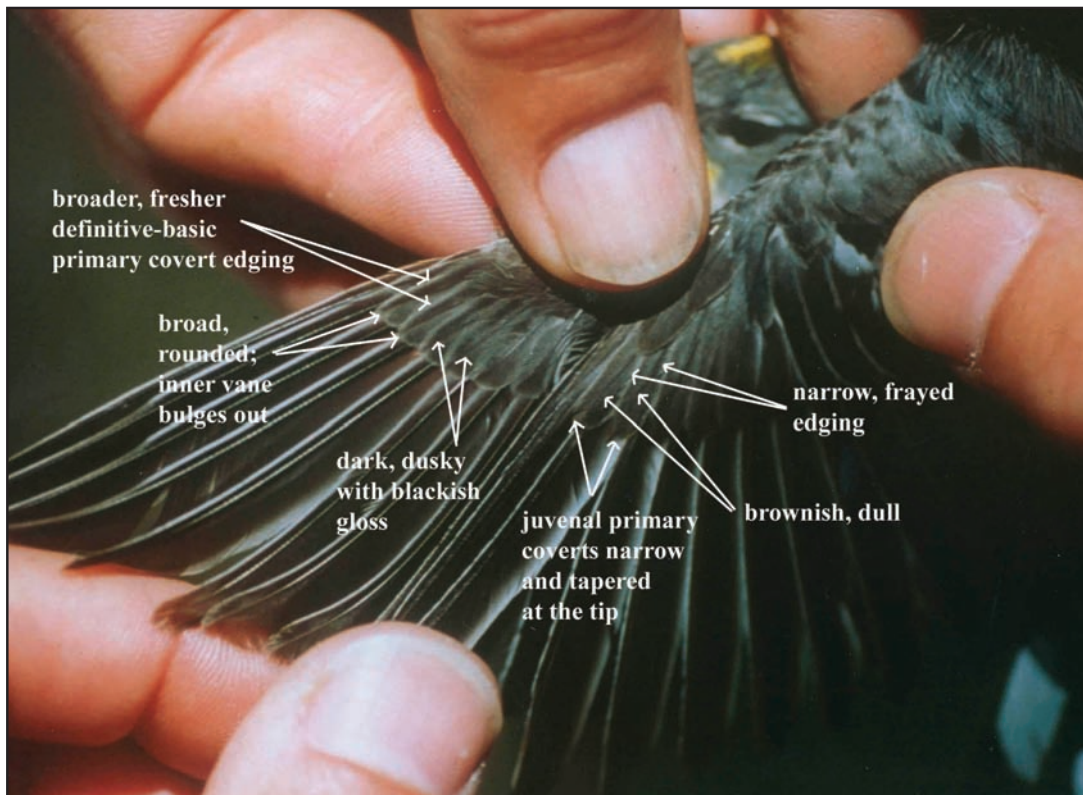


Figure 9

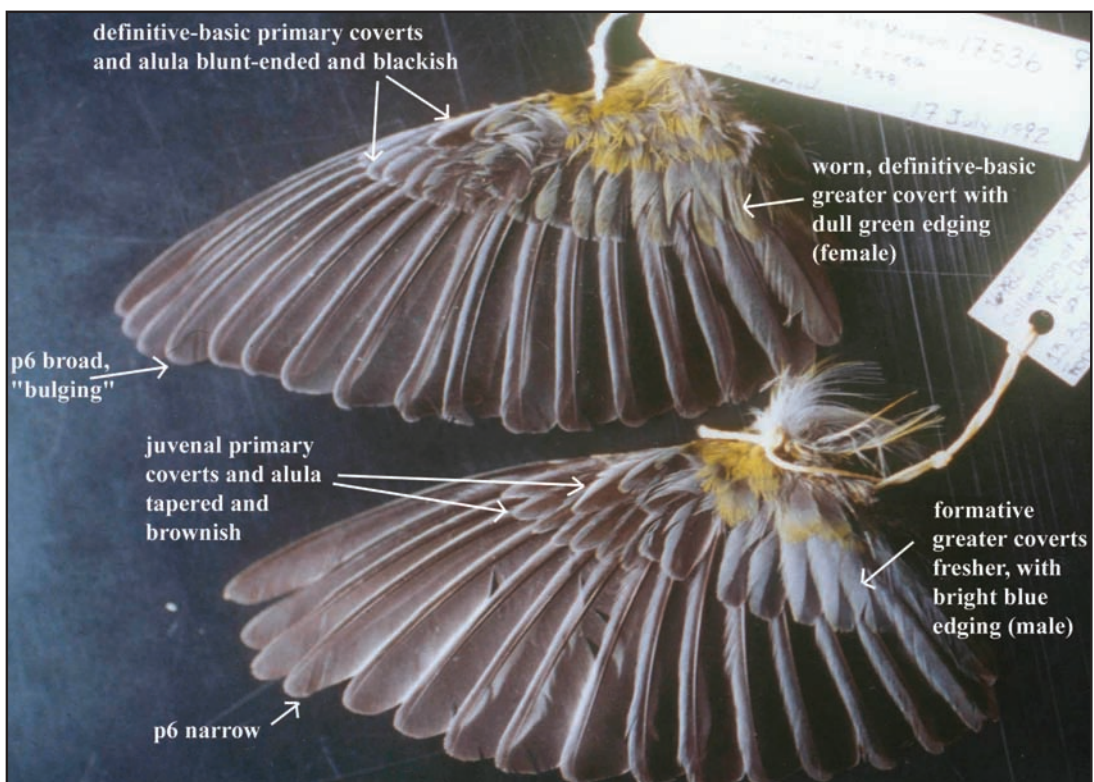


Figure 10

Figure 9: Audubon's Warblers, ASY female, left; SY male, right. July in CA.

The two wings shown in Figure 9, held one right next to the other, serve to contrast the primary coverts of SY (right) and ASY (left) Audubon's Warblers. To make the comparison it is important to consider comparable feathers: the tiny outermost primary covert, not visible in the SY appears as a tiny blackish, white-edged bulge at the very base of the outermost primary in the ASY; it is backed almost entirely by the index finger. This covert is always pointed, tiny, and often not readily apparent. The next one in, primary covert 8, barely shows its tip in the ASY and is markedly shorter than the remaining primary coverts; in the SY, it is present but masked by the next covert in. The next two coverts in, primary coverts 7 and 6, are the ones most easily seen in the SY (the remaining ones are obscured by the shade) and are readily apparent in the ASY. These are the two in which contrasts in primary coverts between SY's and ASY's are usually the most apparent. There are three main differences between those two feathers in the two wings: first, the tip of the basic ASY coverts are broader and more rounded, with the inner vane bulging out, while the juvenal SY coverts are narrower and tapering distinctly, especially in the inner vane toward the tip. Second, the ASY feathers are dusky, showing a blackish gloss; the SY coverts are brownish, lacking the gloss, luster, or color saturation shown by the ASY coverts (this is not an artifact of lighting). Third, the SY coverts show more wear, with more fraying in the edging than the cleaner-edged, fresher ASY coverts. Note, however, that the edging color, after about 12 months exposure has dulled to an almost indistinguishable beige on both feather sets. Differences in edging are most useful on fresh feathers and often fade and wear to uselessness over time.

Figure 10: Prothonotary Warblers, ASY female, above. July, loc. unknown; SY male, below. May in NC.

The two Prothonotary Warbler wings in Figure 10 embody some of the fundamental differences between SYs (below) and ASYs (above) in a species with a partial preformative molt and no prealternate molt. These are primary shape, primary covert shape, alula shape, and overall flight feather color. Primary shape is a subtle character generally apparent only in direct comparison like this; therefore, it is not often mentioned in the ID Guide. In this photo, the difference is most apparent in primary 6 (the outermost primary is primary 9), with the inner web of the basic ASY primary 6 bulging farther before turning up toward the coverts, while the juvenal SY primary 6 angles up toward the coverts more rapidly. More satisfying are the differences in shape in the primary coverts and the alula, with the ASY's broader and blunt-ended and the SY's clearly tapered, or even pointed, by comparison. Comparing the overall vane color of the primaries, primary coverts, and, in particular, the alula – the feathers where the colors are truest in this photo – a subtle difference between a blacker hue in the basic feathers of the ASY and a paler brown in the juvenal coverts of the SY emerges.

One further contrast between the two wings is not age-related. The most apparent color contrast between the two wings, the difference between the greenish edging of the ASY's greater coverts and the bluish edging of the SY's greater coverts is, in fact, sex-related: the SY is a male, the ASY is a female. As a species that undergoes a partial preformative molt, the SY male apparently replaced all of its greater coverts as well as the median and lesser coverts, the carpal covert, the alula covert, and the lesser alula (but not the primaries, secondaries, greater alula or primary coverts) during its preformative molt at about the same time in the season that the ASY molted all of its feathers during the prebasic molt. The two months' difference in collection date, (July for the ASY and May for the SY) may explain the greater degree of wear seen in the ASY's secondary coverts (though that may also be an artifact of rougher post-mortem handling).

This difference in collection date makes for one final interesting comparison: obviously, because of the collection date, it would not be possible to capture two such birds at the same time. Because the

Figure 10 caption continued on p. 16

Figure 10 (continued from p. 15)

difference in collection month corresponds approximately to the difference in the timing of the molts that produced the flight feathers on the two birds, the feathers have experienced equal exposure; thus, any remaining differences in shape or color must be inherent to juvenal vs. subsequently grown feathers and their reaction to exposure. In fact, differences between the feathers of the two age classes would be exaggerated when caught during the same day, since the broader, stronger, glossier ASY feathers grew during the previous prebasic molt, while the narrower, weaker, paler juvenal SY feathers grew during the "prejuvenal" molt, one to three months earlier.

Figure 11: Philadelphia Vireo, HY. September in CA.

The contrast between the replaced greater coverts and the retained primary coverts is not immediately apparent in this Philadelphia Vireo. The primary coverts, however, lack the gloss and bright color that the greater coverts show on their outer web; they also show considerably more wear. Most obvious in this wing is the sharp contrast between the one replaced primary covert, rounded, fresh, and with a bright green luster; the second from the outside, and the remaining duller brown, tapered, retained juvenal primary coverts. The tapered rectrices corroborate the HY designation.

Figure 12: Audubon's Warblers, SY males. April in CA.

Both birds belonging to these wings were recovered on the Farallon Islands on April 12. At first glance, one might be tempted to detect a difference in primary covert shape between the two wings, with the wing on the right showing broader, more truncate coverts compared with the more pointed coverts of the bird on the left. Closer examination should reveal that both sets show fairly tapered and narrow coverts. Further, there are no obvious differences in flight feather hue – both are fairly dull brownish – or in wear. Both do show contrasts between pale brown juvenal primary coverts and adjacent formative outer greater coverts, the centers of which are somewhat duskier; the contrast in both wings is strongest between the primary coverts and the carpal covert, which, in both wings, happens to cover the base of the two innermost primary coverts. Both wings are from SY birds with replaced formative secondary coverts as well as a replaced carpal covert but retained juvenal alulas, primary coverts, primaries, and secondaries.

The most striking contrast visible here, however, is not between juvenal and formative feathers, but in the extent of the first prealternate molt undergone by the two birds. While the wing on the left apparently shows only a single feather replaced in the prealternate molt – actually the eighth greater covert (with the ninth and tenth obscured), which contrasts with the remaining greater coverts because it is blackish, broadly white-edged and perhaps slightly longer – the wing on the right shows six replaced greater coverts, as well as several replaced median coverts and other visible blue-gray feathers replaced during its prealternate molt. Thus, both of these birds show three feather generations: juvenile primary coverts and remiges; formative greater and median coverts; and one to many first alternate greater coverts and, in the bird on the right, median coverts. Neither bird replaced as many feathers during the definitive prealternate molt as the ASY Audubon's Warbler shown in Figure 8 (p. 13); however, they could have. Prealternate molts do not tell us much about a bird's age in this species, but it is important to be able to identify their effects and their variability, so as to discount them, if necessary. In these wings, then, the important features for ageing were those unaffected by the prealternate molt: the shape of the juvenal primary coverts and their contrast with the outer, formative greater coverts.



Figure 11

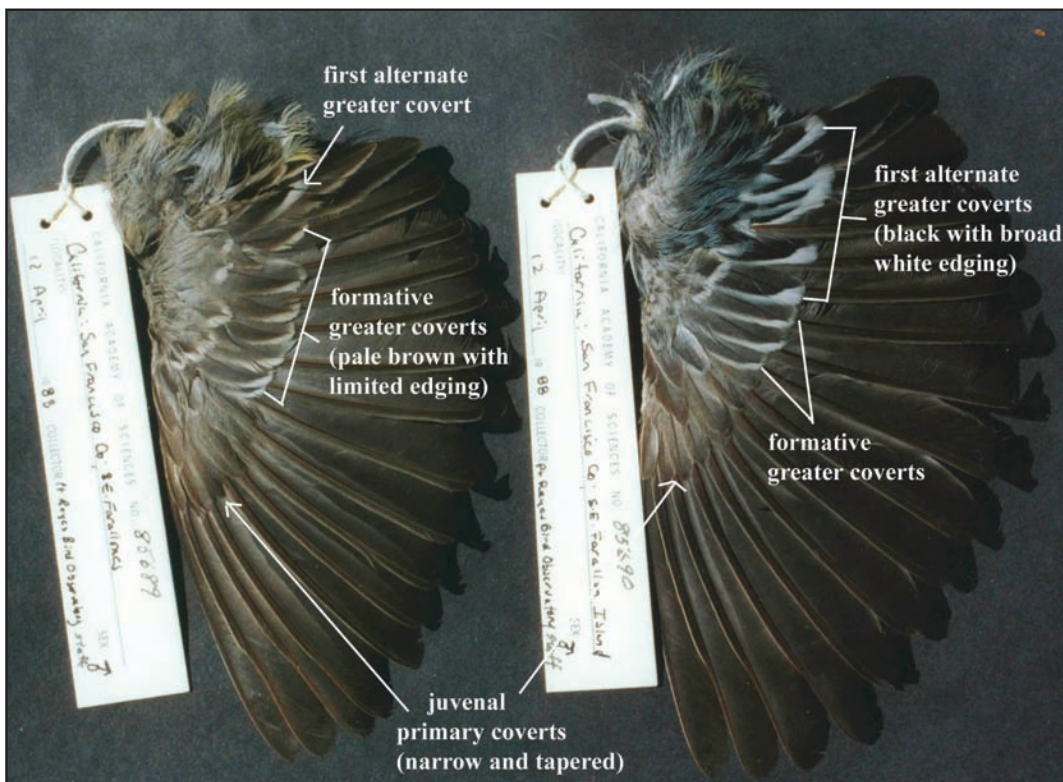


Figure 12

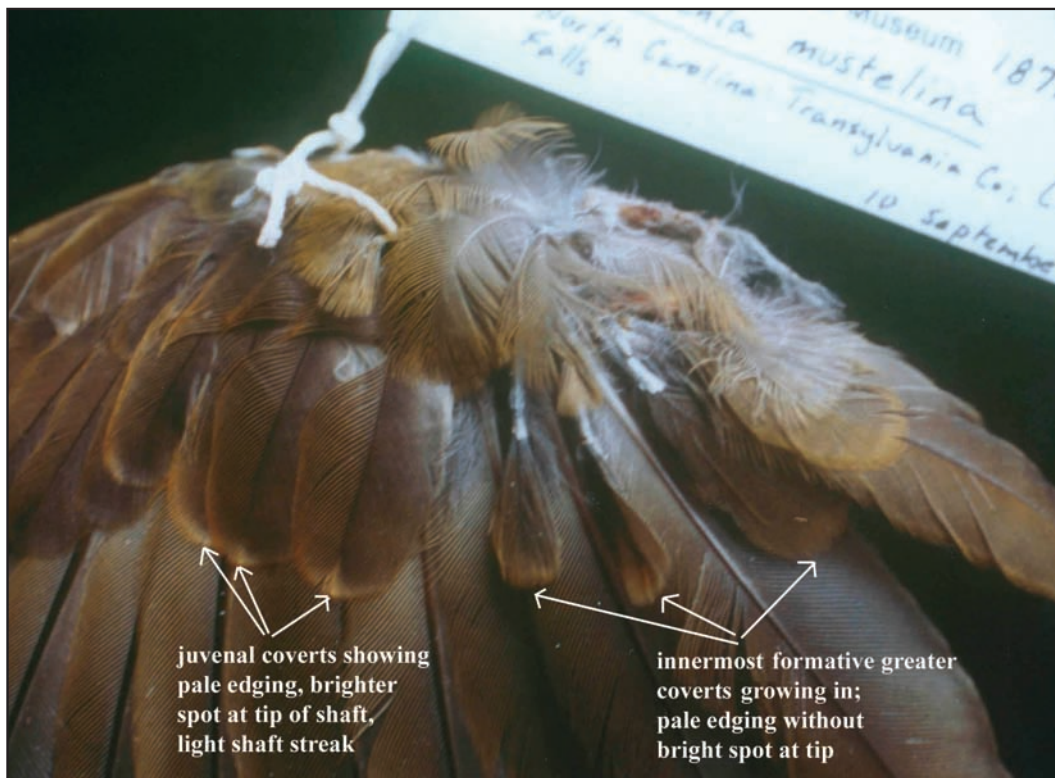


Figure 13

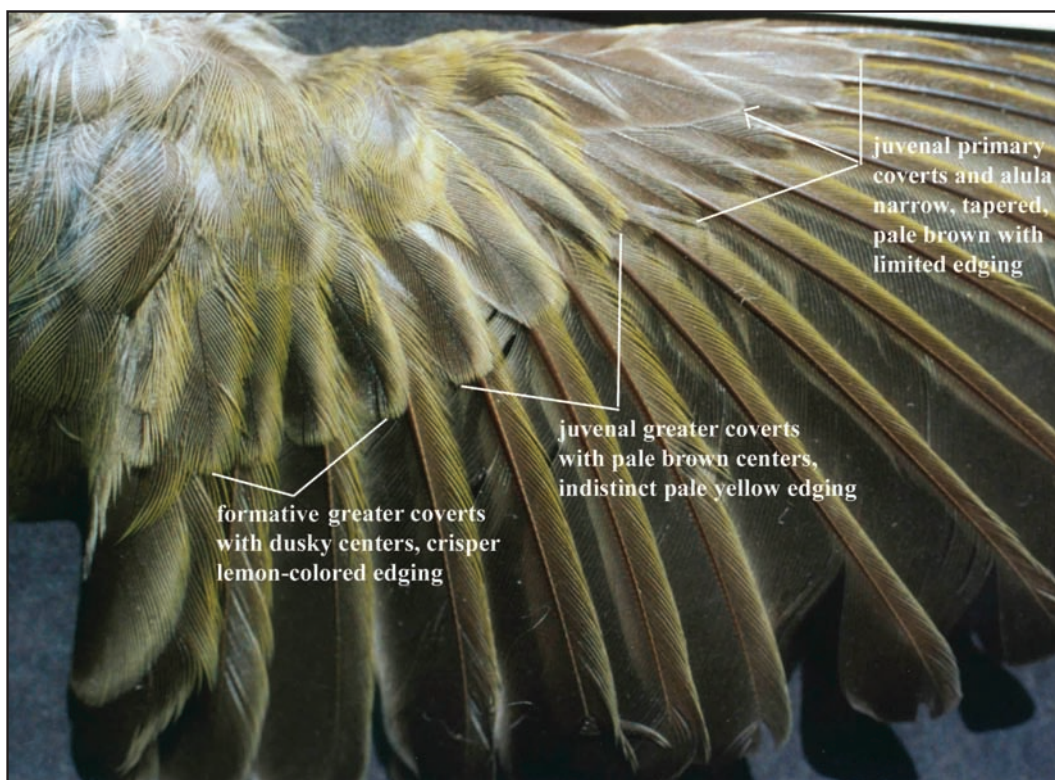


Figure 14

Figure 13: Wood Thrush, HY. September in NC.

This left wing of a Wood Thrush shows the maximum extent of the preformative molt in this species: four greater coverts are being replaced (0-4 replaced according to the ID Guide, p. 401). Some typical features of this molt pattern: when greater coverts are replaced during the preformative molt, they almost invariably are the innermost ones. While those molting in this bird are generally being replaced together, the inner ones tend to be farther along than those molting distally. Thus, in this example, the inner coverts are virtually full-grown while the outer one is still issuing from the sheath. Finally, while both retained juvenal and replaced formative feathers show pale tips, the retained feathers show a brighter pale spot at the tip of the shaft with a light shaft streak, while the replaced feathers merely show uniform pale edging.

the fact that feathers are retained during the preformative molt, yielding a mixed plumage consisting of two feather generations, while *all* feathers are replaced during subsequent prebasic molts, yielding a single-generation, uniform plumage, that allows age classes to be differentiated. The challenge, then, when faced with a bird of unknown age, is to ascertain whether two feather generations are present or whether all the feathers are uniform (but see the discussion of prealternate molts under “Confounding Effects,” p.45). Where to look for molt limits, ie., the contrasts between different feather generations, is detailed in the ID Guide for each species. As for how to look for and identify molt limits, hopefully this guide can provide assistance.

Where to look for molt limits

While the ID Guide gives details on where molt limits can be found in each species, it is valuable to realize that certain patterns of replacement are repeated among different species. How to look for molt limits varies by the species' replacement pattern. Therefore, familiarity with these patterns will increase the efficacy of your search.

Most preformative molts that are not complete, being either partial (contour feathers only except sometimes 1-3 tertials or 1-2 central rectrices) or incomplete (contour feathers as well as some, but not all, flight feathers). Note that the differences between the molt patterns relate, in general, to the specific feathers replaced on the wing and tail. That is why these feathers are the critical ones to consider in making age determinations. To make sense of the feather replacement patterns, keep in mind the feathers' functions. Feather exposure to sun and abrasion is the major cause of feather deterioration and is especially hard on juvenal feathers (see "Feather Wear," p. 39). On the closed wing, the feathers absorbing the brunt of the exposure to the elements are the tertials and the coverts, in particular the greater coverts. Functionally, and even structurally, the tertials, with symmetrical vanes on either side of the central shaft, resemble other coverts more than they

Figure 14: Yellow Warbler, HY (female?). September in CA.

HY Yellow Warblers in fall, as with most other warblers, generally show molt limits between the replaced formative greater coverts and the retained juvenal primary coverts. While this wing shows the pale brown, washed-out, narrow, tapered primary coverts lacking edging that are typical of juvenal feathers, the adjacent greater coverts do not appear any duskier or fresher. The greater coverts are not uniform, however. The contrast between the innermost four replaced formative coverts and the outer juvenal coverts is not an artifact of the photo. They truly show dusky centers and crisper, richer lemon-colored edging as compared to the pale brown centers and indistinct pale yellow edging of the outer coverts.

Figure 15: Vesper Sparrow, HY. July in CA.

This Vesper Sparrow is molting all of its greater coverts during its preformative molt, though apparently it is retaining a stray median covert. This pattern is typical of many sparrows, vireos and warblers. The molt pattern, when active, immediately identifies this bird as an HY, as it did with the Wood Thrush (Fig. 13, p. 18), because the only preformative molt during which greater coverts are replaced without any flight feathers being replaced is the preformative. During subsequent prebasic molts, flight feathers will be in molt while the greater coverts are growing. In this molt pattern, all juvenal flight feathers (primary coverts and all remiges) are retained and, therefore, show those characteristics typical of HY/SY's: for primary coverts, for example, "brownish with pale brown edging" and not "dark brown with grayish (sometimes tinged rufous) edging," which describes those of AHY/ASY's (ID Guide, p. 559). However, once full-grown, distinctions between the replaced greater coverts and the retained primary coverts may be difficult to detect. Furthermore, in sparrows, pseudolimits may complicate matters. In this Vesper Sparrow, for example, the tertials are darker and more brightly edged in buffy-brown than the neighboring secondary coverts. They appear fresher than their neighbors, suggesting recent replacement. But the only ongoing molt in the preformative, during which the greater coverts are being replaced. In fact, the tertials simply grew in a different color than the secondaries during the same prejuvenal molt. The ID Guide generally provides a warning when pseudolimits could confound ageing. For another example of pseudolimits, see the Black-and-white Warblers in Figure 24 (p. 31).

resemble the remaining remiges, which are lopsided with a wide inner and narrow outer vane. Similarly, in the tail, the central pair serve as a protective covering for the remaining rectrices. They are bilaterally symmetrical and are raised above the plane of attachment of the remaining rectrices ensuring that they cover the closed tail. Because of the protection they provide for the remaining flight feathers and because of their extreme exposure to wear, the tertials and central rectrices are the only flight feathers likely to be included in partial preformative molts.

For the purpose of finding molt limits, preformative molts that are not complete show three basic patterns in which feathers are replaced in the wing: replacement of some greater coverts, replacement of all greater coverts (occasionally with terts and/or central rectrices), and replacement of greater coverts and some flight feathers. In the type with the least number of feathers replaced, only some greater coverts are involved, along with the median and lesser coverts. Sometimes as few as none or as many as all of the greater coverts may be replaced, but generally in this type of replacement, these extremes are unusual; in the more typical case, with a few greater coverts replaced, they invariably are those near the body (though sometimes the odd, innermost tenth covert, which often looks different from the remaining greater coverts, is excluded). Several of the photographic examples demonstrate this pattern, mostly species representing groups for which this pattern is typical: the Wood Thrush (Fig. 13, p.18) shows four inner greater coverts actively molting.

Figure 16: Rose-breasted Grosbeak, SY male. April, loc. unknown.

Often, partial preformative molts will also include tertials or central rectrices, as in this obvious example of a SY male Rose-breasted Grosbeak (though the smallest, innermost tertial is, apparently, missing). This partial preformative molt included the lesser, median, and greater coverts (though some inner greater coverts are also missing), the alula and alula covert, at least one tertial, and two pairs of inner rectrices. In most other species, this pattern is not quite as obvious (e.g., Fig. 30, p. 36) or can be obscured by pseudolimits (e.g., Fig. 24, p.31).

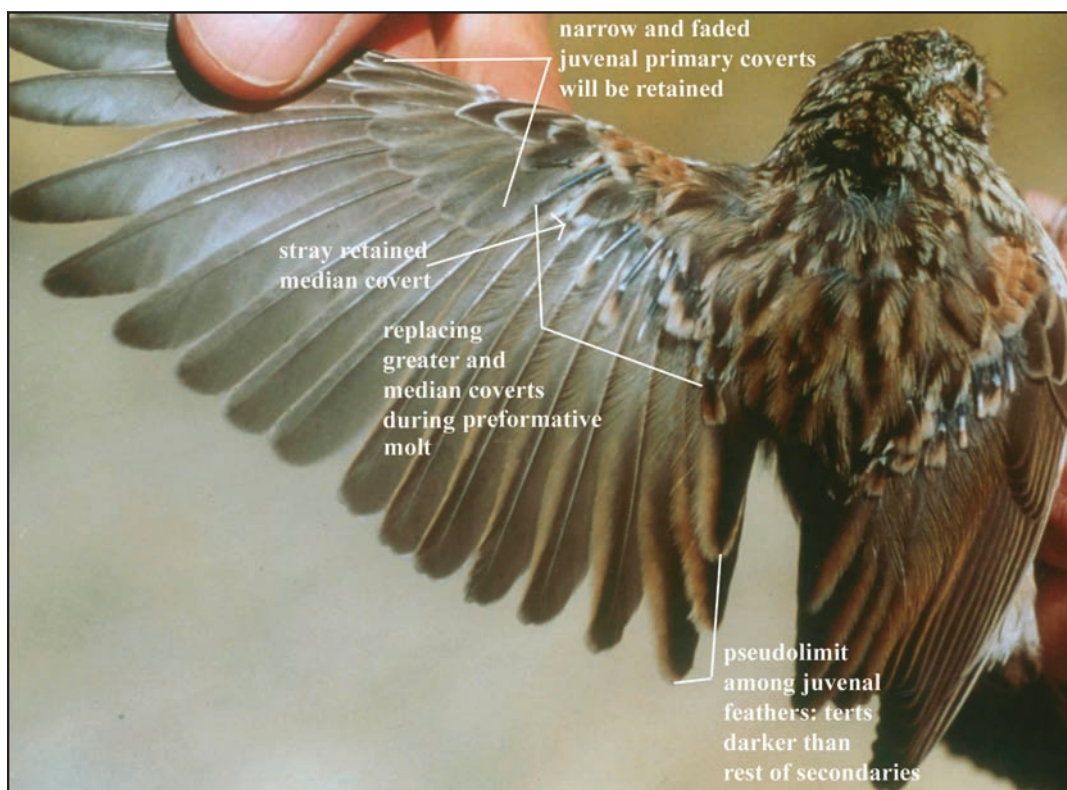


Figure 15

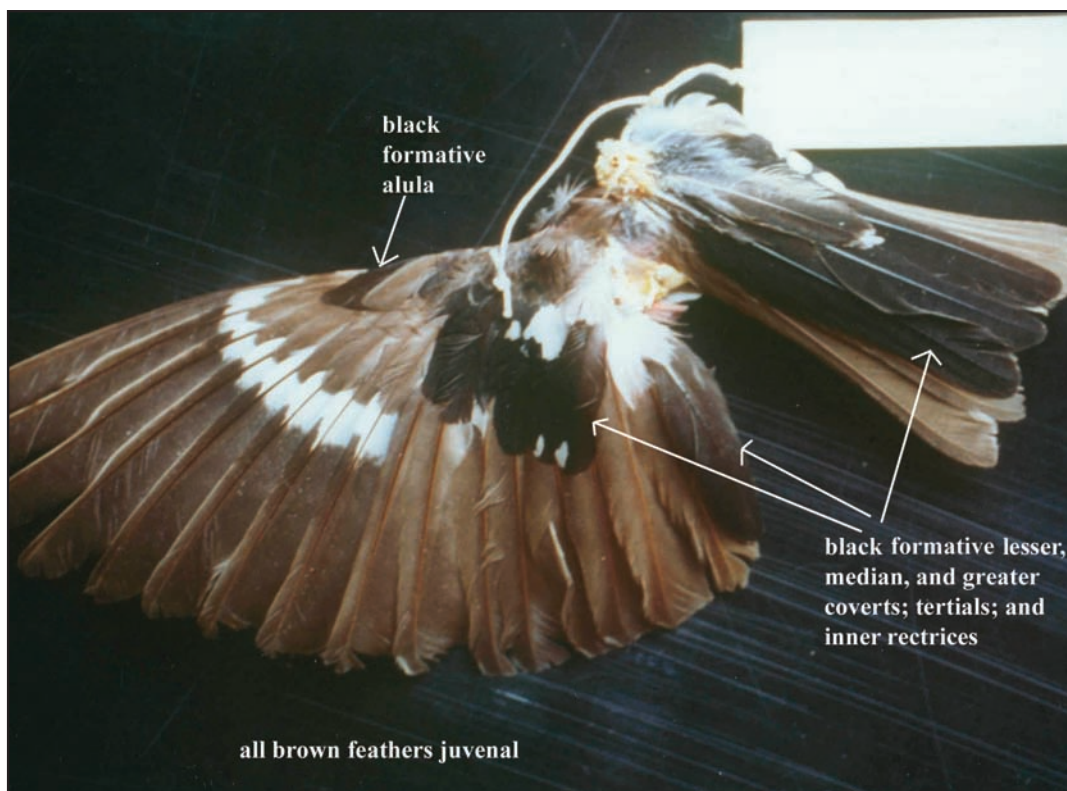


Figure 16



Figure 17

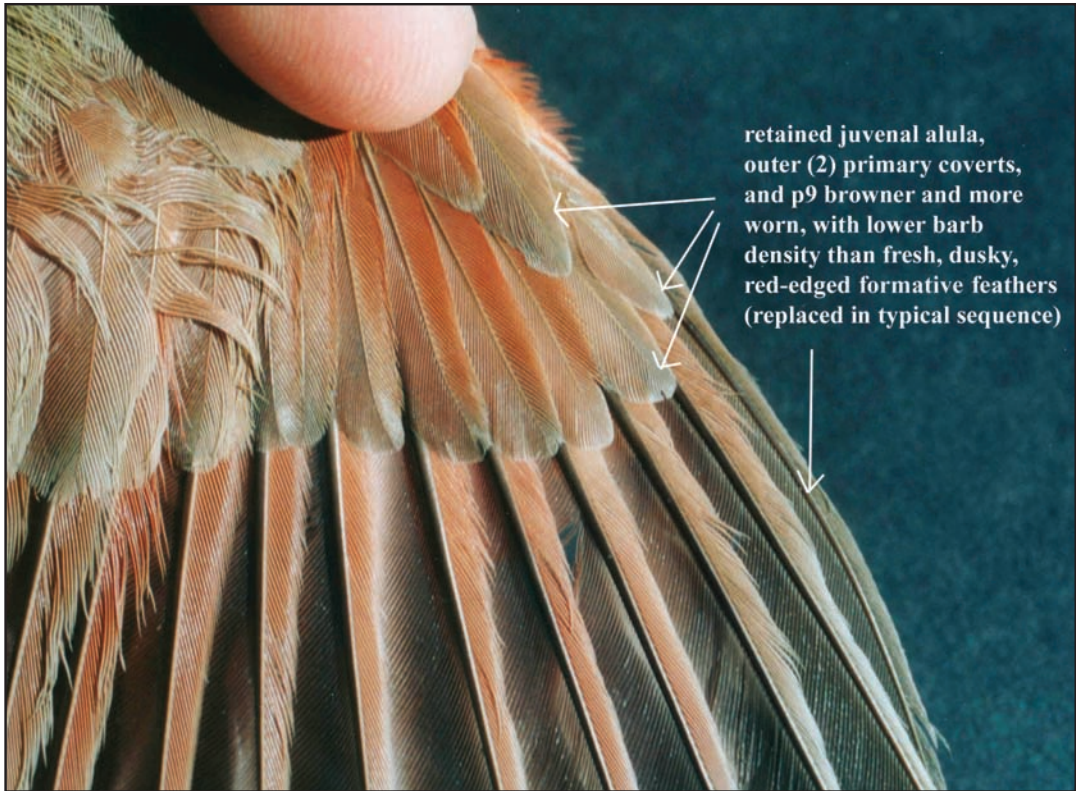


Figure 18

Figure 17: Indigo Bunting, SY male. June in NC.

Figure 17 shows a typical SY bunting with an incomplete preformative and a partial first prealternate molt. In buntings, during incomplete preformative molts, outer primaries and tertials and inner secondaries are typically replaced leaving a block of retained juvenal feathers in the middle of the wing. Further, all juvenal primary coverts are retained while all greater coverts are replaced. This is the pattern apparent in Figure 17: there is a distinct molt limit between the outer five primaries, which show a semisweet chocolate brown rachis, have dusky inner and outer webs, and are fresh and long, and the inner four, which, in contrast, show milk chocolate-colored central shafts, have pale brown webs, and are more worn and relatively short. By June, the month this bird was collected, differences originally apparent in the edging color have faded and become subtle. On the inner side of the wing, the three tertials are clearly blacker compared to the brown secondaries, despite their much greater exposure; these feathers were also replaced during the preformative molt. Thus, the retained juvenal remiges consist of the inner four primaries and all six secondaries.

Another contrast is apparent between the bleached, pale brown juvenal primary coverts without any edging and the dusky formative greater coverts with beige-aqua edging. The faded and worn primary coverts, in particular, are distinctive for HY/SY plumage (cf. with Figs. 31 and 32, p. 41). Even more striking, however, is the contrast between the bright blue-edged and blackish-centered innermost greater coverts and the remaining ones. The blue-edged feathers represent coverts replaced during the first prealternate molt, when the body plumage of the bird changed from brown basic plumage to mostly blue alternate plumage. Thus, this wing shows three generations of covert feathers: juvenal primary coverts, formative outer greater coverts, and first alternate inner greater coverts.

For differentiating SY's from ASY's, it is more important to consider the color and edging of the primary coverts and to ascertain the presence or absence of molt limits among the primaries than to determine which feathers molted in the prealternate molt, because both age classes have variable prealternate molts, but only HY's have incomplete preformative molts that retain juvenal primary coverts and inner primaries.

Other examples in increasing order of subtlety, are: Gray Catbird (Fig. 4, p. 8), Carolina Chickadee (Fig. 28, p. 35), Hermit Thrush (Fig. 5, p. 8), and Yellow Warbler (Fig. 14, p. 18); see also Acadian Flycatcher (Fig., p. 13).

The Yellow Warbler example in Figure 14 (p. 18) is interesting in that the wing shows a pattern atypical for the species, with a molt limit among the greater coverts. Most Yellow Warblers molt all of their greater secondary coverts during the preformative molt, a pattern of partial molt typical of vireos, most warblers, and many sparrows. In this pattern, the molt limit occurs between the greater

Figure 18: Northern Cardinal, SY male. May in VA.

In a few species, preformative molts will either be complete or will fail to finish. These birds undergo a preformative molt in typical sequence, but may retain the last feathers to molt, the inner secondaries, the outer primaries, and, more often, the outer primary coverts. This cardinal, for example, retained the juvenal outer two primary coverts, the greater alula, as well as primary 9, apparently. Note the contrast in color, wear, and barb density between the retained and replaced primary coverts and alula feathers; the retained juvenal feathers are fairly obvious. Finding them, in this case, is more a matter of knowing where to look than being able to detect a difference. Note also, though, that in this species there does not appear to be a major difference in primary covert shape between retained juvenal and replaced formative feathers.

coverts, which molt into definitive plumage, and the primary coverts, which are retained juvenal feathers, as are the remaining flight feathers. In many cases, the alula feather may be retained along with the primary coverts.

The Vesper Sparrow (Fig. 15, p. 21) also shows this pattern, with all the greater coverts in preformative molt, unaccompanied by any molting flight feathers. Note that the pattern shown by the Vesper Sparrow precludes the possibility of a complete molt, since the sequence of molt in complete molts always involves flight feathers throughout the molt of the greater secondary coverts. Since no flight feathers are in molt while this individual's greater coverts are in molt, we can deduce that they will not be replaced during this molt. Other photographs showing evidence of this pattern of partial preformative molt are the HY Black-and-white Warbler (Fig. 24 (bird on right), p. 31), the SY Prothonotary Warbler (Fig. 10 (bottom), p. 14), Philadelphia Vireo (Fig. 11, p. 17), and Audubon's Warbler (Fig. 7 (bird on left), p. 13).

Sometimes tertials or central rectrices are included in these partial preformative molts. The contrast between the replaced and retained feathers is dramatic in the example of the Rose-breasted Grosbeak (Fig. 16, p. 21), one of the North American species in which molt limits in males are among the easiest to recognize. The order of priority in which the tertials are included in partial molts is variable, though often the middle is molted first, followed by the inner, then the outer. In the Chipping Sparrow example (Fig. 30, p. 36), though, only the innermost tertial was replaced. In some species (such as Rose-breasted Grosbeak), central rectrices may be molted as well. Since they are the central, covering feathers of the tail, they are the most exposed to wear. As a result, the contrast between these and the remaining feathers may be masked by wear over time.

On occasion, if all three tertials are replaced, adjacent secondaries may be involved as well. However, secondaries and primaries are typically included only in the third major pattern, the incomplete preformative molts. Often in incomplete preformative molts, the flight feathers replaced include a variable number of outer primaries, inner secondaries and tertials (termed an "eccentric" molt, as it is initiated in the middle ["center"] of the tracts and proceeds from there ["ex"]), so that a block of retained, juvenal outer secondaries and inner primaries remains in the center of the wing. This block often shows contrast with the replaced formative feathers at the extremities of the wing. Examples of species with this type of molt include Indigo Bunting (Fig. 17, p. 22), White-eyed Vireo (Fig. 21, p. 28), and "Traill's" Flycatcher (Fig. 22, p. 28), in increasing order of detection difficulty. In each of these examples molt limits appear most clearly between outer formative primaries and the block of inner juvenal primaries and secondaries, as well as between the retained primary coverts and the replaced greater coverts (although the "Traill's" Flycatcher shows an anomolous pattern in that the six inner primary coverts are replaced and the three outer ones are retained, an admittedly subtle contrast).

Some species have unusual replacement patterns; as with the more typical patterns, the key is to look for molt limits in the right place, as detailed in the ID Guide. Northern Cardinal, for example, sometimes undergoes a complete preformative molt, with no subsequent plumage differences between HY/SY plumage and AHY/ASY. Often, apparently particularly so in northern populations, the molt fails to complete, and the bird retains (as in Fig. 18, p. 22) the juvenal outer primary coverts, greater alula, and outer primaries. The bird in Figure 18 also had three retained inner

secondaries. These birds are said to undergo an incomplete preformative molt with flight feather replacement in "typical" sequence, referring to the typical replacement of flight feathers in complete molts (sequentially from primary 1 and secondary 1), though the lack of completion itself is by no means "typical," as it is shown by only eight North American passerine species.

In other cases, apparent contrasts may reflect circumstances other than retention patterns (see also "Pseudolimits," p. 45). In the Summer Tanager (Fig. 19, p. 27), for example, production of the males' red pigment appears to be turned on by a poorly understood metabolic or hormonal switch during the prebasic molting season. Feathers replaced accidentally at other times of the year grow in green or yellow. If the first feathers are molted before the switch is activated during a programmed molt, they will grow in yellow as well (primaries 1 and 2 in the photo, along with the associated primary coverts).

Finally, caution is advised when considering accidental feather replacement (significantly asymmetric feather replacement patterns). While accidental replacement of a feather in a tract of otherwise retained juvenal feathers can make the contrasts between juvenal and subsequent feathers particularly obvious (as in the primary coverts of the Philadelphia Vireo, Fig. 11, p. 17), it can lead to spurious conclusions if the possibility is ignored that the contrast may merely be the result of feather age difference due to accidental replacement: a fresher adult feather in a tract of older adult feathers.

In conclusion, when looking for molt limits, it is crucial to begin searching in the right place. The ID Guide indicates specifically where to look, and understanding likely patterns will give you a head start in knowing where to look as you read through the accounts.

How to look for molt limits:

The most important aspect of ascertaining whether or not the wing feathers show molt limits is to be conscious of the probable feather replacement patterns during the preformative molt for that species. Determine, in particular, whether or not molt limits are likely to occur between or within feather tracts (e.g., between greater coverts and primary coverts or within greater coverts). This is an important distinction for identifying which characteristics and feathers to focus on.

When molt limits occur within a feather tract, it is important to keep in mind that the limit represents a difference between one group of feathers and an adjacent set within the same tract and that, therefore, there must be two adjacent feathers that have clear contrasts between them, even if subtle. Keep in mind that outer feathers in a tract may show inherent or wear-related differences from inner ones. A clinal difference in edging color between outer and inner greater coverts is not a molt limit; there must be a break between two adjacent feathers within the tract. Notice on the ASY Prothonotary Warbler wing, for example (Fig. 20, p. 27), that the inner greater coverts have a greenish cast which the outer ones lack. This difference does not constitute a molt limit because the change is gradual; there is no sudden change from one feather to the next (and in fact, molt limits don't generally occur among the greater coverts in Prothonotary Warbler).

In general, five inherent feather characteristics can be identified which help to distinguish replaced from retained feathers: shaft color, vane color, edging color and distribution, shape, and length. The five characteristics are not equally useful for each type of feather. Differential degrees of feather and

Figure 19: Summer Tanager, ASY male. May in VA.

Sometimes, apparent molt limits may not represent age-related features. This Summer Tanager shows exquisite uniformity – broad red edging and dusky feather centers – across all of its wing feathers, except P1 and P2 and their associated coverts. In Summer Tanagers, feathers replaced adventitiously during non-molting periods can be grown in green or yellow. Apparently, during molt, a pigmentation switch is turned on, producing the brilliant red color. Should the prebasic molt initiate before this switch is entirely turned on, the first feathers to molt will come in green or yellow. In this bird, the change can be seen as the switch occurs: P1 and its covert grew in yellow while P2 is yellow-orange at the tip, orange halfway up the shaft, and as red as its neighbor, P3, toward the base; its associated covert seems to be entirely red already. This pattern was symmetrical on both wings. This phenomenon, described in the ID Guide in one of the boldfaced notes on p. 526, while of general interest, provides us only with indirect ageing clues in a species in which ageing is already relatively straightforward. This pattern indicates that the last flight-feather molt undertaken was a sequential complete molt: with this pattern in the spring it must be an ASY, as only an AHY would have undertaken such a molt in the previous fall. Finally, note how pointed and narrow the ASY primary coverts are in this species compared to some of the others we've looked at (Red-eyed Vireo, Prothonotary Warbler, Audubon's Warbler, etc.)

these also vary among species, fade and wear as a result of feather exposure constitute a sixth consideration. Because wear is not an inherent quality of the feathers and is subject to great variability over time and as a result of environmental factors, it is addressed both here and later under "Confounding Effects." Differences in the five characteristics between replaced and retained feathers are generally exacerbated by the poorer quality of the juvenal feathers and by the several more months of exposure to which they have been subjected.

Exposure of the central shaft of juvenal feathers changes its color relatively quickly from a fresh blackish color to a dull brown, or from "dark chocolate" to "milk chocolate." This contrast is particularly evident in flight feathers, primaries for example, and can be seen in birds with incomplete molts relatively easily; see the molt limit between primaries 4 and 5 in the Indigo Bunting (Fig. 17, p. 22), and in the White-eyed Vireo (Fig. 21, p. 28), for example.

Figure 20: Prothonotary Warbler, ASY male. May in VA.

This wing shows classic characteristics of an ASY wing: broad, flared primary coverts, particularly primary coverts 6 and 7 (the eighth, the outermost visible one, is always more pointed; the ninth is much shorter and narrower, hidden in this photo), that hardly show signs of wear; further, they show broad edging as well as dusky feather centers that contrast only slightly with the edging and blackish centers shown by the greater coverts. All of these feathers, along with the remiges which are definitely blackish without a sign of brown, show uniform gloss and luster. The SY contrasts between juvenal primary coverts and formative greater coverts, typical for species that molt all greater coverts during partial preformative molts, are simply not present (see Fig. 10, p. 14).

It may be tempting to identify a molt limit among the greater coverts, since the innermost coverts show more of a green wash in the edging than do the outermost coverts. However, to identify a molt limit, there must be a marked difference between one feather and the next; in this wing, the transformation is gradual from bluer-edged outer coverts to greener-edged inner coverts with a greenish wash to the blue edging. Thus, no molt limit can be identified.

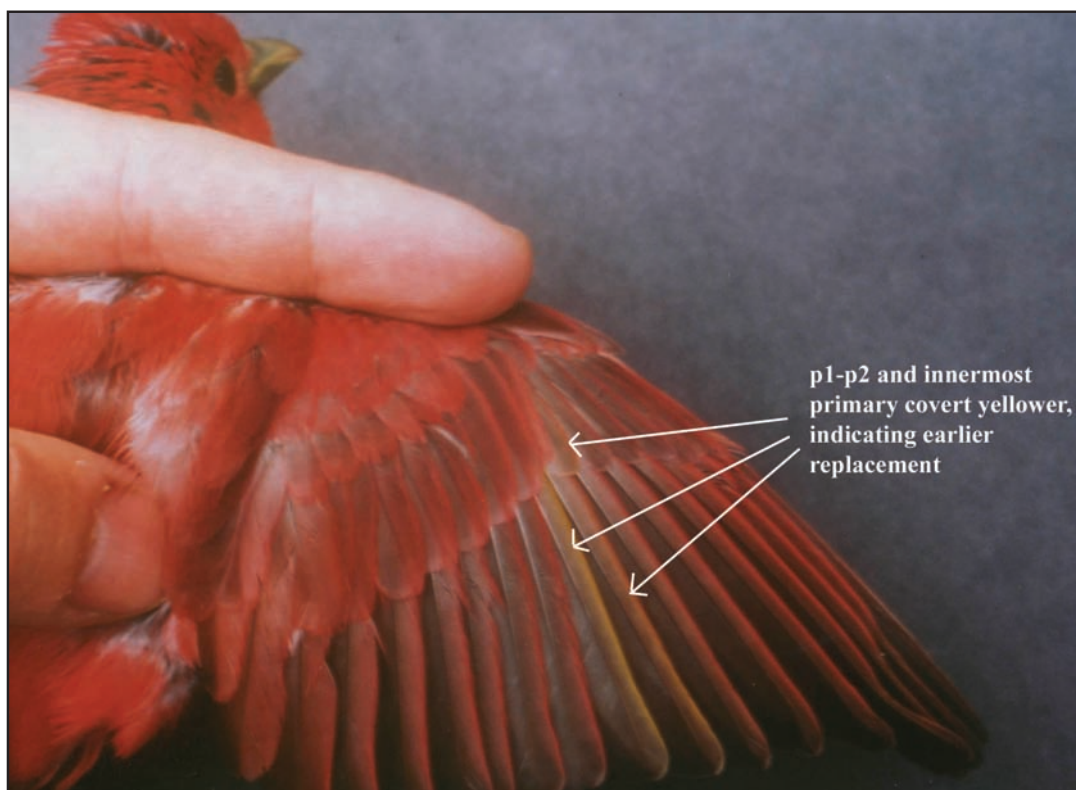


Figure 19

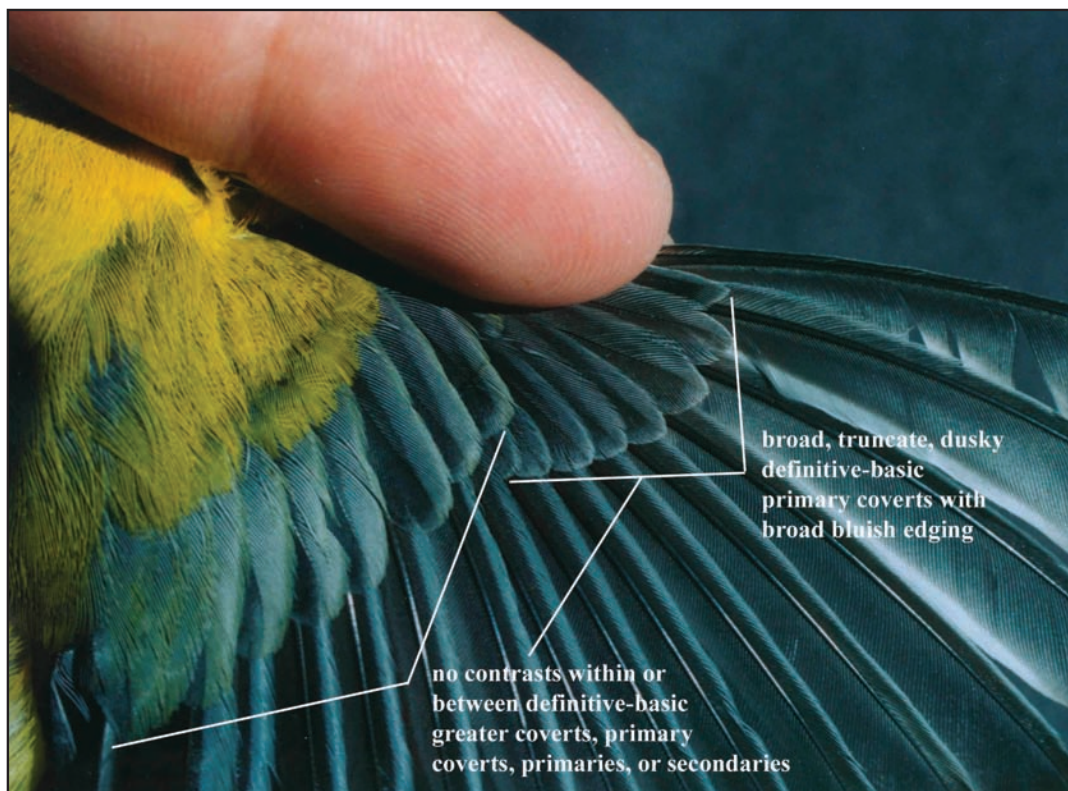


Figure 20

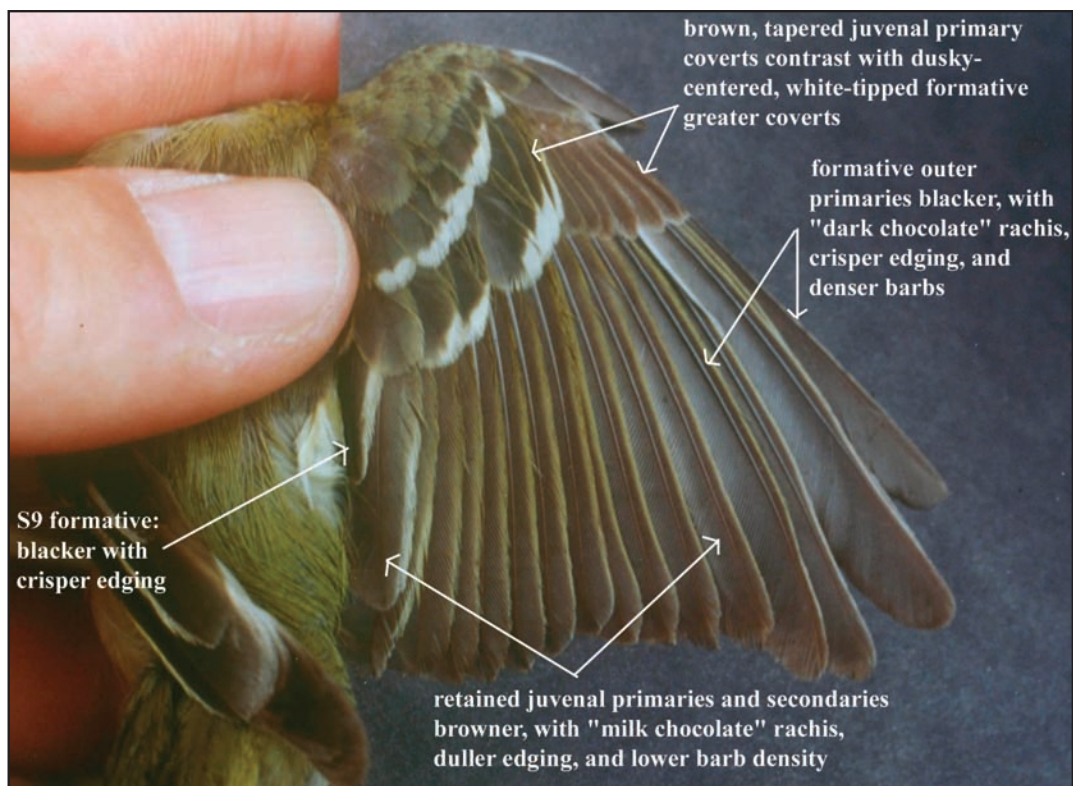


Figure 21

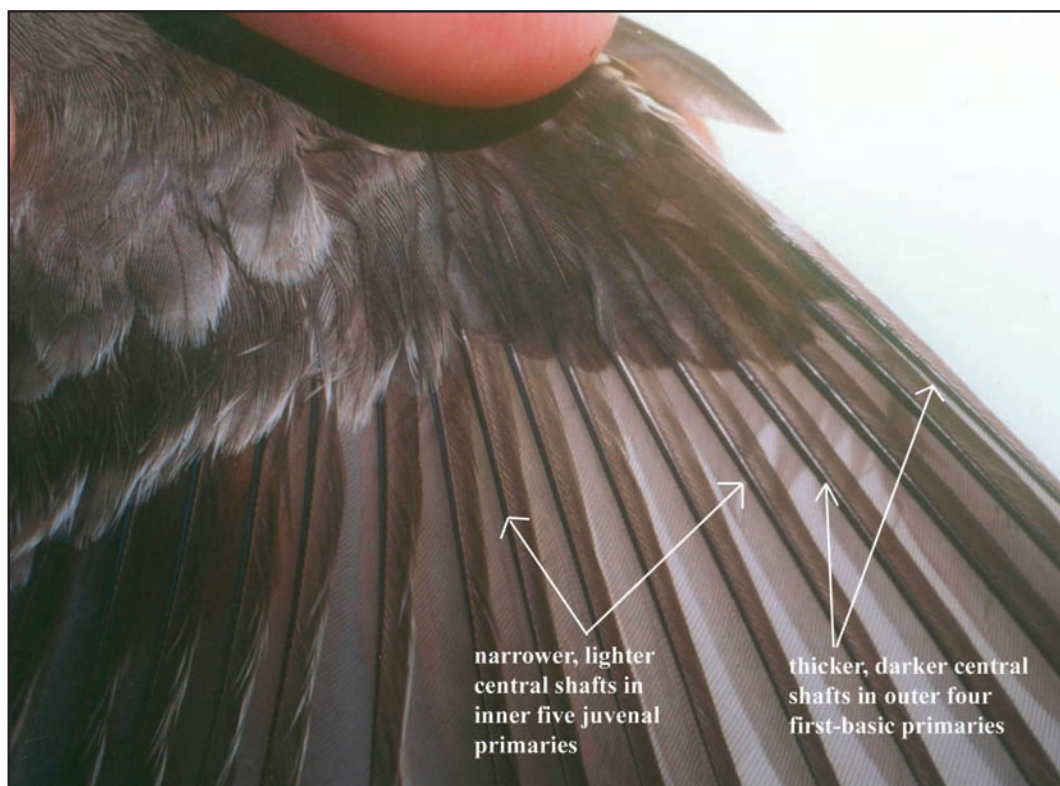


Figure 22

Figure 21: White-eyed Vireo, SY. April in NC.

Similar to the Indigo Bunting in Fig. 17 (p. 22), this White-eyed Vireo also shows evidence of an eccentric preformative molt, though the differences among the remiges are more subtle. Counting in carefully from the outermost primary, the outer four visible primaries (plus a fifth hidden between the outer two) have been replaced, while the inner four represent retained juvenal primaries. The differences between these feathers are most apparent in the shaft color (dark chocolate in the replaced feathers, milk chocolate in the retained ones), the overall vane color (slightly blacker in the replaced feathers, most noticeable perhaps in the outer vane near the base), the edging (crisper, bolder green in the replaced feathers), and the barb density (tighter, denser in the replaced feathers, most easily compared on the inner vanes of primary 4 versus primary 5). On the inner side of the wing, apparently only the small innermost tertial molted: it is blacker and more crisply edged than the two longer tertials. Clinching the SY determination for this individual is the sharp contrast between the dusky-centered greater coverts and the pale brown primary coverts, more evidence of an incomplete molt.

In the "Traill's" Flycatcher photo (Fig. 22, p. 28), the contrast in shaft colors is masked by their reflectivity; however, the four outer primaries appear to have a slightly wider shaft than the six inner primaries, emphasizing the inherent structural weakness of the retained juvenal inner primaries. The central shaft is not nearly as useful when examining primary or greater coverts. Tertials and central rectrices experience such a great deal of exposure that differences in shaft colors between differently aged feathers may become masked by fading over time, as both retained and replaced feathers acquire a uniform milk chocolate color.

Vane or web color is often the most apparent difference between retained and replaced feathers; in any case, for better or for worse, it is often the feather feature our eyes try to contrast first. All feathers when fresh show high luster and gloss: bright colors appear saturated and browns are dusky (i.e., they are suffused with blackish). For example, the fresh juvenal flight feathers of the HY Song Sparrow on the left in Figure 23 (p. 31), which are so fresh that the outer primaries still show light tips, could in good conscience be classified as a blackish brown, dark brown, or dusky. The bird on the right is an SY bird whose juvenal flight feathers a year ago were as black as are the HY's in the picture. In the course of the year they have faded from blackish brown to medium brown or even pale brown, if you consider the primary coverts.

Figure 22: "Traill's" Flycatcher, probably Alder, SY. May in VA.

Even more subtle is the difference between the outer four replaced formative and the inner five retained juvenal primaries in this "Traill's" Flycatcher. The reflectivity of the central shafts makes it more difficult to detect any differences in color. What can be detected, though, is a difference in shaft thickness: the central shafts of the four outer primaries as a group are thicker and wider than those of the inner five primaries. This matches the weaker nature and flimsier structure of juvenal feathers. What was odd about this individual's molt pattern is that, while it showed an eccentric molt pattern among the primaries, there were also molt limits among the primary coverts: while virtually indistinguishable in the photo, the inner three primary coverts were clearly fresher and darker than the more worn, paler, and more translucent outer six primary coverts. If truly a molt limit, this is thus far unreported for passerines, though the molt patterns of this species complex in the East are still rather poorly known.

Figure 23: Song Sparrows, HY left; SY, right. June in CA.

The first temptation is to identify these two birds as follows: blackish on the left, brown on the right – ASY versus SY. In fact, the picture shows a different contrast, namely a fresh HY bird on the left and an SY bird on the right, showing to what extent the juvenal flight feathers (tertials, secondaries, and primaries and their associated primary coverts) will wear within a year. Fresh juvenal feathers often grow in as black as those of AHY birds. Over the course of a year, though, because they are of poorer quality, they experience more and more rapid fading. This substantial difference between these feathers at different times of the year emphasizes to what extent color and wear are relative terms and must be considered in relation to the amount of exposure the feathers experience and the length of time they were exposed. Because juvenal feathers are weaker and generally older than formative feathers, they will always be relatively more worn and faded, but their aspect will change dramatically over the season. Thus, molt limits become more obvious as the season progressed from wither through spring and summer.

In direct comparison with an equally fresh adult bird's basic flight feathers, in fact, the HY's juvenal feathers *would* appear duller, less saturated, less blackish, more brown, rather more diaphanous, again due to the inherently poorer quality of the feather material, a skimpier product. However, opportunities for such comparisons are generally rare, since most juveniles appear long before most adults have completed their prebasic molt. By the time the adults have fresh flight feathers, juveniles have had their feathers exposed to the elements for one to several months. This difference in the timing of plumage acquisition serves to heighten the contrast between the two feather types: the poor-quality juvenal feathers fade to brown much more quickly than do the basic feathers. In direct comparison, this difference is often readily apparent. For example, the Black-and-white Warblers in Figure 24 (p. 31), both captured in October, show a striking contrast between the brownish primaries, secondaries, and primary coverts of the HY on the right and those same feather tracts, clearly blackish, of the AHY on the left. In this picture, the effect is exaggerated unfairly by sex differences: the HY is a typically dull-colored female, the AHY a typically glossier male. However, as we shall see shortly, the color difference in the vanes cannot be ascribed to sexual dimorphism alone.

Usually, we do not have the luxury of having age classes side by side for color comparison. The color question applies similarly when assessing a given wing for the presence or absence of molt

Figure 24: Black-and-white Warblers, AHY male, left; HY female, right. October in Cuba.

These two Black-and-white Warblers show strong contrasts in the color of the flight feathers: the one on the right has pale brown juvenal flight feathers, indicating an HY bird, while the one on the left has black ones, indicating an AHY. The bird on the right also shows buffy flanks, typical of females, while the plumage of the bird on the left is clean white and black (only the tips of some of these feathers show in the photo), typical of males. How can I be sure that the difference in flight-feather color is age related not just sex-related? The female also shows a striking contrast between the greater coverts and the primary coverts, black versus pale brown. The black greater coverts are much closer in color to those of the male; they were replaced, as is typical, during her recent partial preformative molt. An AHY/ASY female would show a much less marked contrast between the greater coverts and the remaining flight feathers. The tertials of the HY female, however, with their broad white edging, appear as if they had molted along with the greater coverts. As with the Vesper Sparrow (Fig. 15, p. 21), they may represent pseudolimits, feathers that convey the impression that they have been replaced more recently than their neighbors because they grow in darker to begin with.



Figure 23

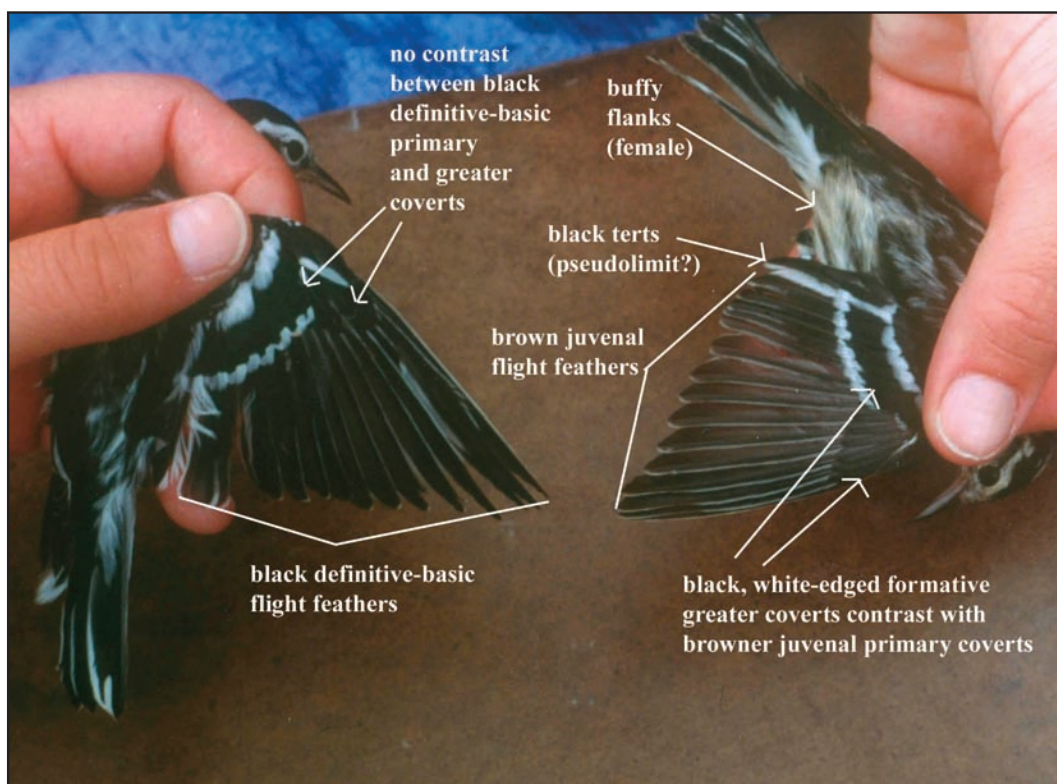


Figure 24



Figure 25



Figure 26

Figure 25: Red-breasted Sapsucker, TY. August in CA.

Figure 26: Downy Woodpecker, TY, male. April in NC

Woodpecker molts in both HYs and AHYs include a variable number of secondary coverts and all primaries, but feathers are often retained among the primary coverts and secondaries, so these tracts are the most important to consult for finding molt limits, the key to age determinations. Distinguishing between two kinds of molt limits can be helpful: those between juvenal and definitive feathers and those between definitive basic feathers of different generations. Juvenal feathers, which can be retained for several years, often stick out, since they tend to wear much more quickly to a pale brown (the inner primary coverts, for example, in Figures 25 and 26). Contrasts between definitive basic feathers of different generations can be much more subtle, often distinguished only by slight differences in the saturation of the black base color and in differences in the wear of the white patches; Figure 27 shows some examples of this.

Often, the most rewarding tract to examine when ageing woodpeckers is the primary coverts. In the pre-formative, many woodpeckers retain all of their juvenal primary coverts. Both birds in Figures 25 and 26 show strong contrast between inner pale brown coverts and fresh and blackish outer coverts. This is typical of birds in SY/TY plumage (TY's in these two cases as both are spring/summer birds), which often have replaced just a block of outer primary coverts. Thus, at least some inner juvenal primary coverts are regularly retained through two prebasic molts.

limits. Retained juvenal feathers will appear relatively faded and pale brown compared with the replaced, relatively fresh and dusky formative feathers – key words used repetitively, like a mantra, in the ID Guide. In bright-plumaged birds like cardinals (Fig. 18, p. 22) or in species that have formative plumage feathers that contrast obviously with their juvenal counterparts (Gray Catbird (Fig. 4, p. 8), or Rose-breasted Grosbeak (Fig. 16, p. 21), the contrast between the retained and replaced greater coverts can be so strong that it is missed because the observer didn't realize they belonged to the same tract! Be sure you can account for all the coverts when looking for contrasts among them.

In woodpeckers, the fading of primary coverts can be so strong as to have the same effect, though they started out as black as their neighbors (Figs. 25-27, pp. 32 and 35); in these birds, the degree of wear – abrasion and fraying – on the feathers also helps to distinguish them. Furthermore, because of adult prebasic molts that are often incomplete, woodpeckers present their own set of challenges in ageing and are thus worthy of some examples (read also the woodpecker introduction in the ID Guide, pp. 163-166).

Most species with molt limits, though, don't show contrasts that are so straightforward to identify. In individuals that show molt limits among the greater coverts, the Yellow Warbler for example (Fig. 14, p. 18), the vane color is often the feather characteristic that shows the contrast most readily. The replaced formative feathers (inner greater coverts) tend to maintain the duskiness of the inner vane much more readily than do the older juvenal feathers (outer greater coverts), which typically fade to a lusterless pale brown. As before, the difference in color tone must appear between one feather and the next, the one that molted and the one that didn't.

In the Carolina Chickadee (Fig. 28, p. 35), it isn't so much a difference in duskiness that distinguishes the replaced from the retained greater coverts, but that they are "grayer" as opposed to "tinged brownish" (ID Guide, p. 334). This difference can be seen between the sixth covert from the

Figure 27: Downy Woodpecker, ATY (4Y?), female. May in VA.

During definitive prebasic molts of woodpeckers, a variable number of primary coverts are replaced. In Figure 27, the bird apparently replaced only three visible inner primary coverts. As a result, the primary coverts appear to show three generations of feathers acquired as follows: all juvenal primary coverts were retained through the preformative molt. During the second prebasic molt, the outer four coverts were replaced; these now appear as dull black feathers with the white semi-circles at the tips worn off. During the third prebasic molt, the inner three primary coverts were replaced which now appear fresh and glossy black with the white tips still clearly intact. These contrast strongly with the very worn, dull-brown, presumably juvenal covert in the middle that was left behind during both the second and third prebasic molts. These newest primary coverts contrast more subtly with the other adult-type, outer, primary coverts which are duller, less glossy black and have lost their white tips. As the ID Guide indicates in a bold-faced note on p. 189, the presence of three feather generations among the primary coverts, one of which is a juvenal feather may well be definitive for TY/4Y; thus, the spring bird in Figure 27 may well be a fourth-year bird. However, more study is needed to confirm this; e.g., the bird may also be a 4Y/5Y or older that has, anomalously retained this juvenal covert through multiple prebasic molts, or the old covert may be an adult feather retained for two or three molts.

A contrast between adult-type feathers can also be seen among the secondaries in Figure 27, which, like the primary coverts, are often retained during adult prebasic molts: secondaries 1-3 are duller black, more frayed at the tip, and have lost much more of their white highlights to wear than the adjacent inner secondaries. As can be seen on other parts of the wing (inner greater coverts and tertials), the wearing away of the structurally weak white spots can produce interesting feather shapes. Caution is advised when using these wear patterns to identify molt limits, since feather exposure may be the more important factor in determining the wear pattern. The molt limit should be evident not just in the wear pattern but also in the glossiness and freshness of the respective feathers, as they are between secondaries 3 and 4. By contrast, the wear pattern of the white highlights differs significantly between the innermost secondary and the visible tertial, with the tertial showing a "threadbare," worn-out white patch compared to the relatively fresh white patch on the secondary. Both feathers, though, appear equally glossy black; the difference in wear is a result of the tertial's greater exposure.

Figure 28: Carolina Chickadee, entering 2nd PB. May in VA.

The molt limit among the greater coverts of this Carolina Chickadee is much more subtle than in the Gray Catbird (Fig. 4, p. 8). Counting back from the outermost apparent greater covert: the first is obvious; the second curves back and overshadows the third somewhat; the fourth curves back and is tucked under a secondary; the fifth is apparent, while the sixth is half tucked under the seventh. The molt limit is between the sixth, which is retained, and the seventh, which, along with the remaining inner greater coverts, is replaced. Both groups, by May, show considerable wear, but the replaced formative feathers have a bluish cast, while the retained juvenal feathers are distinctly browner. A case could be made that the outermost greater covert, bluer and fresher, is replaced, but that would be unusual. What is, of course, most noticeable about this wing is the initiated sequential molt in typical sequence, i.e., typical of a complete molt. Furthermore, this sequential molt was occurring symmetrically in both wings, indicating that this Carolina Chickadee had indeed initiated a complete prebasic molt by May 25, 1999, in southern Virginia — early even by the dates given in the ID Guide (Jun-Sep), perhaps a non-breeder or a failed breeder. The point is, however, despite the obvious ongoing molt in this wing, we can, by studying subtle differences in the older feathers present, still identify the specific age class of this bird. Once the initiated molt has run its course, the bird will be identifiable only as an AHY; but until it drops those greater coverts, it is identifiable as an SY. Thus, as an SY, it is entering its second prebasic molt.

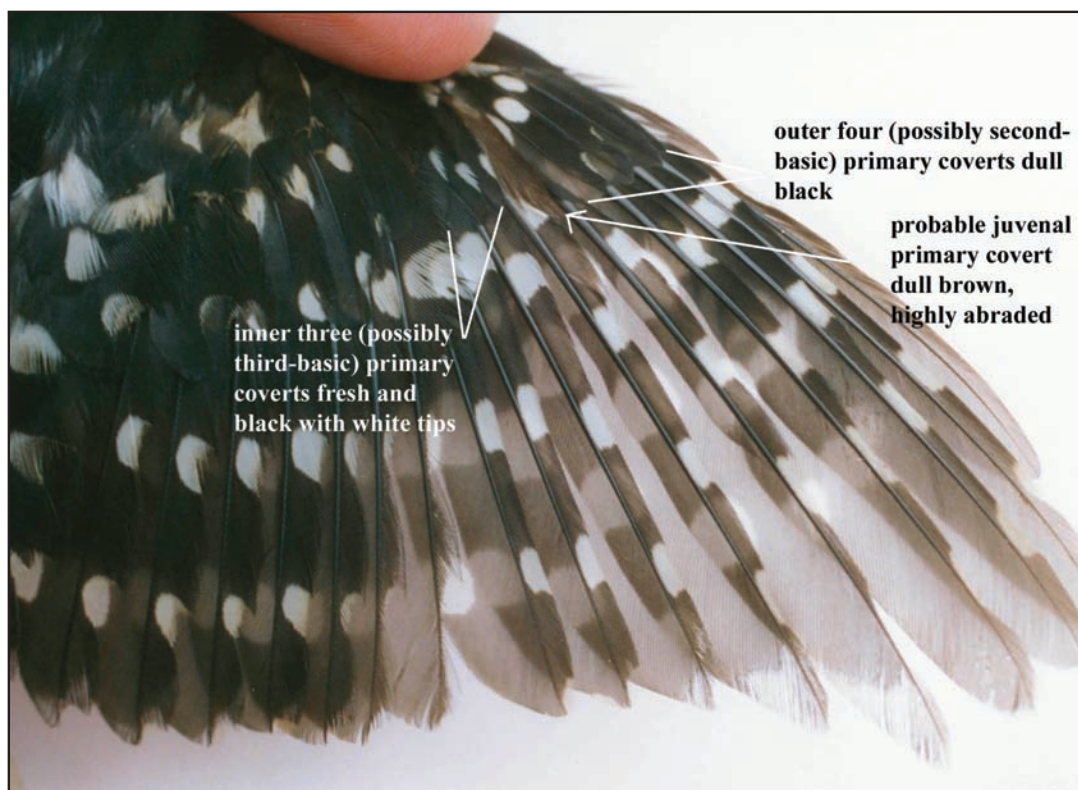


Figure 27

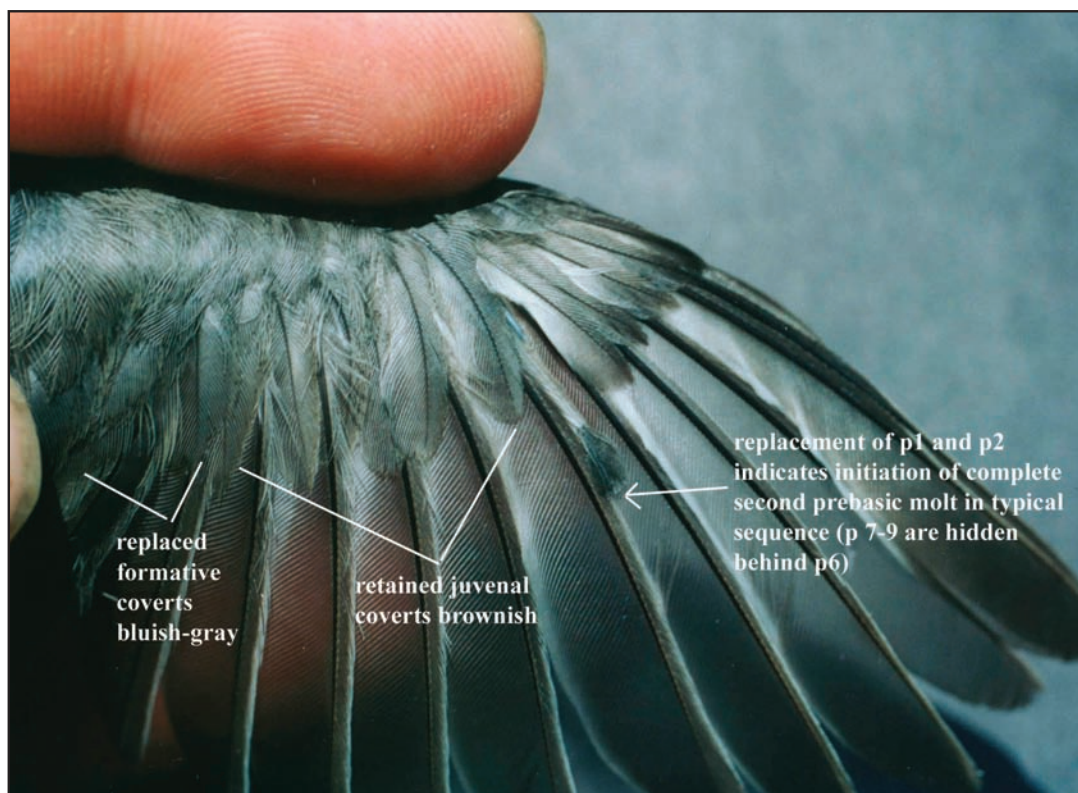


Figure 28

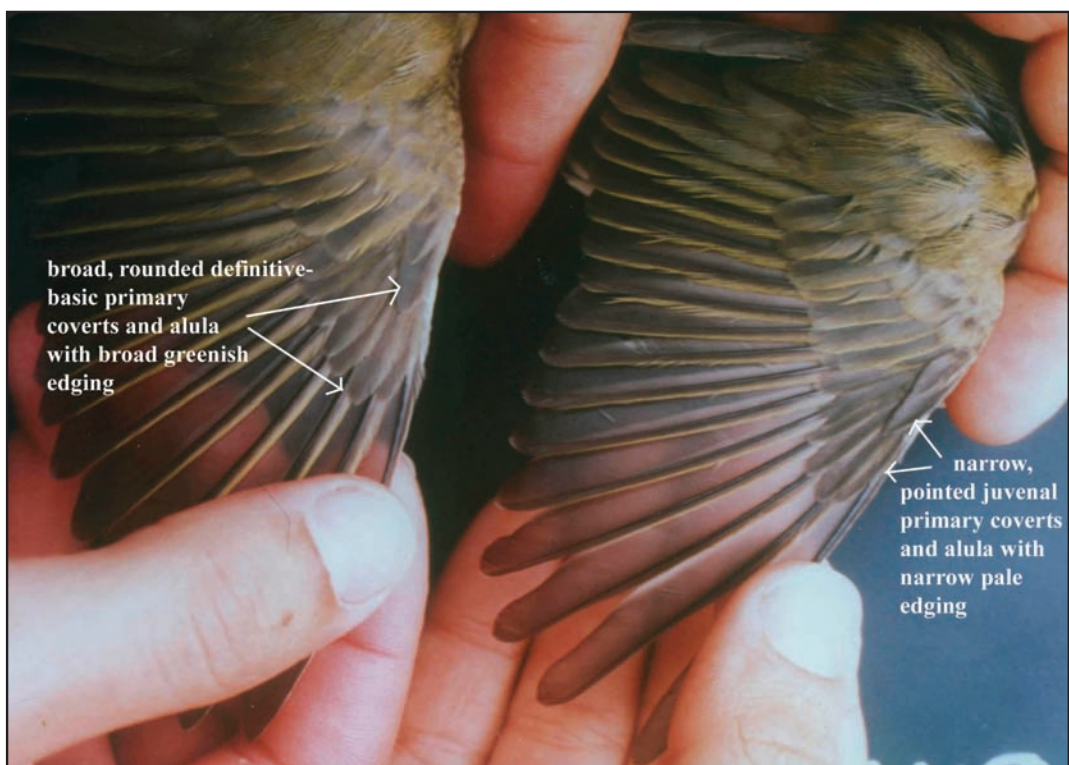


Figure 29

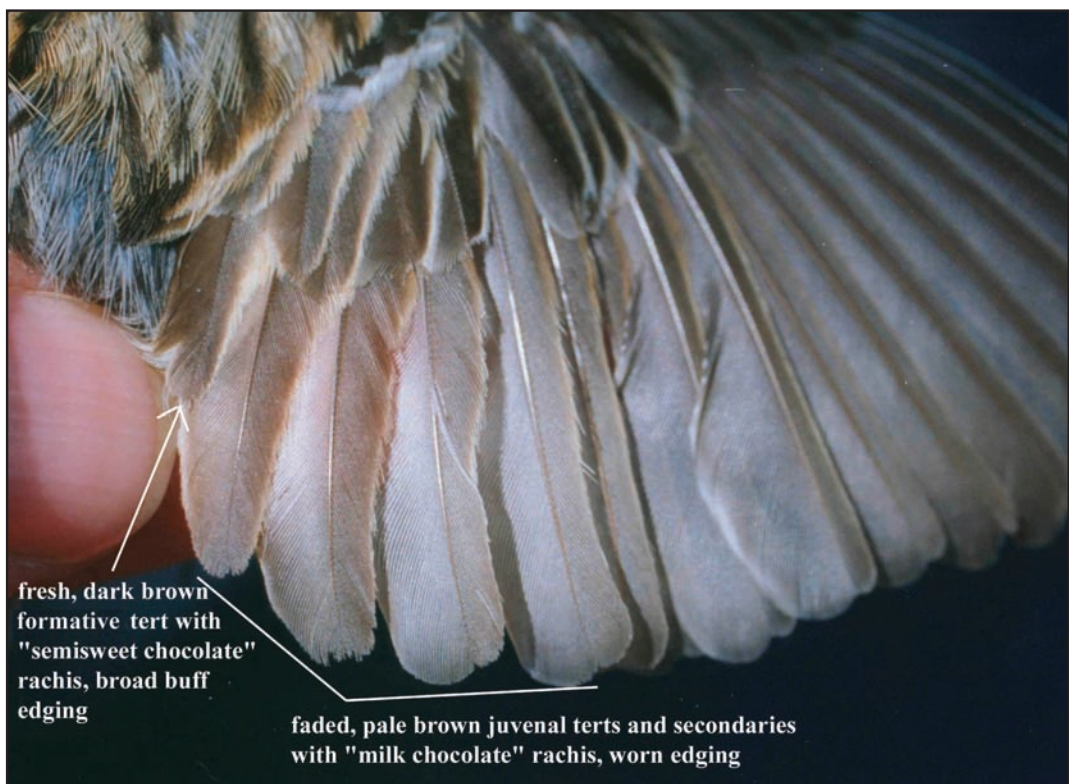


Figure 30

Figure 29: Red-eyed Vireos, ASY, left; SY, right. May in VA.

The differences between these two Red-eyed Vireo wings are more subtle. The shape of the primary coverts of the individual on the right is slightly narrower, as both the inner and outer webs do not appear to flare out as far from the shaft. Striking is the shape of the alula feathers, which are much more pointed in the bird on the right than the one on the left; while distinctive among these two birds, the ID Guide indicates that the greater alula is "usually" molted during the preformative molt (p. 289), along with the greater coverts and is therefore not a reliable criterion. Another apparently useful mark for distinguishing these two birds is the edging on the primary coverts (as well as the alula): the edging on the left bird is broad and distinctly greenish, taking up virtually the entire outer web of the coverts, while that on the right bird is narrow and pale. Based on these differences in shape and color, as well as corroborating evidence in molt limits among the tertials and ossification patterns, the bird on the right could be aged an SY and the bird on the left an ASY.

A final note: the SY bird shows dusky streaks on the primary coverts just inside their narrow pale edging, a feature not shared by the ASY coverts. I have seen this on a number of species in the spring in which ASY's show broad, relatively brightly colored outer webs to the primary coverts. Normally, primary coverts of AHY/ASY's are dusky or at least show a darker baseline color than the paler brown of their HY/SY counterparts. In species that show a back and covert coloration similar to Red-eyed Vireo, such as Ovenbird and Yellow-breasted Chat, spring SY's show distinct greenish but narrow edging on the juvenal primary coverts set off by a darker center to the feather. By contrast, ASY's show a much broader, brighter edge to basic feathers, often taking up most of the outer web and, as a result, lack the darker feather centers. Watch for this; it may warrant further investigation.

outside (count carefully, as one is tucked under a secondary), which has a brownish cast, and the seventh which lacks the brownish hue and is clearly grayer. The ID Guide specifies whether "duskiness" is the key element in distinguishing feather generations, or whether other colors, as in Carolina Chickadee, may be more important.

Contrast in vane color is often hardest to detect when two different feather tracts are contrasted, usually the primary coverts, which are often retained, and the greater coverts, which are often replaced. In these cases inherent differences in the colors of the feather tracts must also be taken into consideration. Usually, some experience with a given species is required before this distinction can

Figure 30: Chipping Sparrow, SY. April in NC.

This individual shows tertial replacement in a partial preformative molt. The innermost, smallest tertial, extending just halfway down my thumbnail, shows marked contrast with the other tertials. The most obvious difference is in vane color; it is dusky, while in the retained juvenal tertials they are a faded pale brown. The rachis color of the replaced feather, despite its greater exposure, covering the other feathers, still is slightly darker (semisweet chocolate) than that of the retained tertials (milk chocolate), though the difference is obscured by the reflectivity of the shafts. Finally, while the cinnamon edging has almost completely worn off the retained tertials and neighboring secondaries – in fact, the concavity of the outer margin indicates how much light edging has been lost when the width of the outer web at the base of the feather is traced down toward the tip – a substantial amount of the paler buff edging on the replaced tertial is still present. In this species, prealternate molts are limited to the head feathers, so this contrast, as it was symmetrical on both wings, must have resulted from the previous partial preformative molt, indicating it is now an SY bird.

be made with certainty. However, extreme cases are often readily identified. For example, the SY White-eyed Vireo (Fig. 21, p. 28) shows faded, pale brown, juvenal primary coverts that contrast markedly with the rich, blackish brown ("dusky"), lustrous, formative greater coverts. The ASY Prothonotary Warbler wing (Fig. 20, p. 27), by contrast, shows duskiness in the inner vanes of the greater coverts that contrasts only slightly, if at all, with the duskiness on the inner vanes of the primary coverts (the outer vanes consist mostly of wide color edging). For the ASY Summer Tanager (Fig. 19, p. 27), the same holds true, although the duskiness is visible on both inner and outer vanes of the feathers, as the edging is much more narrow.

Back to the Black-and-white Warbler (Fig. 24, p. 31), then: are the feathers brown on the bird on the right because she is a female, or does she show a molt limit? Comparing the greater coverts with the primary coverts we see that, in fact, there is a marked contrast between the two groups, despite the relatively indistinct photo. The greater coverts more closely resemble the black wing feathers of the ASY male, while the primary coverts are a pale, lusterless brown. This October bird was an HY.

Finally, several species with a heavy green wash on their flight feathers tend to show a darkening to the central parts of the vane of juvenal primary coverts over time. While the basic AHY/ASY greater and primary coverts maintain lustrous, wide color across the entire outer vane throughout the year, their juvenal counterparts, particularly the primary coverts (typically the only ones retained), show thin, lusterless edging and, in particular, dark centers. The comparison of the SY and ASY Red-eyed Vireos (Fig. 29, p. 36) shows this contrast clearly. The Philadelphia Vireo (Fig. 11, p. 17) shows the same pattern, less clearly, but particularly between the juvenal primary coverts and the adventitiously replaced one towards the outside, near the outer edge of the wing. Ovenbirds also appear to show a similar pattern.

As these last examples demonstrate of feather edging, both the color and its distribution, can also be an important clue to identifying molt limits. Caution is advised in the use of this character, however. Edging color and width often changes within feathers of a single feather tract (see Fig. 20, p. 27), sometimes varies more substantially by sex than by age, and, due to a high degree of exposure, is subject to fading and wear (see "Confounding Effects," p. 39), which can quickly mask its usefulness. Nevertheless, contrasts are often easily visible (e.g., p. 45, "Prealternate molts" for Acadian Flycatcher (Fig. 7, p. 13) and Indigo Buntings (Figs. 17, 31, and 32, pp. 22 and 41, respectively)). The difference between the replaced inner formative and retained outer juvenal greater coverts of the Yellow Warbler (Fig. 14, p. 18), a September bird, is more subtle, but with study, it can be seen to be a more concentrated rich lemon color on the replaced inners that contrasts lightly with the paler, more washed out yellow margins of the retained outers. The ID Guide often indicates the helpfulness of the edging in identifying molt limits; however, once the feathers are seven months old or so, wear and fading may completely undermine its usefulness.

In *Catharus* thrushes and Wood Thrush, particular caution and a thorough understanding of the usefulness of the "buffy tips" to the juvenal greater coverts for identifying HY/SYs is advised. In the past, the presence or absence of "buffy tips" to the greater coverts was often used to conclusively identify HY/SY or AHY/ASY birds, respectively. In fact, the greater coverts of birds in either plumage may show or lack buffy tips. Typically, both feather types, juvenal and those grown in preformative and prebasic molts, show buffy tips when fresh. The main difference lies in the distribution of the buff. Juvenal coverts

generally have buff spots at the covert tip's center. The buff traces up alongside the central shaft, forming a shaft streak. On the other hand, definitive feathers only show light color, if any, on the tip of the outer web; it does not form a streak along the shaft and is rarely as bright as the spot on the juvenal feathers. There is a good illustration of this difference in fresh feathers in the ID Guide, Figure 233, p. 393. The Wood Thrush in preformative molt (Fig. 13, p. 18) also shows the difference well.

Another problem with this simple distinctive mark is that it is on the very tip of the feathers and therefore prone to abrasion. By the spring, the tips are often worn off. Such a bird would appear to lack buffy tips along the shaft and thus could quickly be released as an ASY for lack of typical juvenal buffy tips. Sometimes, close examination will not only turn up remnants of the buffy tips, but allow identification of a molt limit. On the Hermit Thrush (Fig. 5, p. 8), the second covert from the body (between the inner tertial and the body) shows an indistinct pale patch toward the tip, while the adjacent, outer feather shows a vestigial buff streak along the shaft. The next one does, too, but after that the "buffy tips" appear to be progressively lost to wear. This inner covert also shows a denser array of barbs along the shaft than does the adjacent outer covert, another good clue that this October 26 HY bird molted at least that one inner greater covert during its preformative molt, within the normal range for the species ("0 to 4 inner greater covs," ID Guide, p. 400). However, with the distinction between the buffy tips across the molt limit already somewhat vague by the end of October, how useful will that character be five months later, in April? Thus, molt limits are a far better means to age *Catharus* thrushes than the presence or absence of buffy tips.

Feather shape and feather length, already discussed as fundamental differences between juvenal and corresponding feathers grown subsequently, warrant only a few comments here. "Narrow and tapered" and "broad and truncate" are categories easiest to identify in direct comparison. As indicated, they also vary species by species. This comparison can be seen in individual birds when feathers from two generations are present together in one tract as we saw in the Philadelphia Vireo (Fig. 11, p. 17) for shape and in the White-eyed Vireo (Fig. 21, p. 28) for length. It is difficult to have confidence in a tapered-vs-truncate or a narrow-vs-broad assessment during the first encounter with a species. The best way to learn to distinguish feather shapes by age is to study those birds of known age – as indicated by recaptures, skull ossification, or other criteria – before applying the criteria to birds of unknown age. It is equally important to know the limits of your recognition capabilities for a given species and time of year; comparing your results taken independently on a recapture to data previously taken, which may have provided other corroborating evidence, can help you gauge your consistency.

Confounding Effects

Feather wear

Feather wear is a term used to describe both the color change as well as the fraying and abrasion that feathers undergo as a result of exposure. Exposure wears down feathers both through structural weakening and break-down as a result of solar irradiation, and through physical abrasion against foliage and the ground. In theory and under controlled conditions, feathers of the same quality exposed to the elements equally will show equal degrees of wear. By the same logic, feathers exposed for longer periods of time should show more wear than feathers replaced more recently. In fact, wear is often a useful criterion in identifying molt limits between feather generations, thus

Figure 31: Indigo Bunting, ASY male. April in NC.

Figure 32: Indigo Bunting, ASY male. May in VA.

The number of greater coverts replaced during the prealternate molt is rather variable, as these two pictures demonstrate. Figures 31 and 32 show ASY male buntings with complete prebasic and variable prealternate molts. Figure 31 is a classic ASY male: he features a uniform wing with uniform blue-edged primaries, uniform blue-edged primary coverts, and no contrast obvious among the greater coverts, secondaries or rectrices. On first glance, Figure 32 resembles the SY male Indigo Bunting in Figure 17 (p. 22) more than it does Figure 31. However, it also represents an ASY male. Again, he shows uniform blue-edged primary coverts and no contrast among the primaries in shaft color, vane color, wear, or edging. These are the two feather tracts most affected by differences between incomplete preformative versus complete prebasic molts, and least affected by prealternate molts. The significant contrasts visible in the wing in Figure 32 are the result of a minimal prealternate molt, which replaced only about half the median coverts, seven greater coverts (some obscured), the central tertial, and perhaps secondary 5. The ASY in Figure 31 replaced all greater and median coverts and apparently all three tertials; the inner three secondaries, although darker and more brightly blue edged than the outer secondaries, appear to be basic feathers with a wear effect due to varying degrees of exposure. The ASY in Figure 31 replaced all greater and median coverts, apparently replaced all three tertials, and may even have molted the inner three secondaries, as they appear darker and more brightly blue-edged than the outer secondaries, although the cline in appearance also suggests a wear effect due to varying degrees of exposure. In any case, the bird in Figure 31 underwent a thorough prealternate molt resulting in a uniform blue wing, in contrast to the much browner ASY in Figure 32 which underwent a much more restricted prealternate molt, leaving it with brown lesser, median and greater coverts, tertials and secondaries leftover from the basic plumage. Both ASY's thus show two feather generations among the coverts: basic primary coverts and at least some alternate greater coverts.

warranting its discussion under "How to look for molt limits." If it were so easy, feather wear would qualify as the single most reliable way of distinguishing feather generations. However, because there are several factors that confound the use of wear as a reliable criterion for differentiating feather generations, it is also discussed here as the most important *confounding* factor in separating out feather generations.

The tertials of the Indigo Bunting (Fig. 32, p. 41) present a classic example of how wear can help identify different feather generations: the middle tertial is considerably fresher than its two neighbors, showing no fraying or nicks. In fact, when differences in wear are this obvious, often other characteristics – feather color, edging width, or edging color, as in this case – make the distinction straightforward. In any case, differences in wear between two feather generations are most obvious when the younger feathers are entirely fresh.

There are a number of factors that make assessing differences in feather wear particularly treacherous; they include: inherent differences in feather quality, differences in degree of exposure of various feather tracts, differences both among individuals as well as between species in behavioral characteristics that result in different rates of exposure and abrasion, and the effect of length of exposure on differences in feather appearance.

Because juvenal feathers are of poor quality, they tend to wear down and fade more rapidly than subsequently grown feathers. Thus, this characteristic actually *emphasizes* the difference

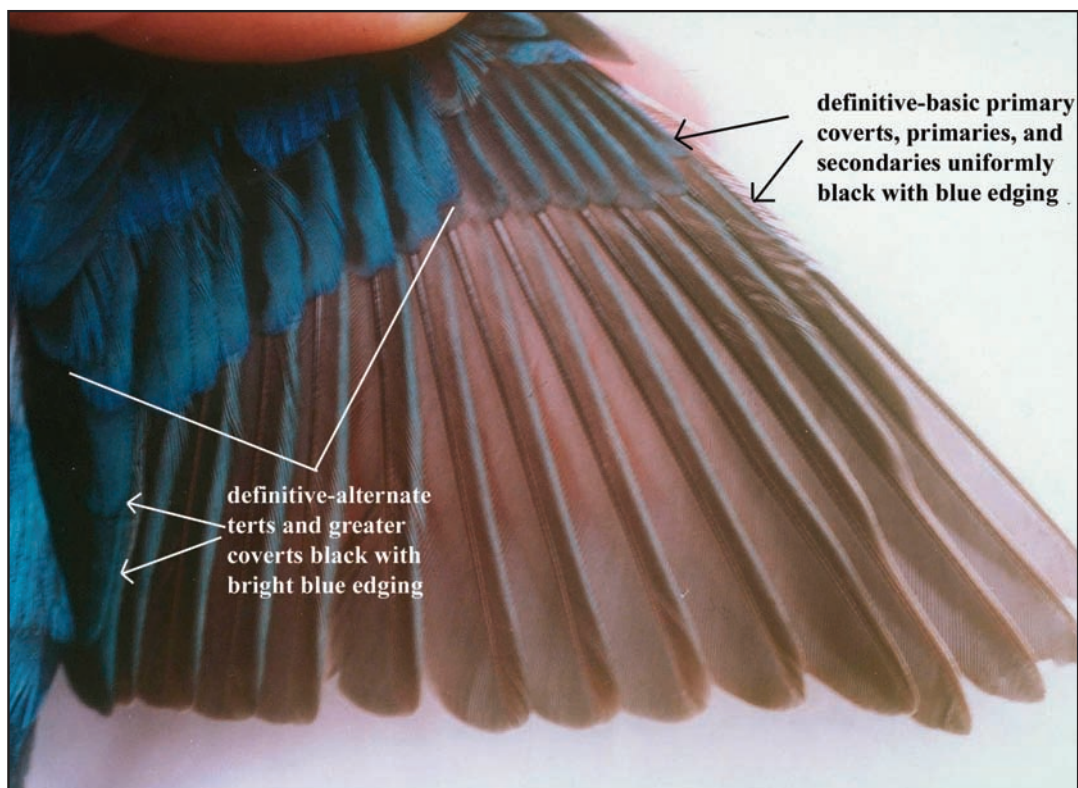


Figure 31

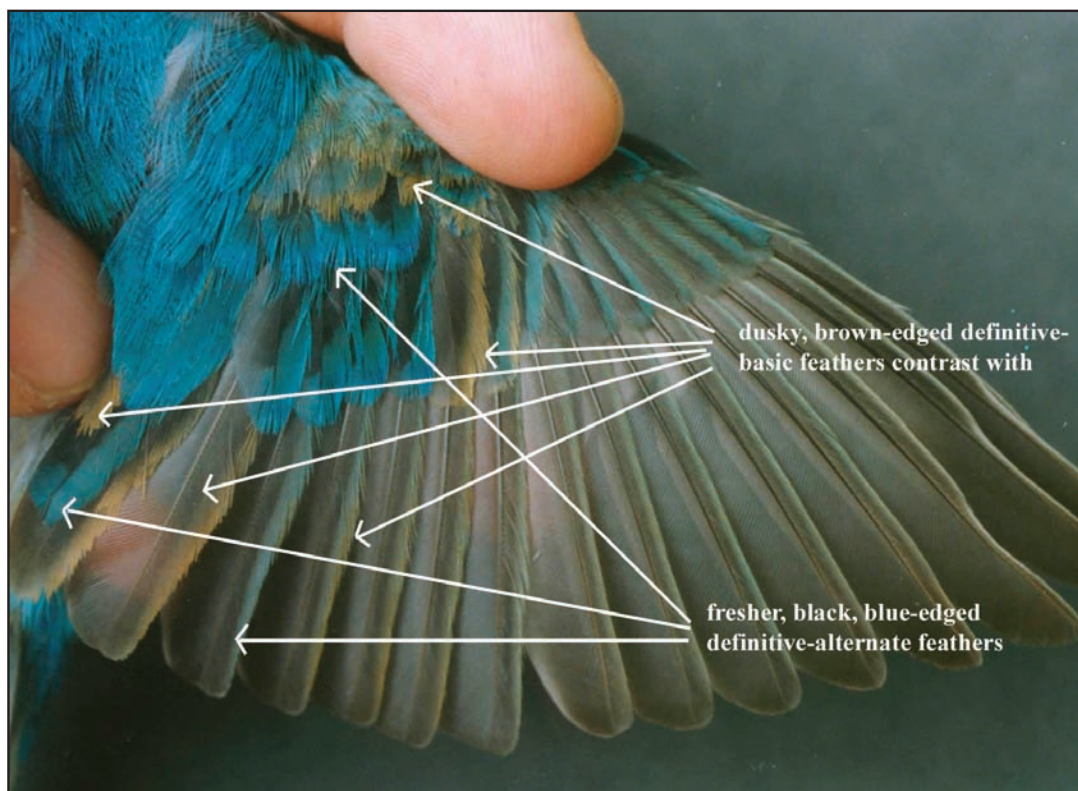


Figure 32

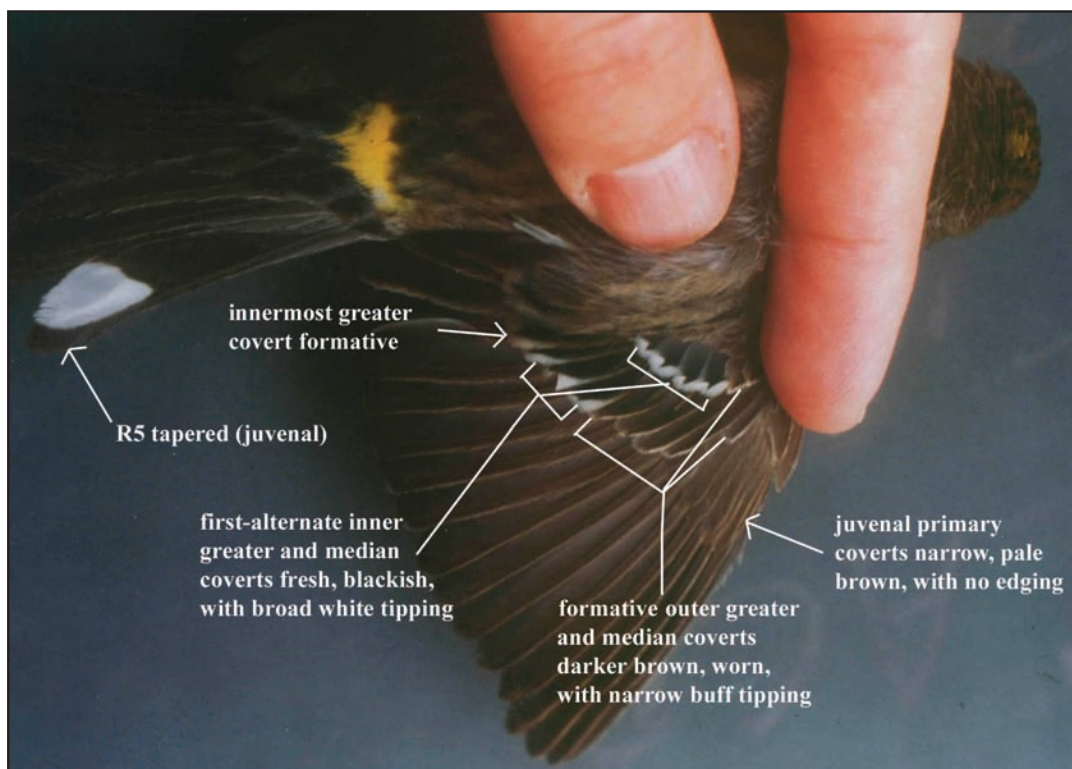


Figure 33



Figure 34

Figure 33: Myrtle Warbler, SY female. April in NC.

This female Myrtle shows distinct molt limits between the inner median and greater coverts and their outer neighbors. The contrast between the two groups of feathers – blackish, fresh and broadly white-tipped versus dusky, worn and narrowly buff-tipped – is abrupt. However, both SY and ASY birds could show similar replacement patterns, meaning that the presence of prealternate molt limits is usually not helpful for ageing this species. In this wing, however, there is another, more subtle molt limit as well: while the outer greater coverts show dusky centers, the primary coverts, in comparison, are pale brown and lack edging. This is the molt limit that identifies this bird as an SY, which is further corroborated by the tapered rectrices (the pattern of white is difficult to assess since, apparently, only rectrix 5 is showing). An ASY should show primary coverts that are broad and dusky with clean edging. In spring and summer birds of species that show prealternate molts, it is often difficult to distinguish molt limits arising from preformative molts and those arising from prealternate molts. When three feather generations are present, as in this female Myrtle Warbler, drawing the conclusion that it is an SY bird is not difficult. However, what if only two feather generations are apparent? Checking the primary coverts for juvenal characteristics – pale brown, narrow, tapered, with little or no edging – is often the best you can do. As with this individual, the rectrices may prove helpful as well.

between juvenal feathers and those replaced during ensuing partial or incomplete preformative molts: all things being equal, they wear and fade more quickly than comparable adult-type feathers. As a result, retained juvenal feathers are often in particularly poor shape shortly before they are replaced during the second prebasic molt. The June SY Song Sparrow (Fig. 23, p. 31), for example, has primaries with their tips shorn off and their outer webs frayed to the shaft. With these feathers already exposed for longer periods of time – from a few weeks to about three months more – one could expect the differences to be obvious. While the difference between retained and replaced feathers is subtle when the replaced feathers are fresh (typically in the fall, after the preformative molt), six or seven further months of wear (by the following spring) often increases the differences between the two feather generations. The significance of the difference in age between the two feather generations heightens as the feathers age: three months difference in feather age is less visible between feathers that are one and four months old than between feathers nine and twelve months old. It is the extreme variability in wear produced by the other factors that makes judgments based only on wear both difficult and suspect.

Exposure is probably the single most important factor affecting wear, more important than feather structure. Exposure is the degree to which a given feather is exposed to the elements and is predetermined by the location of the feather on the body. On the folded wing, for example, the resting position for most birds, certain feathers remain exposed to the elements while others are folded under – and protected. These exposed feathers, mainly the tertials, the outer greater coverts, and the middle primary tips (forming the primary projection), wear and fade much more rapidly than the feathers they cover and protect. A couple of examples from the pictures demonstrate the effect of exposure: the outer two tertials of the Chipping Sparrow in Figure 30 (p. 36) are the same age as

Figure 34: Blue Grosbeak, age ??, sex ??. May in VA.

This is a test bird: this Blue Grosbeak was mostly brown with a strong blue wash all over the head. Using the ID Guide and the skills you honed looking at these photographs, determine its age and sex.

the adjacent secondaries, yet they are heavily frayed and nicked at the tip whereas the secondaries are clean-tipped.

Similarly, the tips of primaries 6 and 7 of the White-eyed Vireo in Figure 21 (p. 28) show much more wear than primaries 8 and 9 of equal age, because on the closed wing their tips are exposed to the sun (see the left, closed wing). In fact, primaries 6 and 7 show a "fade line" near their tips; beyond the fade line, where they are exposed on the closed wing, fraying and fading are extreme. Before the fade line, where the adjacent primary overlies the feather and protects it on the closed wing, fraying and fading are much less pronounced. Primaries 8 and 9, which are shorter than primary 7 on the closed wing, appear to be in good condition, with little obvious wear. Finally, the inner primary coverts of the Northern Cardinal (Fig. 18, p. 22) appear much fresher than the neighboring greater coverts, yet they are the same age. This is because the primary coverts tuck neatly under the greater coverts on the folded wing.

Exposure, in fact, is so important to individual feathers' constitutions, that it often dictates the molt strategy in partial or incomplete preformative molts; it is not a coincidence that those feathers most protected on the wing – secondaries, inner primaries, and primary coverts – are those least likely to molt. Thus, when comparing wear between two feathers, keep in mind that greater coverts, tertials and certain primaries wear much more quickly than neighboring feathers or other tracts on the wing.

The habits of species and individuals also affect the degree of wear on their feathers. Thus, it can be futile to draw conclusions based on wear comparisons between species, and sometimes difficult to draw conclusions based on wear comparisons between individuals within a species. Species that live in the forest subcanopy (Red-eyed Vireo) tend to show less wear than those occupying sunny edges (Prairie Warbler); those that mostly perch (flycatchers) tend to show less wear than those that mostly fly (it is no coincidence that nine of twelve North American swallow and swift species undergo a complete preformative molt, otherwise an uncommon strategy among North American landbirds); those that live on the ground (thrushes), occupy dense undergrowth (Common Yellowthroat), or are cavity nesters (chickadees) tend to show more feather abrasion than those whose lifestyle exposes their feathers to fewer abrading agents. Such differences in behavior, some of which may also be sex-specific, give rise to a variable degree of exposure which may apply to individuals within a population as well. In any case, when examining feather wear, keep the lifestyle of the species and possible variation within the species in mind; this should help put into perspective the amount of wear seen.

Finally, the relative age of the feather must be considered, too, when assessing wear. Note that in the ID Guide references to wear ("fresh" or "abraded") are often prefaced with "relatively." When you realize that, in comparing wear in feathers, you must take into account the relative age of the feathers, their durability depending on their provenance (juvenal, formative, or basic plumage), their susceptibility to exposure, and the habits of the species, it becomes clear that age determinations based on contrasts in wear must be made with caution. For example, for species that replace all of their greater coverts in the preformative molt but retain their primary coverts (sparrows), the ID Guide suggests that birds in HY/SY plumage will show "relatively abraded pp covs contrasting with the slightly fresher gr covs." While this is true initially when the greater coverts indeed are fresh, it must be understood that the greater coverts will proceed to wear much more quickly than the

protected primary coverts and that, after six further months of exposure, they may well appear equal in wear to the older but more protected primary coverts. It is important to remember that the ID Guide's use of the term "relatively" in conjunction with descriptions of wear encapsulates this entire bee's nest of circumstances relating to wear.

Prealternate molts

A prealternate molt is fairly common among many species. Typically, though, the prealternate molt, while often producing easily identifiable molt limits, does not produce replacement patterns distinctive for different age classes. In fact, when tertials or many greater coverts are molted in a prealternate molt, their replacement may (but usually do not) mask replacement patterns from the preformative molt that could have been diagnostic. Thus, in species that undergo an extensive prealternate wing molt, it is important to be sure that molt limits you detect are distinctive for a particular age class and not the result of a replacement pattern seen universally during the prealternate molt of any age class. Obviously, molt limits detected prior to the prealternate molt cannot be attributed to it.

The Acadian Flycatcher (Fig. 7, p. 13), is unusual in that the fairly clear molt limits within the greater coverts and the tertials, while a product of a prealternate molt, are distinctive for SY birds, in the extent shown in this wing. ASY Acadians generally molt a maximum of two greater coverts, whereas this individual replaced four, within the limits of an SY's typical maximum of seven.

More typical of the confounding effect prealternate molts can have is the female Myrtle Warbler (Fig. 33, p. 42). She shows distinct molt limits among the greater and median coverts. This replacement pattern is typical for both SYs and ASYs, however, and thus useless for ageing. The feature that *is* significant for ageing is the evidence of the previous partial preformative molt, the more subtle molt limit between the dusky greater coverts and the pale brown, narrow, and tapered primary coverts. This SY bird thus shows three generations of coverts: juvenal primary coverts, formative outer greater coverts, and first-alternate inner greater coverts.

The high degree of variability in the prealternate molt may produce plumages that appear quite different from one another, yet do not differ in the diagnostic ageing criteria. Thus, the two male SY Audubon's Warblers in Figure 12 (p. 17) differ only in the extent of the first prealternate molt. Both show three generations of covert feathers, as in the Myrtle Warbler before, though in the bird on the left, there is only one alternate greater covert, the innermost.

Comparing the Indigo Buntings in Figures 31 and 32 (p. 41) one might assume that Figure 31 represents an ASY while Figure 32 shows an SY. However, in the characteristics diagnostic for ASY's, uniform primaries and relatively fresh, blue-edged, broad primary coverts, they do not differ. The only substantive difference between the two birds is the extent of the prealternate molt, which in the bird of Figure 31 apparently included all visible coverts except the carpal covert and all three tertials. In the bird in Figure 32, on the other hand, it included only a limited number of greater and median coverts, a single tertial, and perhaps secondary 5. Both wings represent ASY birds; the brown merely shows to what extent feathers from the basic plumage were retained but gives us no indication as to the age of the bird. For all we know, the bird in Figure 32 may, in fact, be *older* than that shown in Figure 31.

Pseudolimits

Pseudolimits is a term used to represent contrasts between feathers of a single feather generation that show substantial differences in baseline coloration or edging such that they suggest a molt limit between two different feather generations. Such contrast is regularly seen among tertials or between tertials and neighboring secondaries, especially among sparrows. In the Vesper Sparrow shown in Figure 15 (p. 21), for example, the three tertials have blackish versus brownish centers and cinnamon versus buffy edging compared with the adjacent inner secondaries. The bird is undergoing its preformative molt without replacing any of the tertials; thus, all are simultaneously grown juvenal feathers, yet they contrast strikingly in color with the secondaries of the same age.

Timing of molt

The descriptions in the ID Guide are of plumages. While monthly ranges are given for each plumage, the descriptions do not refer as much to the months indicated as to the molts that produce and replace the plumage in question. During times of year near the molt thresholds – around the prealternate molt, for example – it is critical to determine whether or not the individual in question has already undergone the season's molt. In early spring, for example, two feather generations *before* the prealternate molt probably indicates an SY bird, while two feather generations present *after* the prealternate molt may well suggest an ASY bird. Knowing which feathers are likely to be replaced during a prealternate molt and what those replaced feathers should look like is critical to correct interpretations of molt limits.

Birds in active molt may be particularly easy to age or may present particular challenges. Often, the molt pattern itself is key. Molt of greater coverts only or of full body plumage without any flight feathers generally indicates a partial preformative molt, typical of many HY birds, such as the Wood Thrush and the Vesper Sparrow in Figures 13 and 15 (pp. 18 and 21), respectively. Sequential flight feather molt, even in its earliest stages (Carolina Chickadee (Fig. 28, p. 35)) – or in its latest, when just secondary 6 remains in sheath – is indicative of a complete prebasic molt (or of flight feather replacement in typical sequence in a small number of species with incomplete molts), and in the fall can identify many birds as AHYs. In these individuals, though, more specific age classes may be determined if the remainder of the outgoing plumage is scrutinized for molt limits or other age-specific characteristics.

SUMMARY

To locate molt limits on a bird, first identify the appropriate feather tracts using the ID Guide.

For **molt limits among the greater coverts**, consider the following key points in conjunction with the plumage descriptions in the ID Guide:

- Look for obvious differences in length and color, being sure that you are accounting for all coverts (in passerines). The innermost is often anomalous; do not confuse the carpal covert, short and tucked between the greater and primary coverts, with the outermost greater covert.
- Look for contrasts in the overall vane colors, particularly for contrasts in the duskiness of the inner vanes. If you detect such differences, see if you can confirm a greater density of barbs along the vane of the replaced feather in comparison with the retained feather.
- Look for contrasts in the color, intensity or saturation, and distribution of the edging to the feathers. Be mindful of the length of time the feathers have been exposed and thus subjected to degradation of edging integrity.
- Be sure any molt limit patterns you detect follow appropriate replacement patterns: you should be able to pinpoint molt limits to a difference between two adjacent feathers. Normally, the feathers proximal to the body from the molt limit should be formative, those distal from the molt limit should be juvenal.
- If the feathers all appear uniform, consider the possibility that none or all of the greater coverts could have molted. If all may have molted, check for molt limits between greater and primary coverts. If none may have molted, check if the feathers show any evidence, based on your experience with the species, of being retained juvenal feathers (brownish cast in Gray Catbird or Carolina Chickadee, buffy shaft streaks in *Catharus* thrushes, etc.). Also, check for molt limits among the remaining wing feathers: between the median and greater coverts or among the lesser and median coverts, the carpal covert, and the feathers of the alula.
- Finally, consider "Confounding Effects" (especially feather wear and prealternate molts).

For **molt limits between the greater coverts** and the primary coverts, consider the following key points in conjunction with the plumage descriptions in the ID Guide:

- Look for contrasts in the overall vane color of the two sets of feathers, dusky for the replaced formative greater coverts and pale brownish for the retained juvenal primary coverts.
- Look for signs that the whole set of primary coverts is retained; if so they should appear tapered, narrow, relatively abraded, and pale brown, with little or no edging, measured by your experience with the species.
- If a contrast is not apparent, consider the possibility that both feather tracts are uniformly adult, i.e., broad, truncate, dusky, evenly edged in lustrous colors. If this does not seem obvious, the bird is probably intermediate in this character.
- Finally, consider "Confounding Effects" (especially feather wear and prealternate molts).

For **molt limits involving the tertials**, consider the following key points in conjunction with the plumage descriptions in the ID Guide:

- Look for subtle differences in shaft color among the three feathers or between the three feathers and the adjacent secondaries, especially on the basal part of the tertials, where they are protected from extreme exposure by an overlying feather.
- Look for contrasts in the vane colors, particularly for contrasts in the duskiness of the inner vanes. If you detect such differences, see if you can confirm a greater density of barbs along the vane of the replaced feather in comparison with the retained feather.
- Look for contrasts in the color or for stark contrasts in the extent of wear to the edging of the feathers. Be mindful of the length of time the feathers have been exposed and thus subjected to degradation.
- Consider the possibility that none of the tertials replaced during the preformative molt or that all molted along with some adjacent secondaries. If none molted, they are more likely to be much more worn than neighboring secondaries because of their location.
- Finally, consider "Confounding Effects" (especially feather wear, prealternate molts, and pseudolimits).

For **Molt limits among the primaries and secondaries**, consider the following key points in conjunction with the plumage descriptions in the ID Guide:

- Look for differences in shaft color (dark chocolate vs. milk chocolate) among the feathers expected to molt by comparing adjacent feathers, one by one.
- Look for subtle contrasts in the vane and edging colors, particularly for dull, diaphanous browns in retained juvenal feathers and dusky browns in the replaced formative feathers.
- If you detect a contrast among the primaries, look for a "step" in length between the set of retained (usually inner) juvenal primaries and the replaced formative outer ones. Wear can sometimes exaggerate this step.
- Finally, consider "Confounding Effects" (especially feather wear and timing of molt).

For **molt limits among the rectrices**, consider the following key points in conjunction with the plumage descriptions in the ID Guide:

- Look for clear differences in terminal shape between adjacent feathers, and for subtle differences in shaft color and overall vane color among the rectrices.
- Discount differences in wear and fading between the central rectrices and the remaining ones if the central ones are considerably more worn than their neighbors. They are subject to a great deal more wear which you should expect to see, even if they grew in together. They should not be retained while others are replaced; they are always the first to go.
- Finally, consider "Confounding Effects" (especially feather wear and prealternate molts).

REFERENCES

- Carney, S.M. 1992. Species, Age, and Sex Identification of Ducks Using Wing Plumage. US Fish and Wildlife Service, Washington.
- Dwight, J. Jr. 1900. The sequence of plumages and moults of the passerine birds of New York. *Ann. New York Acad. Sci* 13:73-360.
- Howell, S.N.G., C. Corben, P. Pyle, and D.I. Rogers. 2003. The first basic problem: A review of molt and plumage homologies. *Condor* 105:635-653.
- Jenni, L. and R. Winkler. 1994. Molt and Ageing of European Passerines. Academic Press, New York, NY.
- Phillips, A.R. 1974. The first prebasic molt of the Yellow-breasted Chat. *Wilson Bull.* 86:12-15.
- Pyle, P. 1997a. Identification Guide to North American Birds, Part I. Slate Creek Press, Bolinas, CA.
- Pyle, P. 1997b. Molt limits in North American passerines. *N. Am. Bird Bander* 22:49-90.
- Pyle, P., S.N.G. Howell, R.P. Yunick, and D.F. DeSante. 1987. Identification Guide to North American Passerines. Slate Creek Press, Bolinas, CA.
- Pyle, P. 1997c. Flight-feather molt patterns and age in North American owls. *Monographs in Field Ornithology* 2:1-32.

ACKNOWLEDGEMENTS

I would like to acknowledge a number of people and museums who have been particularly helpful with this project: Douglas Long, curator at the California Academy of Sciences, kindly provided access to their ornithological collection. Hannah B. Suthers, curator of birds at Princeton University's ornithological collection and a MAPS contributor, kindly provided access to the University's specimens. John Gerwin, curator for birds at the North Carolina State Natural History Museum, provided generous access to the skins in their collection and general support for the project; Rebecca Browning, preparations specialist at the museum, also provided help and, along with other preparators at the museum, has begun a set of excellent spread-wing preparations. I thank Susan Riddle for generously offering the use of a number of photographs, five of which were included (Figs. 3, 9, 15, 23, and 25), and Steve N.G. Howell and Priscilla Yocom for providing the line drawing on the title page. I received particular encouragement for tackling this project from Peter Pyle and I thank him for that as well as the use of one slide (Fig. 8). He also provided extensive comments on an earlier draft of this guide. I thank David DeSante and Peter Pyle for careful editing of the final draft, and David DeSante and Nicole Michel for greatly improving the design of this guide. Finally, I owe special thanks to Nicole Michel for providing electronic versions of the photographs and the excellent graphical annotations on them, and for skillfully laying-out the entire manuscript; and to Christina Robinson-Swett of the Bureau of Reclamation and Priscilla Yocom for final typesetting of the manuscript.

I'd like to thank the many, many banders around the world, experts, colleagues, and beginners alike, who have taught me to look carefully and articulate what I see; but, in particular, I'd like to thank Trevor Lloyd-Evans at Manomet Observatory for introducing me to bird-banding and Gabriel Gargallo, a Catalanian bander, for honing my vision to see differences where, before, there were none. Furthermore, without the motivation provided by The Institute for Bird Populations' Bander Training Program and the many questions asked by students in the classes, this manual would never have taken shape. I would like to acknowledge The Institute for Bird Populations' MAPS (Monitoring Avian Productivity and Survivorship) Program and its Program Director (David F. DeSante), its funders (including DoD Legacy Resource Management Program, USDA Forest Service, National Park Service, National Fish and Wildlife Foundation, USGS/Biological Resources Division, and US Fish and Wildlife Service/Division of Migratory Bird Management), and its many contributors. Finally, I would like to thank Barbara Raulston and the Bureau of Reclamation (Lower Colorado Region) for assistance in developing and printing this manuscript.

This is Contribution Number 178 of The Institute for Bird Populations

INDEX

- blackbirds 11
 Bushtit *Psaltirparus minimus* 11
 Bunting, Indigo *Passerina cyanea* 10, 23, 24, 29, 38, 40, 45
 Cardinal, Northern *Cardinalis cardinalis* 11, 23, 24, 33, 44
 Catbird, Gray *Dumetella carolinensis* 5, 9, 10, 20, 33, 34, 47
 Chat, Yellow-breasted *Icteria virens* 10
 Chickadee, Carolina *Poecile carolinensis* 20, 33, 34, 37, 46, 47
 chickadees 44
 columbids 11
 Crossbill, Red *Loxia curvirostra* 1
 cuculids 11
 ducks 1
 Flycatcher, Acadian *Empidonax virens* 10, 13, 20, 38, 45
 Alder *Empidonax alnorum* 29
 “Traill’s” *Empidonax alnorum/traillii* 24, 29
 flycatcher 11
 Grosbeak, Blue *Guiraca caerulea* 43
 Rose-breasted *Pheucticus ludovicianus* 20, 24, 33
 hummingbirds 11
 kingfishers 12
 larks 11
 nightjars 11
 Ovenbird 38
 owls 5, 11
 Phainopepla *Phainopepla nitens* 11
 Redpoll, Common *Carduelis flammea* 1
 Redstart, American *Setophaga ruticilla* 13
 Sapsucker, Red-breasted *Sphyrapicus ruber* 33
 Sparrow, Chipping *Spizella passerina* 24, 37, 43
 Song *Melospiza melodia* 10, 30, 43
 Vesper *Pooecetes gramineus* 20, 24, 46
 sparrows 23, 44, 46
 Aimophila 11
 Ammodramus 11
 Starling, European *Sturnus vulgaris* 11
 Swallow, Barn *Riparia riparia* 1
 swallows 11, 44
 Swift, Black *Cypseloides niger* 11
 swifts 44
 Tanager, Summer *Piranga rubra* 11, 25, 26, 38
 Thrush, Hermit *Catharus guttatus* 9, 10, 20, 39
 Wood *Hylocichla mustelina* 19, 20, 38, 39, 46
 thrushes 44
 catharus 38, 47
 trogons 12
 Vireo, Philadelphia *Vireo philadelphicus* 11, 16, 24, 25, 38, 39
 Red-eyed *Vireo olivaceus* 10, 37, 38, 44
 Warbling *Vireo gilvus* 10
 White-eyed *Vireo griseus* 10, 24, 29, 38, 39, 44
 vireos 23
 Warbler, Audubon's *Dendroica coronata* 11, 13, 15, 16, 24, 45
 Black-and-white *Mniotilta varia* 24, 30, 38
 Myrtle *Dendroica coronata* 43, 45
 Prairie *Dendroica discolor* 44
 Prothonotary *Protonotaria citrea* 11, 15, 24, 25, 26, 38
 Yellow *Dendroica petechia* 19, 20, 23, 33, 38
 warblers 23
 weavers 11
 Woodpecker, Downy *Picoides pubescens* 33, 34
 woodpeckers 2, 5, 12, 33
 Wren, Bewick's *Thryomanes bewickii* 10
 House *Troglodytes aedon* 6
 Winter *Troglodytes troglodytes* 1
 wrens 5
 Wrentit *Chamaea fasciata* 11
 Yellowthroat, Common *Geothlypis trichas* 44



The Institute for Bird Populations



U.S. Bureau of Reclamation

ISBN: 0-9618940-2-4