Birding by Feather: A Molt Primer

by Peter Pyle

With rising gas prices and the need for humans to become a more responsible species on Earth, birding will by necessity become a more localized sport, especially for the majority of us with low to moderate incomes. Rather than crossing the country or state looking for single vagrants, many of us will be forced to look more closely at the common birds in our own backyards. But this isn't necessarily a bad thing. Personally, I prefer to gain a deeper knowledge about a few species of a single ecosystem than a superficial knowledge about many species scattered about. The advent of digital imaging technology, easily shared through the internet, can greatly help us learn more about the molts, plumages, and structure of our birds, which in turn can help us age, sex, and identify them to species and subspecies. Collectively, there is still much for us to discover on these subjects. Dare I predict that "digital birding" at home on our computer monitors, to fully classify and document select observations, will someday supplant long-distance travel to simply log sight records at the species level?

Every digital image of a bird I see online contains useful knowledge about molts and plumages. The crispness of many images allows what I call "birding by feather," such that every visible feather can be properly classified to feather generation, reflecting previous molts. Birding by feather is the opposite of "jizz birding" and may be preferred by those believing that the whole is equal to the sum of its parts. To collectively bird by feather online, it is imperative that we are all on the same page regarding terminology for feather tracts, molts, and plumages. Here I dissect some images using Humphrey-Parkes molt and plumage terminology, which I strongly encourage birders to learn and to employ as our future standard for birding by feather.

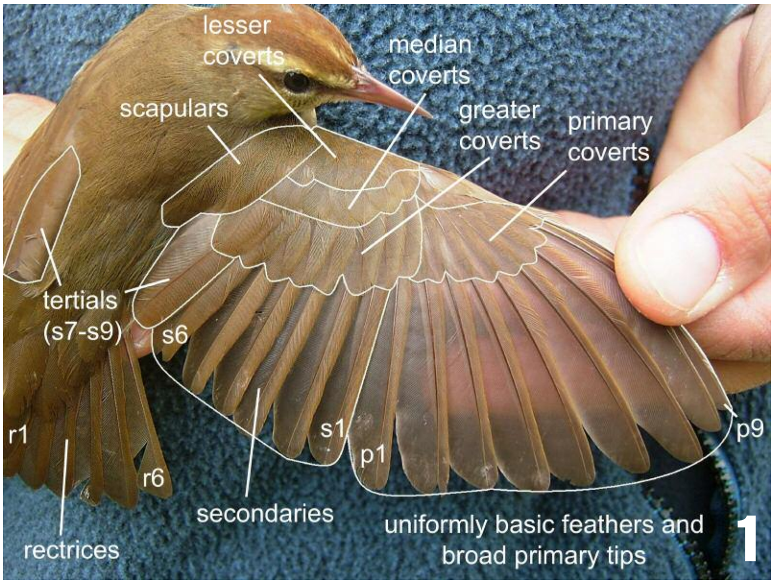


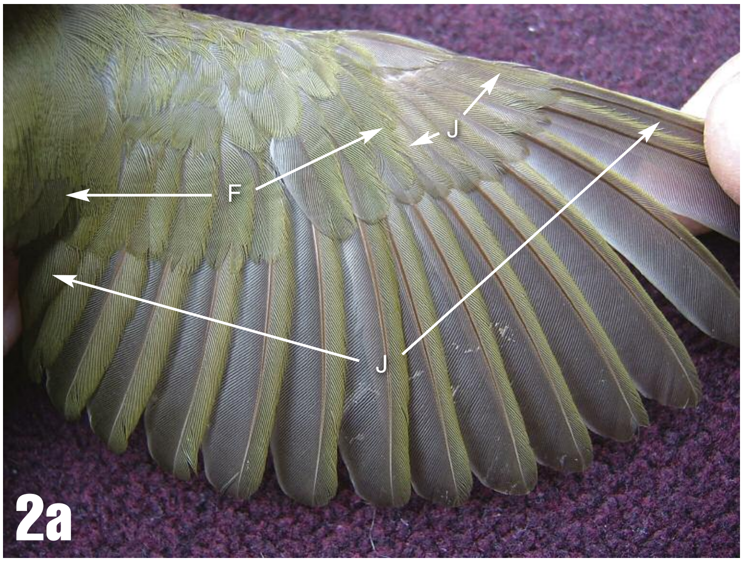
Fig. 1. Swainson's Warbler, North Carolina, 6 May 2006. ***Photo by © Peter Pyle.***

This figure provides an overview of feather tracts useful for birding by feather and age determinations. The terminology follows that of most standard references, including Parts 1 and 2 of my *Identification Guide to North American Birds*.

The lesser, median, and greater coverts are collectively known as the "secondary coverts" (e.g., "greater secondary coverts") and the "primary coverts" shown in the image are technically the "greater primary coverts." However, the unmodified terms indicated in the image have gained wide usage. Note also that these unmodified terms refer to the upperwing, an additional modifier being needed for analogous covert tracts of the underwing, e.g., "underwing greater coverts."

Most passerines have nine or ten functional primaries, nine secondaries (including three tertials), and 12 rectrices. Tanagers, sparrows, buntings, blackbirds, finches, and warblers (including this Swainson's Warbler captured for banding) have nine functional primaries while most other North American passerines have ten primaries, the outermost primary often reduced in length. The tertials are technically part of the secondary tract, differing only in having shafts inserted into the fleshy tissue surrounding the joint between the ulna and humerus, rather than being attached to the ulna as are the more distal secondaries. Other bird families show variable numbers of these feathers: Grebes, storks, and flamingos have 11 functional primaries; larger birds can show up to 30 secondaries (albatrosses) and seven tertials (eiders); North American hummingbirds have only six secondaries; and the number of rectrices can vary from eight (anis) to 16 in Wilson's Snipe and 20–24 in pelicans. Note the numbering sequences of the feathers: distally (toward the wingtips) among the primaries, proximally (toward the body) among the secondaries (including the tertials), and distally among the rectrices on both sides of the tail. This numbering pattern generally reflects molt sequences and is important to learn when birding by feather.

This Swainson's Warbler is in a definitive cycle (in this case at least two years old), having undergone a complete prebasic molt the preceding summer following the breeding season. Note the uniform quality to the definitive basic wing feathers, along with the broad rectrix and primary tips. First-spring individuals typically show worn juvenal primaries, primary coverts, and secondaries, contrasting with fresher formative secondary coverts (see Fig. 2), and thinner, more-pointed, and more-worn juvenal outer rectrices and primaries. The two tertials s8 and s9 are missing from the right wing. We call this "adventitious" feather loss (and replacement) and not part of molt, as 6 May is too early in the season for the next prebasic molt to have begun.



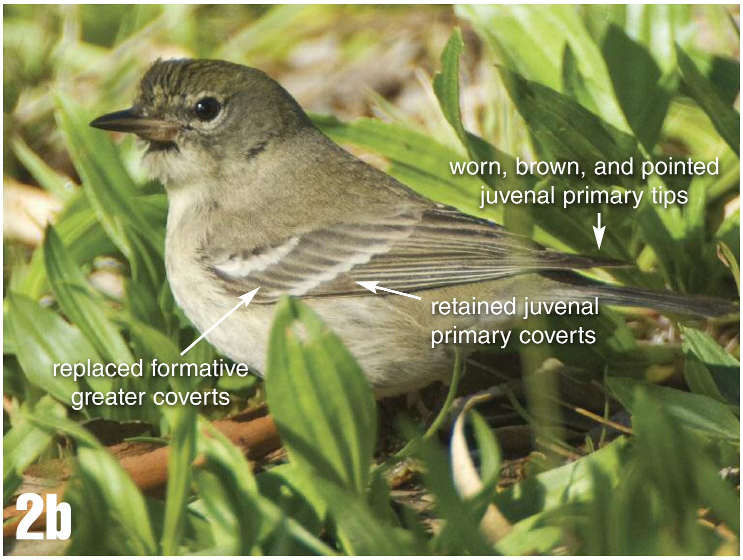


Fig. 2a. Ovenbird, North Carolina, 9 May 2006.
Photo by © Peter Pyle.

Fig. 2b. Pine Warbler, California, 26 February 2008.
Photo by © Robert Harrington.

Fig. 2c. Grace's Warbler, California, 21 October 2007.
Photo by © Douglas Aguillard.

Fig. 2a shows the wing of a first-cycle (~1-year-old) Ovenbird that was captured for banding. In contrast to the Swainson's Warbler (Fig. 1), note the "molt limits" between the retained, worn, juvenal (J) secondaries, primaries, and (especially) primary coverts, and the fresher and better-quality, replaced, formative (F), lesser, median, and greater coverts. This replacement pattern, known among banders as the "block pattern," is typical of most first-cycle warblers, vireos, and sparrows following the preformative molt. The primary coverts are often visible on sitting birds, and can be used to age many warblers, sparrows, vireos, and other passerines in the field.

For example, the Pine Warbler in Fig. 2b can also be aged as a first-cycle bird due to the brown, retained juvenal primary coverts, contrasting with the darker, replaced formative greater coverts, and the worn and brown juvenal primary tips.

In contrast, the Grace's Warbler in Fig. 2c has blackish basic primary coverts with grayish edging, uniform in color and quality with the greater coverts, and broad and blackish basic primary tips and rectrices. Our ability to determine that this female Grace's Warbler was in its definitive cycle (and >1 year old) helped confirm it as a returning vagrant from the winter before. The McGill Bird Observatory Photo Library and the Powdermill Avian Research Center Bird-Banding websites offer hundreds of images and extensive further tips on aging passerines in the hand by molt limits.

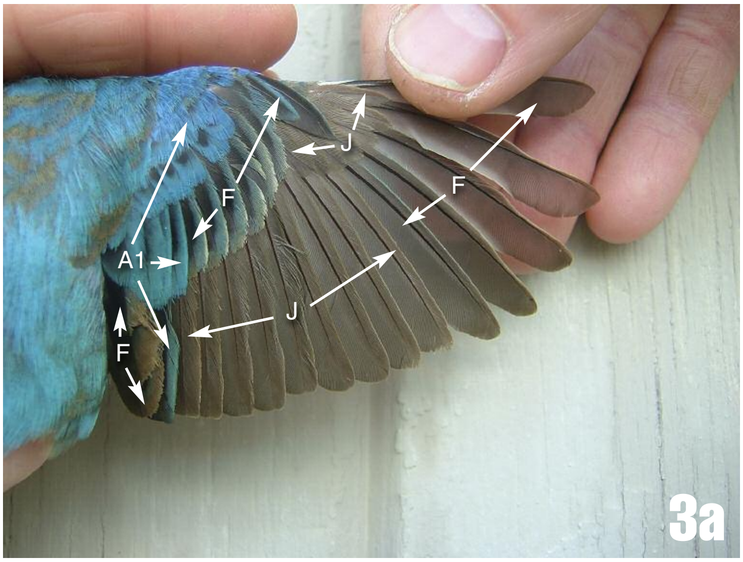


Fig. 3a. Indigo Bunting, Indiana, May 2007.
Photo by © Peter Pyle.

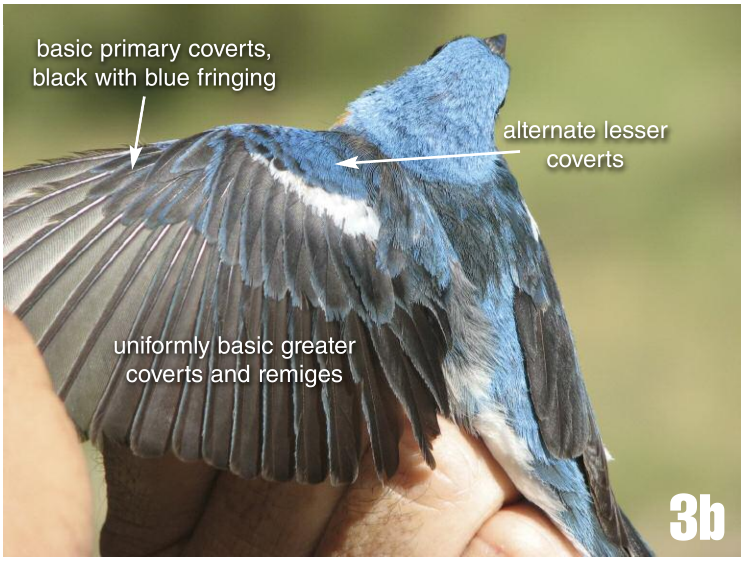


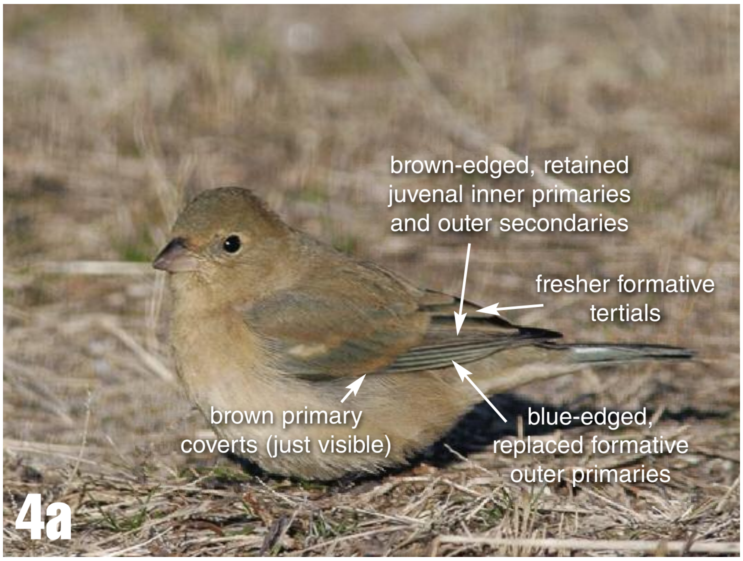
Fig. 3b. Lazuli Bunting, Arizona, July 2007.
Photo by © Peter Pyle.

The images show a first-cycle Indigo Bunting and definitive-cycle Lazuli Bunting captured for banding. *Passerina* buntings have what is known as "eccentric" preformative molts, during which outer primaries (but not primary coverts) and inner secondaries are replaced, leaving a block of juvenal outer secondaries and inner primaries in the center of the wing. Eccentric preformative molts occur in some sandpipers, flycatchers, shrikes, wrens, thrashers, sparrows, orioles, and other taxa, many of which inhabit xeric habitats and/or sunny, open country.

On the Indigo Bunting (Fig. 3a), note the contrast in freshness, quality, and shaft color between the retained juvenal (J) inner primaries (p1–p4), and the replaced formative (F) outer primaries (p5–p9), and between the retained juvenal primary coverts and outer secondaries (s5–s1), and the replaced formative outer greater coverts. The lesser and median coverts, the inner four greater coverts, s6, and most of the body feathers were replaced during the first prealternate molt (marked A1), whereas the tertials and some body feathers were replaced during the preformative molt but retained during the first prealternate molt. All of these contrasts indicate a first-cycle individual in spring, approaching one year of age.

The adult Lazuli Bunting (Fig. 3b), in comparison, has uniformly definitive basic feathers. Note especially the color of the definitive primary coverts compared to the juvenal coverts of the Indigo Bunting. Note also the subtle difference between the fresher s1 and the more worn p1, caused by a gap of 2–3 weeks between the replacement of these two feathers (s1 is typically replaced when primary replacement has reached p5 or p6), resulting in what banders call an "s1–p1 contrast." This contrast is especially useful in aging adults of species with protracted and complete prebasic molts. Good online examples include a definitive-cycle Pink-footed Shearwater and a definitive-cycle Buller's Shearwater, both photographed by Bill Schmoker.

Interestingly, Lazuli Buntings lack the extensive prealternate molts found in both first-year and adult Indigo Buntings. Specifically, the prealternate molt in this Lazuli Bunting involved most lesser coverts but no other feathers of the wing. The definitive prealternate molt of Indigo Bunting, in contrast, typically includes most or all wing coverts and tertials. The question is still wide-open: What accounts for the extensive variation in the prealternate molts among species of *Passerina*?



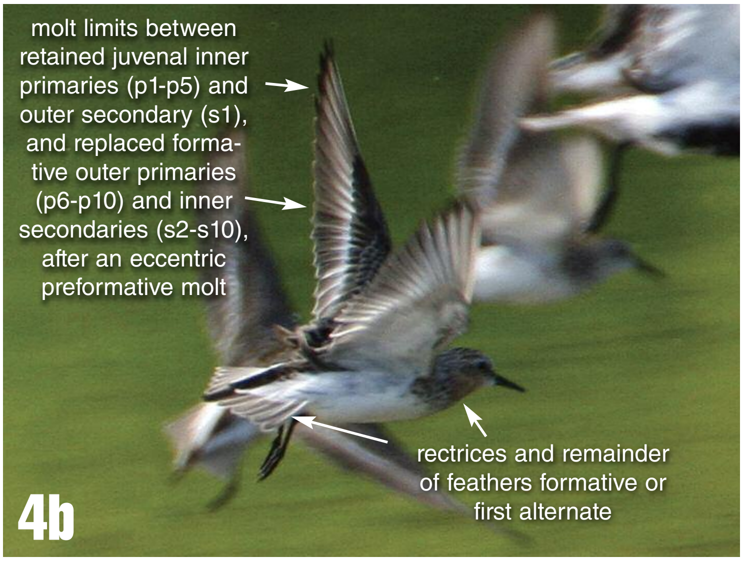


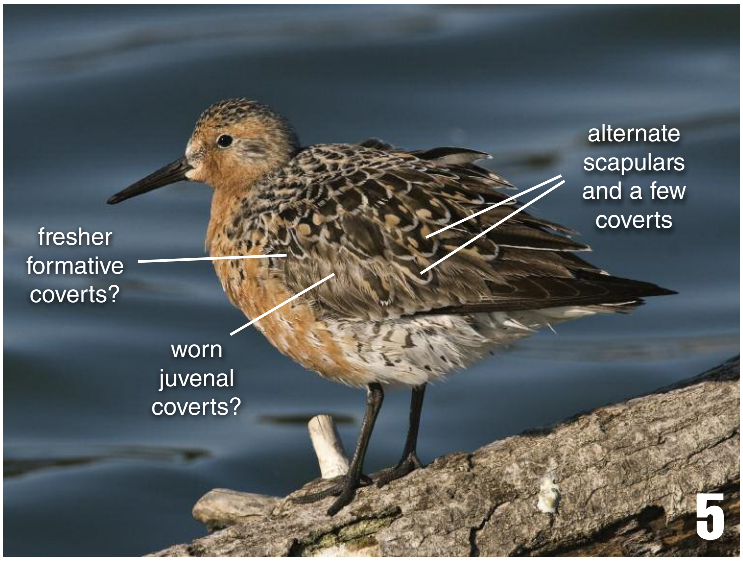
Fig. 4a. Lazuli Bunting, Connecticut, January 2007.
Photo by © Julian Hough.

Fig. 4b. Red-necked Stint, Indiana, 23 May 2006.
Photo by © Leland Shaum.

Crisp digital images can allow the detection of eccentric molts in the field. This vagrant first-cycle Lazuli Bunting (Fig. 4a) shows contrast between the newer, formative, bluer-edged outer primaries (p5–p9) and the retained, juvenal, browner-edged inner primaries (p1–p4) and outer secondaries, and between the fresher formative tertials and the older juvenal secondaries. Birds with eccentric molt patterns typically replace all rectrices: The blacker formative rectrices, edged blue basally, indicate a male, whereas females have browner formative rectrices with duller and more-greenish edging.

Likewise, this vagrant Red-necked Stint (Fig. 4b) shows an eccentric pattern and is therefore in its first cycle. Note the juvenal outermost secondary (s1) and inner primaries (p1–p5) contrasting with the darker formative inner secondaries and outer primaries. These were the only juvenal feathers retained during the preformative molt of this individual and the only indication as to its age.

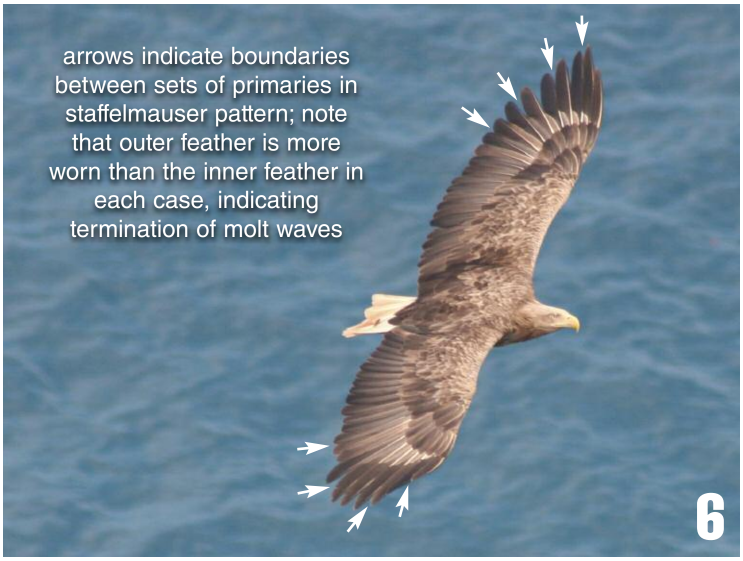
Fig. 5. Red Knot, California, 2 May 2007.
Photo by © Jim Scarff.



This Red Knot shows worn and frayed median and greater coverts, along with pointed primary tips typical of many first-cycle shorebirds in spring. However, it also shows a rather extensive breeding-plumage aspect for a first-cycle individual of this species. It appears that there may be some fresher formative lesser coverts resulting in molt limits within this tract and indicating a first-spring individual, but age in such cases should be confirmed by examination of the open wing.

First-spring shorebirds can vary in appearance from a complete non-breeding aspect to obtaining a "full" or near-full, definitive breeding aspect (as with the Red-necked Stint, Fig. 4b). Birds displaying a complete non-breeding aspect are often still in "alternate plumage" (indicating that at least some feathers were replaced during the prealternate molt), but the alternate feathers may be few, and/or may not have acquired a breeding aspect due to hormonal cycles and other factors. Molts and plumages of shorebirds also show extensive variation based on wintering latitude; individuals going to the southern hemisphere generally having more-extensive preformative molts and more-protracted prebasic and prealternate molts than those remaining in the northern hemisphere. Red Knots and several other shorebird species can be especially variable in plumage aspect due to the wide latitudinal wintering range, spanning both hemispheres. For this reason, I believe that the Red Knot is actually monotypic (meaning that no subspecies exist). Instead, I hypothesize that observed plumage variation relates more to environmental factors (e.g., those associated with winter latitude) than genetic factors differentiating populations.

Fig. 6. White-tailed Eagle, Hawaii, 5 March 2005.
Photo by © Brenda Zaun.



Many large birds that need to maintain flight while molting undergo a pattern of remex replacement known as "staffelmauser" or "stepwise molt." A series of incomplete prebasic molts eventually results in multiple waves of replacement through the feather tracts. Among the primaries, staffelmauser results in "sets" of contiguous feathers replaced during a molt, with starting points defined by a fresher inner feather adjacent to a more-worn outer feather. As long as the outer primary is not juvenal, the number of sets defines the minimum age of the bird in terms of molt cycles, which for temperate species usually equates to years. This White-tailed Eagle has five sets of definitive primaries in each wing (divisions marked by the arrows) and is thus in at least its fifth molt cycle and year of life. Sets on the right wing include p1, p2–p4, p5–p7, p8–p9, and p10, and those on the left wing include p1–p2, p3–p4, p5–p6, p7–p8, and p9–p10.

It is not uncommon for the wings to lose symmetry in replacement patterns after several years of molt. If the outer primary in such cases is juvenal (usually recognized by being pointed and significantly bleached), the number of sets defines the cycle; thus, a bird with sets at p1–p4, p5–p9, and p10, with p10 juvenal, is in its third cycle and would be approaching three years old in spring. Secondaries in most large birds are replaced inward from s1 and s5 and outward from the tertials. Sets of feathers also occur within this tract but, due to the complex replacement sequence, patterns become obscured once all juvenal feathers have been replaced. Look for staffelmauser patterns in images of North American eagles, ospreys, *Buteo* hawks, boobies, pelicans, frigatebirds, cormorants, herons, and a few other taxa. With practice and a good image of the upper surface of the wing, staffelmauser can easily be recognized on live birds in the field.

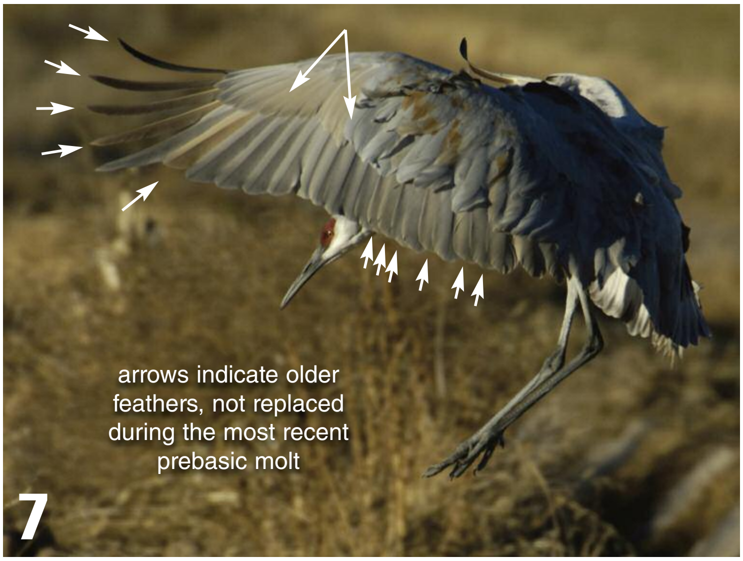


Fig. 7. Sandhill Crane, New Mexico, 21 November 2005.
Photo by © Bill Schmoker.

North American cranes exhibit odd and unique patterns of remigial molt that are far from fully understood. In Sandhill Crane, individuals from resident southern populations appear to undergo staffelmauser patterns as described previously (Fig. 6), whereas individuals from migratory populations can replace all secondaries and primaries synchronously, becoming flightless during molt. These complete simultaneous wing molts in Sandhill Cranes may occur only once every other year, and in Whooping Cranes once every third year (Marty Folk, personal communication). But some Sandhill Cranes can molt primaries and secondaries in different patterns from those described above, seemingly almost random at times, and not well-understood. Some appear to molt feathers in synchronous blocks of 5–6 contiguous feathers, with different sets replaced in alternate years.

The Sandhill Crane depicted here had replaced p1–p4 and p6 during the preceding prebasic molt, leaving p5 and p7–p10 as retained feathers from a previous generation (arrows in image). The secondaries also show at least two generations, with s1–s5, s9, and s11 newer and the other visible feathers older (arrows). Note also that the outer greater coverts and inner primary coverts had been retained in patterns not coinciding with corresponding secondaries and primaries, respectively. The older primaries and secondaries appear not to be juvenal feathers (which would be narrower and more bleached), indicating at least two wing molts have occurred since the first cycle and a bird of at least three years of age (note also the full red head patch, typically gained during the third cycle). Whether or not the replacement sequence of this individual fits into some sort of broader pattern awaits further analyses, perhaps with digital images and by *birding by feather*.