Secondary Aging Criteria

It pays to pay attention to the often-overlooked secondary flight feathers of large soaring birds

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Many large birds do not have enough time to replace all their primaries and secondaries during a single prebasic molt—the annual molt, which often takes place in late summer or fall in the northern hemisphere. The resultant, incomplete replacement patterns among these tracts can be used to age these birds, in some cases up to and beyond their fourth or fifth annual plumage cycles. While there has been increasing focus on "reading" replacement patterns among primaries to age birds, patterns among secondaries have often been regarded as "random" or "too complex" to be useful. (A quick reminder: The *primaries* are the powerful outer flight feathers of the wing; the *secondaries* are the inner flight feathers of the wing. Together, the primaries and the secondaries are known as the *remiges*.)

In this note, I encourage greater awareness of the value of the secondaries in aging large birds. For a case study, I reconsider the age of one of the albatrosses in a recent article in *Birding* (Flood 2015). But before we get to that, let's consider the order, or "sequence," in which birds molt their secondaries.

The replacement sequences for the secondaries are more fixed than for the primaries. In larger birds, moreover, the full replacement of juvenile secondaries usually requires another cycle after all of the juvenile primaries have been replaced, thus allowing age determination for an extra year. For example, many medium-size and some larger raptors and herons replace all juvenile primaries during their second prebasic molt (in the bird's second calendar year, when the bird is about one year old), but retain one or more juvenile secondaries until their third prebasic molt (the following year, when the bird is about two years old; see Pyle 2008a). These juvenile secondaries are thus retained throughout the second cycle.

Most large birds that require multiple years to replace all secondaries are "diastataxic," meaning that a secondary has been lost evolutionarily between what we now call s4 and s5, the fourth and fifth secondaries, respectively, from the outermost. Replacement of secondaries in these birds proceeds distally (outward) from the tertials and proximally (inward) from both s1 and s5. The result is that the last juvenile secondaries replaced are s4, as well as those somewhere between the tertials and s5, depending in part on how many secondaries are present in a species (Pyle 2006, 2008a). The number of secondaries can also vary within a species. For example, Laysan and Black-footed albatrosses have between 25 and 30 secondaries (Edwards and Rohwer 2005; Fig. 1).

On the Age of a Yellow-nosed Albatross

Flood's (2015) treatment on aging Yellow-nosed Albatrosses by molt patterns among primaries represents a good start on the subject. For actively molting birds, it is good to know the sequence in which feathers are replaced. In the case of albatrosses, most if not all species molt the outermost three primaries (p8 to p10) distally and the inner 7 primaries (p7 to p1) proximally (Howell 2006, 2012; Pyle 2008a; Fig. 1). Other factors to consider include "wear clines," the increased amount of wear certain feathers receive (for example, as when outer primaries get increasingly more solar exposure and wear than inner primaries), and "molt clines," the gradual freshening of feathers in sequence that results from protracted molts (Pyle 2005, 2008a).

Flood has provisionally aged an Atlantic Yellow-nosed Albatross photographed off North Carolina on February 22, 2014 as in its third cycle ("3c2y9m" by his classification), reportedly with p9–p10 and some secondaries being replaced and the remainder of the remiges being retained juvenile feathers (Fig. 4 in Flood 2015, reproduced as Fig. 2 here). However, the inner primaries (p1–p8) do not look worn enough to me to be juvenile feathers. I would especially expect p8 to be worn, brown, and frayed as a juvenile feather at 33 months of age, due to its exposed position and the wear clines mentioned above; notice how worn and frayed p7 is on the third-cycle bird shown in Fig. 3 of Flood (2015). The primaries also appear to show a molt cline from p7 to p1, as evidenced by the darkening of the shaft color in this sequence, indicating previous replacement.

Turning to the secondaries on this bird, it appears that s3, s4, and several feathers in the s10–s15 area are newer than the rest (Fig. 2). Because these would be the last secondaries replaced in sequence, it would not be possible for the remaining, older secondaries to be juvenile as proposed. I therefore suggest that the bird is in its fifth cycle (5c4y9m, in Flood's notation), and that it had replaced all primaries once and p9–p10 for a second time, while the juvenile s3–s4 and those among s10–s15 were replaced during the previous molting episode, along with p9–p10. Why does p8 look a bit more worn, with a whiter more bleached shaft, than p7?—That can be explained by its probable replacement during the third prebasic molt, whereas p7 to p1 may have been replaced during the fourth prebasic molt. Replacement patterns among secondaries thus support a conclusion that we might not have reached by evaluating the primaries alone.

As mentioned by Flood (2015), a bird's switching hemispheres can affect normal molting patterns, due to hormonal responses to molt that may be triggered by opposite seasonal day-length regimes. An albatross replacing p9–p10 but not p8 during a molt is unusual. This leads me to speculate that the bird switched from the southern to the northern hemisphere during late summer or fall of the previous year (August or September, 2013); in this scenario, seasonal light regimes then trig-

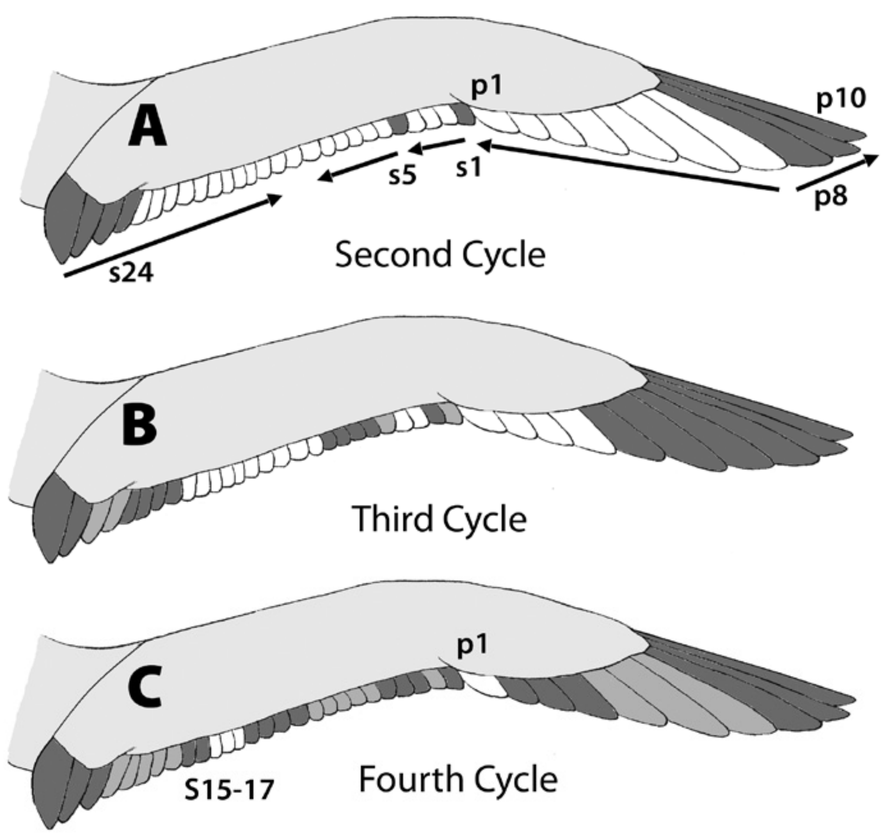

Fig. 1. Shown here are molt patterns by age in Laysan and Black-footed albatrosses; darker shading indicates fresher remiges, with white indicating juvenile feathers.

Arrows in A indicate replacement sequences discussed in the text. The diagrams depict molt patterns typical of individuals in the second plumage cycle (A), individuals in the third cycle (B), and some individuals in the fourth cycle (C); some more-progressed third-cycle birds may also show patterns similar to that in illustration C. First-cycle birds have uniform juvenile remiges, whereas definitive-cycle (including some fourth-cycle) birds show mixed basic feathers in various patterns. Note that molt in larger southern hemisphere species (such as in the Yellow-nosed Albatrosses) progresses slower, with the first molt of primaries typically occurring during the third prebasic molt, as opposed to the second prebasic molt, as is the case with the smaller Laysan and Black-footed albatrosses. See Fig. 182 in Pyle (2008a) for more information. *Illustrations by © Siobhan Ruck.*

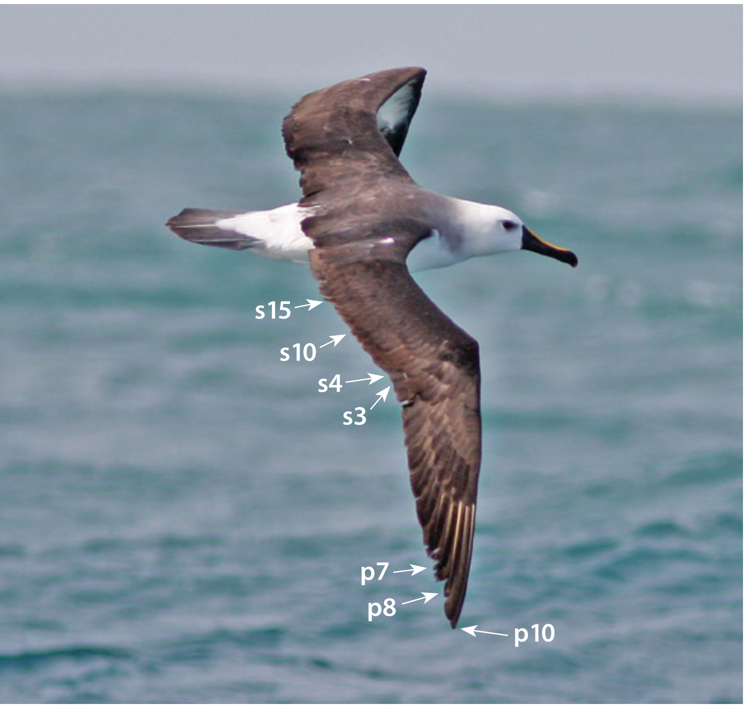

Fig. 2. This **Atlantic Yellow-nosed Albatross** was aged as a third-cycle bird by Flood (2015; his Fig. 4), but is considered here to be more likely in its fifth cycle. Variation in bleaching to the shafts indicates that p7 to p1 have been replaced and that p8 is more worn than p7; although disheveled, p8 is not worn enough to be a juvenile feather 33 months old, as reported by Flood (2015). Note also that s3, s4, and several feathers in the s10–s15 area are newer than the rest of the secondaries, having been replaced during the most recent molt. These patterns are not consistent with a third-cycle bird, which would exhibit more juvenile secondaries at these positions, as in Fig. 1, diagram B, and is instead consistent with a fifth-cycle bird. *Off Hatteras, North Carolina; February 2014. Photo by © Kate Sutherland.*

gered the molt to commence at a more-distal-than-usual primary because of the later date on which the bird entered a typical molting season. A somewhat similar dynamic has been proposed for eccentric molts in passerines (Elrod et al. 2010).

If this bird's molt had been affected by switching hemispheres, what cycle would we consider the bird to be in? Did it begin its fifth cycle early? Or is it still in its fourth cycle (according to southern hemisphere molt timing), having gone on to replace some extra primaries and secondaries due to switching hemispheres? Using a comparison with conventional molt terminology in the Swainson's Hawk, which can molt primaries on both North American summer grounds and South American winter grounds within a single cycle (Pyle 2005, 2008a), we would regard the bird in Fig. 2 as being in its fourth cycle. But, as if molt patterns were not mindboggling enough to begin with, applying molt terminology to vagrants that switch hemispheres mid-cycle may be beyond what mere humans can unravel.

Fig. 3. This **Reddish Egret** shows five brown retained juvenile secondaries on the left wing (s4 and s6–s9, left to right) and three retained secondaries on the right wing (s4 and s7–s8); such asymmetry in these cases is not uncommon. These secondaries are the last to be replaced in the typical replacement sequence; they are the only juvenile feathers remaining, and allow us to age the bird as a second-cycle individual, as all primaries have been replaced and the body plumage at this age is similar to that of an adult. The brown wash to the median and inner greater coverts represents a predefinitive character; these coverts are the earliest feathers typically replaced during prebasic molts in large birds, and thus often show such characters in second-cycle birds. *Merritt Island National Wildlife Refuge, Florida; January 2015. Photo by © Hart Rufe.*

Try It Yourself

Most ABA members don't have ready access to Yellow-nosed Albatrosses, but all of us live in places with one or more species of common, large, soaring birds—birds whose secondaries and primaries are easily observed with binoculars and in digital images. Such species, including herons (Fig. 3), eagles (Fig. 4), ospreys, other large accipitrid raptors, pelicans, cormorants, boobies, storks, and even owls and woodpeckers, can show incomplete replacement patterns among the secondaries, which can be analyzed for a bird's age in the field or in digital images. I encourage bird photographers, especially, to not shy away from taking and saving images of ragged-looking birds, as these are often the sub-adult (technically, predefinitive) or molting birds that can provide the most information on molting patterns and age. Figs. 3 and 4 provide some tips; see also Pyle (2008b).

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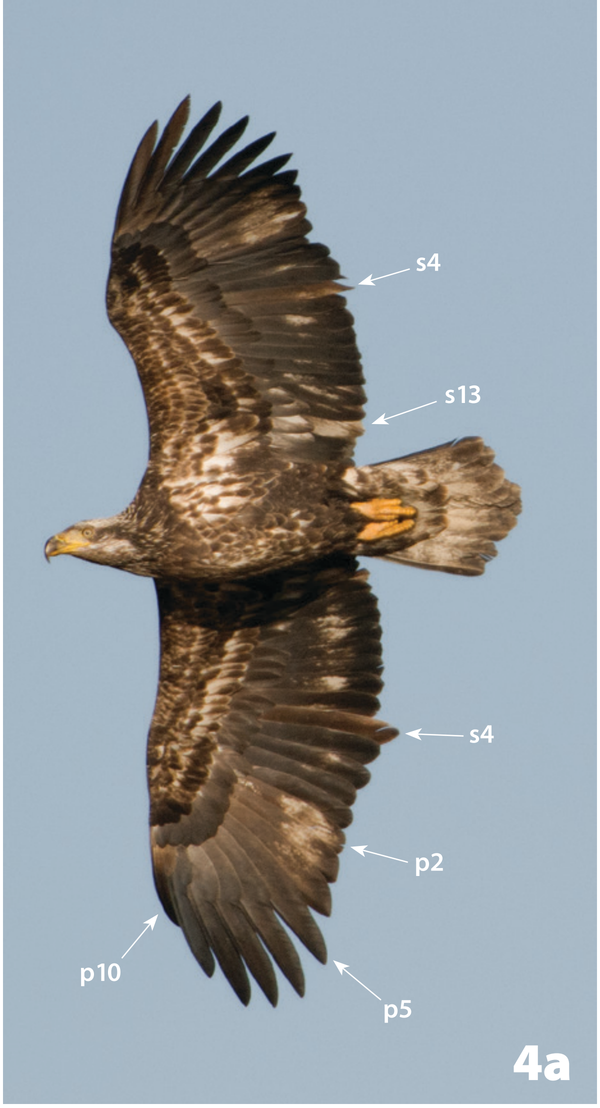

Fig. 4. These third-cycle (Fig. 4a) and fourth-cycle (Fig. 4b) **Bald Eagles** show typical body plumages and molt patterns for these ages. Note in the third-cycle bird (Fig. 4a) that the only remaining juvenile feathers are the s4s on each wing. In raptors and especially in eagles, the juvenile secondaries are often longer than the basic secondaries, as evident here. Among the remainder of the remiges, it appears that p2–p4 and s13 are second-basic feathers and that p1, p5–p10, and the rest of the secondaries are third-basic feathers, indicating that p1–p4 and s13–s17 (of 17 secondaries) were replaced at the second prebasic molt, and that p1 and s14–s17 were replaced again at the third prebasic molt; this pattern is typical of Staffelmauser ("stepwise") molt patterns (Pyle 2006, 2008a).

On the right wing of the fourth-cycle bird (Fig. 4b), no juvenile remiges remain; p1, p5–p8, s2–s3, s6–s9, and s12 appear to be third-basic; and the rest of the feathers appear to be fourth-basic. A similar pattern would be expected after the subsequent molt of the third-cycle bird (Fig. 4a). Definitive plumage is not reached until the fifth or sixth cycles in Bald Eagles; in other large birds, definitive body plumage is reached at an earlier age, but third-cycle and fourth-cycle birds can be distinguished based on remigial molt patterns.

Davis County, Utah; February 2011 (Fig. 4a) and December 2009 (Fig. 4b). Photos by © Mia McPherson–OnTheWingPhotography.com.