Molt, Age Determination, and Identification of Puffins

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Long-lived seabirds, including puffins, typically defer breeding until three or more years of age, and their first year or two of life are spent at sea, away from breeding colonies. In such species the timing and extent of molts are poorly known. Few specimens exist, field study of live birds is often hindered by difficult observation conditions, and a bird's precise age is usually unknown and instead must be inferred. Individual variation in plumage aspect (i.e., color and pattern), bare-part development, and the timing and extent of molt further cloud the picture, even within age-groups. And all of this complexity is superimposed upon inter-annual variation in food resource availability, which may further influence molt timing and, in years of breeding failure, may lead to the absence of an entire age-class (Ainley and Boekelheide 1990).

The impetus for this investigation was frequent debate on the identification and age of immature puffins observed on pelagic trips off California. Species identification is greatly facilitated, however, once a simple factor is appreciated: First-year Tufted Puffins can have white underparts (Fig. 1a). This feature is treated variably in field guides. For example, Sibley (2000) indicates that juvenile Tufted Puffins are all-dark below, whereas NGS (2002) states that juveniles can have "white or dark underparts" and illustrates both types.

While examining specimens for identification criteria, we began to investigate the prerequisite and (at least to us) more interesting topics of molt sequence and age determination. Here we present a preliminary summary, based largely on specimen examination, of molt and aging in Tufted and Horned Puffins. Species determination happens to be useful for understanding these topics, so we start with a brief synopsis of field identification criteria.

Identification of adult Horned and Tufted Puffins in breeding plumage is straightforward. But what of individuals in other plumages? In order to make sense of these more-difficult plumages, it is essential to have a basic grasp of molt and aging. The approach in this article is to examine in some detail various characters that are evident from a study of museum specimens—with the hope that the lessons learned can be put to good use at sea. *Adult* ***Tufted Puffin*** *in transition to non-breeding plumage. Santa Cruz County, California; September 2004. © Mike Danzenbaker.*

IDENTIFICATION

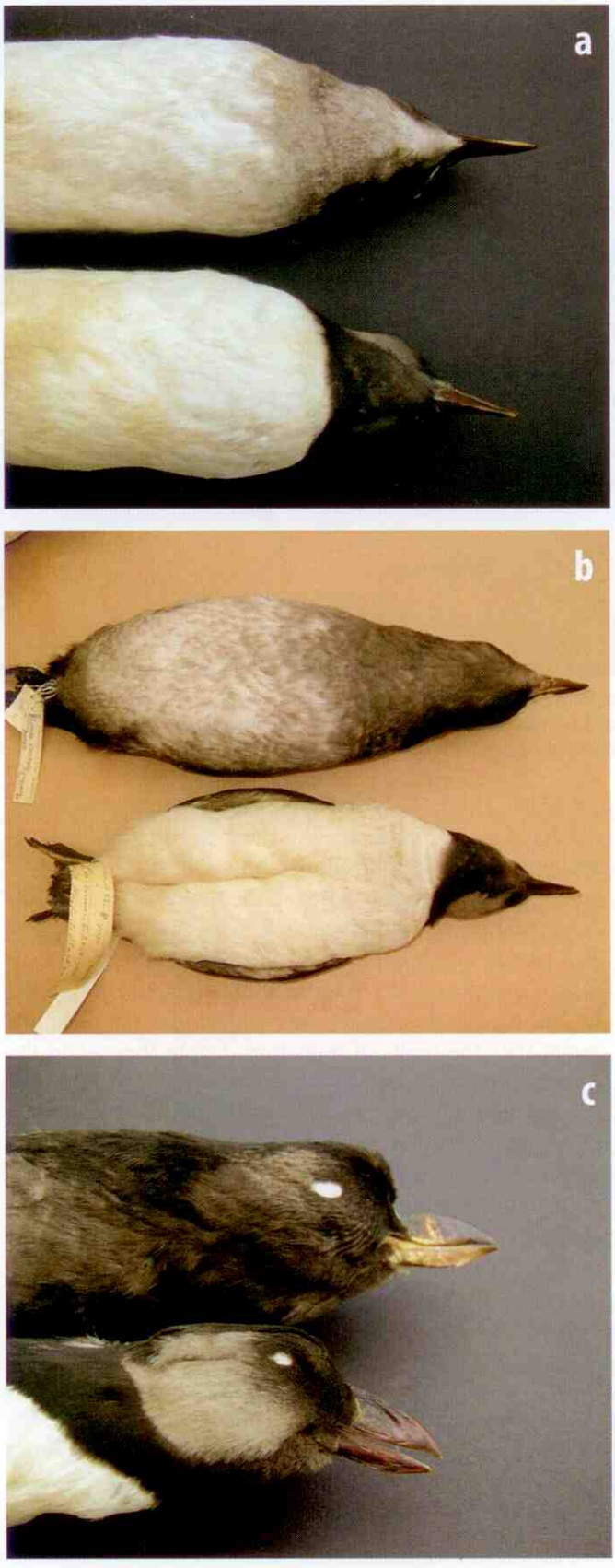
Juveniles of both Tufted and Horned Puffins have relatively narrow, dark-orangish bills that lack the distinctive shape and coloration which readily distinguish adults. Both species also share generally dusky heads and upperparts, and white to whitish bellies, but they still show certain adult-like plumage criteria that enable species identification throughout the first year (Fig. 1). For those with open minds and lofty goals, separation of first-year Horned Puffin from Atlantic Puffin can usually be accomplished by examination of the throat and face patterns (Fig. 2). A Horned Puffin reached Mackenzie, North West Territories, and a Tufted Puffin made it to Maine (AOU 1998); populations of two ostensibly Atlantic alcids, Dovekie and Black Guillemot, have crossed the Arctic to inhabit the Bering Sea; and Long-billed and Ancient Murrelets have made long-distance flights all the way to the Atlantic Seaboard. Hence, pelagic observers in both oceans should be familiar with criteria to distinguish non-breeding plumages of Horned and Atlantic puffins, just in case...

MOLTS

The molts of both Tufted and Horned Puffins are poorly known (summarized by Gaston and Jones 1998; Piatt and Kitaysky 2002a, 2002b; Thompson and Kitaysky 2004). Adults of both species acquire their breeding plumage in spring and their non-breeding plumage in fall, but little or conflicting information exists on the timing of flight-feather molts (here also simply termed "wing molts"), which, in puffins, are synchronous (i.e., all remiges are dropped almost simultaneously, rendering birds flightless). Essentially nothing has been published concerning pre-definitive molts (i.e., the molts of immatures before they attain the definitive plumage aspect).

Piatt and Kitaysky (2002a, 2002b) inferred that definitive molts are similar between the species, but our specimen data indicate distinct differences (Fig. 3). Whereas adult Tufted Puffins typically undergo wing molt during late fall and early winter, adult Horned Puffins molt their remiges (and upperwing coverts and tail) in spring, a strategy similar to that of the Atlantic Puffin (Salomonsen 1944, Harris and Yule 1977, Cramp and Simmons 1985). These divergent molt strategies show an interesting parallel to those of loons: Red-throated Loon exhibits a sequence similar to that of Tufted Puffin, whereas Pacific and Common Loons have a sequence similar to that of Horned Puffin (Palmer 1962, Woolfenden 1967).

Interpreting the molt sequences of puffins and loons



presents an interesting challenge to the application of Humphrey and Parkes's (1959) terminology for molts and plumages. If one simply considers the adult strategies, which is usually how presumed homologous molts have been determined, then it seems reasonable to conclude that adult Horned Puffins *delay* their wing molt until spring, as has been proposed for Pacific and Common Loons (Palmer 1962, Woolfenden 1967). However, if one reviews the sequence of wing molts in loons and puffins starting with juveniles, then a different interpretation is suggested (Fig. 3).

In their second calendar-year, all species of puffins and loons undergo a wing molt from spring through late summer, the timing varying somewhat among (and within) species. Species-specific differences become evident in the third and subsequent calendar years (Fig. 3). Note, though, that if adult wing molts really are *delayed* in Horned Puffin and in larger loons, then their second-calendar-year wing molt (labeled PB2 in Fig. 3) would be a novel or inserted molt relative to the strategy of Tufted Puffin and Red-throated Loon (see Fig. 3), and thus should be considered a prealternate or presupplemental molt according to Humphrey-Parkes nomenclature.

It is of course possible that an additional wing molt has evolved in some species but not in others; and it is also possible that molts have shifted from an ancestral pattern, such that a complete prebasic molt now occurs in spring. This latter interpretation would mean that the bright "breeding plumage" is the basic plumage, as has been argued recently for ducks (Pyle 2005), and which emphasizes the important distinction between homologies of molt and homologies of color (Howell et al. 2004). We suggest that it is easier for hormones which control color to shift temporally than for entire prebasic molts to shift (but short-duration synchronous wing molts may be more flexible). It is therefore more parsimonious to view second-calendar-year wing molts as being homologous in all puffins and loons (Fig. 3). Second-calendar-year wing molts are shared by many species, suggesting that they are part of an ancestral pattern.

Consequently, relative to the molts of Tufted Puffin and Red-throated Loon, the third and subsequent calendar-year

Fig. 1. Three comparisons of first-year Tufted Puffin (upper) and Horned Puffin (lower). The underparts of Tufted Puffins vary from white with a pale gray throat (**a**) to grayish with a dusky throat (**b**); but note the lack of distinct contrast between the dark throat and white breast as with Horned Puffin. First-year Horned Puffins also show the well-defined grayish auricular region found in basic-plumaged adults, whereas in Tufted Puffins the face is typically dark with the hint of a pale supercilium, a precursor to the breeding tufts developed later in life (**c**). These criteria are similar throughout the first year of life. *Specimens in (**a**): collected in February off Japan. Tufted Puffin specimens in (**b**) and (**c**): collected in August off Oregon. Horned Puffin in (**b**) and (**c**): collected in September in Alaska. © Peter Pyle.*

wing molts of Horned Puffin and larger loons are simply occurring *before* the breeding season, not being delayed. Thus, their prebasic molt is split, with the wing feathers renewed in spring (overlapping with the prealternate molt of head feathers), and the head and body feathers in fall to early winter (Fig. 3). Another Arctic-breeding species, the Ivory Gull, also molts most of its primaries prior to breeding, starting in March or April (Howell 2001); if it had synchronous wing molt like puffins and loons, rather than the more-common sequential molt (one primary at a time), then its wing molt would also be completed in spring. Thus, for certain Arctic-breeding, shorter-distance migrants, more resources for wing molt appear to be available before the breeding season than in the short period between the end of breeding and the onset of winter.

It thus appears that both puffins and loons exhibit the Simple Alternate Molt Strategy (Howell et al. 2003). The provisional molt schedules for puffins shown in Fig. 3 will undoubtedly require modification as more data from wild birds are acquired; even the extent of prealternate molts needs to be clarified. Note that definitive prebasic molts probably occur earlier in the season in failed breeders and non-breeders. The ornamental bill plates are shed mainly in late August – October and regrown mainly in March – early May.

PLUMAGE SEQUENCES AND AGE DETERMINATION

The results of our specimen examination suggest that Tufted and Horned Puffins can be aged through their second (Horned) or third (Tufted) calendar-year by plumage aspect. The ages of adults may be further inferred by size and shape of bill plates and the number of bill-plate grooves, as documented in known-age Atlantic Puffins (Harris 1981) and inferred for Tufted Puffins (Tanaka and Ogi 1986; Fig. 6).

Tufted Puffin apparently requires three years to obtain brownish-black underparts (often with some whitish mottling), a pattern it then retains for life (Fig. 4). The elongated head plumes and ornamental bill plates of breeding adults appear not to develop fully until the fourth or fifth calendar-year (Fig. 5; Tanaga and Ogi 1986). By this age, however, individual variation in maturation rates may cause overlap between advanced individuals of one age-group and retarded individuals of the next-oldest age-group, so caution is warranted.

Horned Puffin shows less variation in plumage aspect by age, with the white underparts and breeding head pattern not varying with maturity as in Tufted Puffin. First-spring birds have a gray face and dusky lores, similar to juvenal and definitive basic plumages, after which the definitive plumage aspect is attained (Fig. 7). Thus, from second-basic plumage onward, age must be inferred by bill-groove criteria. Variation in length of the eponymous horn (a keratinous protuberance) might also repay investigation as a possible aid to aging.

We conclude by cautioning readers that our summary is based on specimens of unknown-age birds; therefore, much

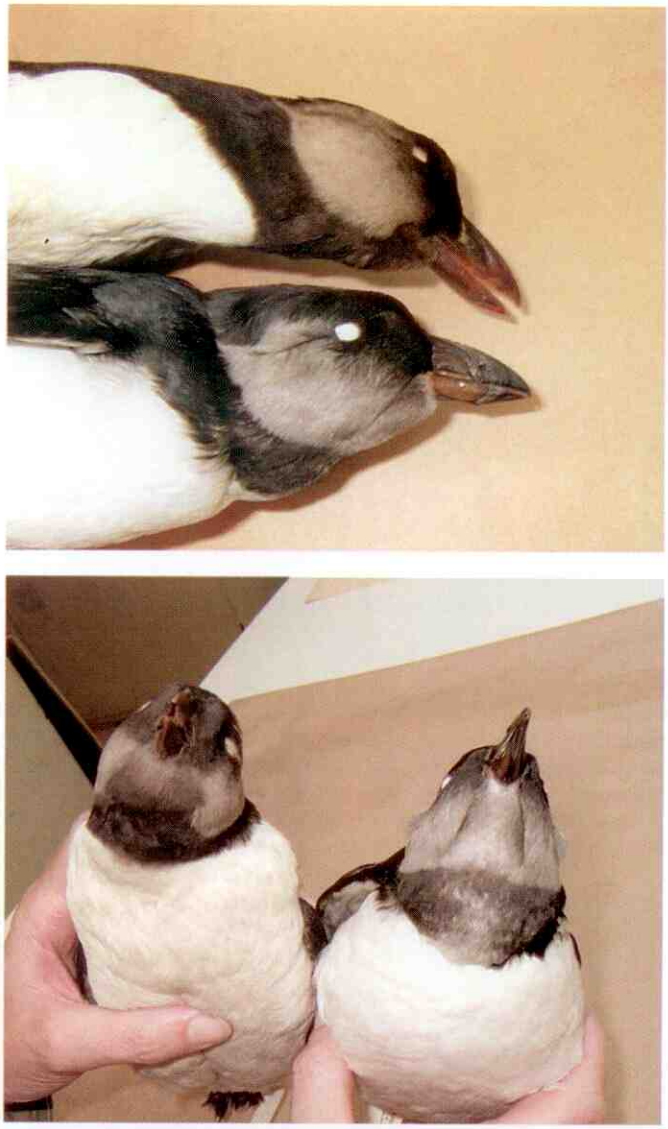


Fig. 2. Two comparisons of first-year Horned (top & left) and Atlantic (bottom & right) Puffins. Adult Horned Puffins have a blackish chin and throat, whereas adult Atlantic Puffins have the grayish malar region and chin separated from the white breast by a distinct dark band. These features are also shown by first-year birds, although somewhat less distinctly. The combination of blacker upperparts and breast with a more-distinct breast band and paler throat should allow separation of most first-year Atlantic from first-year Horned Puffins at sea. Differences in bill shape (see Sibley 2000) begin to be expressed in second-year and older birds. *Horned Puffin: collected in September in Alaska. Atlantic Puffin: collected in August in Iceland.* © *Peter Pyle.*