

SHORT COMMUNICATIONS

Hybridization of Glaucous and Herring Gulls at the Mackenzie Delta, Canada

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Interbreeding between two holarctic species, the Glaucous Gull and Herring Gull (*Larus hyperboreus* and *L. argentatus*) has been documented only at Bear Island (Barents Sea) and Iceland (reviewed by Ingolfsson 1970). Ingolfsson (1970) classified parental and hybrid phenotypes relative to pigmentation patterns of distal primaries, where a hybrid index (HI) of 0 = pure *hyperboreus* and HI 5 = pure *argentatus*, although "an occasional pure bird (*argentatus*) may score as low as 4.2." Based on this system, interbreeding in North America has been suspected. In 595 museum specimens (most taken during the breeding season) of the two species from Canada and Alaska, Ingolfsson (1970) found 7 with HI's of 4.0-4.6, and 26 with HI's of 0.2-1.8. However, with the possible exception of two birds with HI's of 1.8 and 4.0, only two obvious hybrids are known from North America: a bird (HI = 3.6) collected at San Diego, California, and a bird (HI = 3.0-3.5) collected at Pt. Barrow, Alaska (Ingolfsson 1970; Jehl 1971, MS). While working near the Mackenzie Delta, Canada, in August 1984, I observed hybrid *hyperboreus* × *argentatus* regularly, and documented the first instance of interbreeding of the two species in North America.

During 9-31 August 1984, I used 8× binoculars and a 20-45× spotting scope to study the frequency of various phenotypes among adults at two breeding sites [Kay Point, Yukon (69°13'N, 138°17'W), and Escape Reef, Yukon (68°59'N, 137°11'W)], at three loafing sites [Tuktoyaktuk dump and harbor, Northwest Territories (69°27'N, 133°05'W), and Pauline Cove, Herschel Island, Yukon (69°34'N, 138°55'W)], and once at sea (69°37'N, 133°07'W) when gulls were attracted to our drifting boat. Most adults were probably residents because young were being fed at colonies, and the postbreeding dispersal does not begin until late August or early September (Barry and Barry 1982).

I distinguished gulls of the *hyperboreus-argentatus* type from Thayer's Gulls (*L. thayeri*, of which only two were seen) by their larger size, lighter mantle color, yellow to orange eye rings, pale yellow irises, and, in the case of pure *argentatus*, their wing-tip pattern (see MacPherson 1961, Smith 1966). I observed and classified each intermediate according to Ingolfsson's (1970) system. Unlike Ingolfsson (1970), I did not collect specimens, and therefore used a larger scale interval (0.5) than his (0.2). This produced less precise classifications. To reduce the chance of including the same individual more than once, data from only one session of observations at each of the six locations were used in the analyses.

My HI estimates are based on scrutiny of primaries

7-10; I usually could not see primary 6 adequately. Each gull was missing one or two of primaries 5-8 because of molt. This exposed any pigmentation on the inner vane of at least one primary, but necessitated that HI's be based on 2-4 feathers instead of 5. This did not decrease my ability to observe primary characteristics because the outer two primaries, especially primary 10, are most likely to show intermediate character states (Ingolfsson 1970).

Only 5.1% of the individuals had HI's of *argentatus* or intermediates (Table 1). Although at least one colony of *argentatus* was located at the delta (Sitidgi Lake) approximately 75 km from the coast (see Campbell 1973), no primary breeding sites of this species were visited. The ratios of *hyperboreus*, *argentatus*, and hybrids did not vary significantly between locations (G test, $P > 0.05$). Pigmentation patterns of the distal primaries of intermediates were similar to those observed by Ingolfsson (1970) in Iceland (see examples of Canadian hybrids in Fig. 1A, B). HI values of intermediates averaged 3.1 ± 0.9 ($n = 51$), tending toward *argentatus* (Fig. 2). I doubt if intermediates with

TABLE 1. Censuses of adult Glaucous Gulls, Herring Gulls, and their hybrids in the vicinity of the Mackenzie Delta, Canada, 1984.

Location and date	Number seen			Total ^a
	Glaucous	Herring	Inter-mediate	
Tuktoyaktuk dump				
10 August	395	2	14	411
31 August	598	4	22	624
Tuktoyaktuk harbor				
9 August	139	0	5	144
30 August	262	3	12	277
Beaufort Sea, 15 km N of Tuktoyaktuk				
14 August	51	0	5	56
Kay Point				
17 August	18	0	2	20
Escape Reef				
20 August	49	0	3	52
Pauline Cove				
21 August	120	1	7	128
Total	1,098	8	51	1,157
Percentage	94.9	0.7	4.4	100.0

^a At sites where two counts were made, only the data collected when the largest count was made were included in the total.

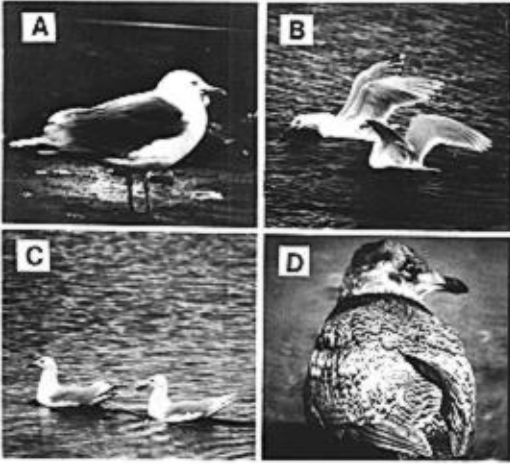


Fig. 1. Gulls seen in the vicinity of the Mackenzie Delta. (A) Tuktoyaktuk dump, N.W.T., HI = 2.0. (B and C) Mated pair near Kay Point, Yukon coast. HI of bird on left = 3.5–4.0; bird on right was a pure Glaucous Gull. (D) Tuktoyaktuk dump, N.W.T., 31 August 1984. Characteristics of this fledgling nearly identical to that of one of two fledglings associated with pair shown in B and C.

HI's ≥ 1.5 were overlooked, but some birds with HI's ≤ 1.0 may have been.

Eye rings of *hyperboreus* and intermediates varied from yellow to orange, with a few appearing scarlet-orange (see Villalobos Color Chart in Palmer 1962). In 7 *argentatus*, eye rings were yellow (4), orange-yellow (2), or orange (1). These findings are similar to those of Ingolfsson (1970). Smith (1966), however, noted only yellow and orange eye rings, respectively, in *hyperboreus* and *argentatus* breeding in the eastern Canadian Arctic. At the Mackenzie Delta, iris color was uniform pale yellow in all adults. The mantle color in 3 of 8 *argentatus* was darker than that of the *hyperboreus*, however, and each of these 3 birds had yellow eye rings.

I found only one mixed pair nesting solitarily (i.e. no other gulls nesting within 1 km) on a mainland beach about 2 km southeast of Kay Point. When first seen from the boat 100 m from shore, the adults were attending two large fledglings that begged at least twice from the *argentatus*-like adult. I estimated this bird's HI at 3.5, although it tended toward 4.0 (Fig. 1B, C). From its size (marginally larger than its mate) and dominant, more aggressive behavior, I judged it to be the male; the smaller bird appeared to be pure *hyperboreus*. When a small boat was landed on the beach, the two adults took flight and landed 30 m offshore, and the young swam out to them. Their presumed nest was located among driftwood near to where the family was first seen. After our party retreated, the four birds flew back to their territory.

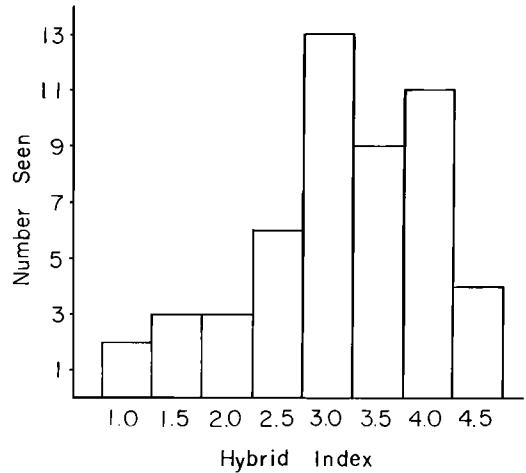


Fig. 2. Distribution of hybrid indices of 51 Herring Gull \times Glaucous Gull intermediates (HI = 0.5–4.5) encountered at random in the vicinity of the Mackenzie Delta during August 1984. (No gulls with HI's of 0.5 were seen.)

The pigmentation pattern of both young resembled heavily marked *hyperboreus*. One had distal primaries that corresponded to N4 of the Munsell Neutral Chart (Munsell Color Co., Baltimore, Maryland), i.e. darker than expected of first-year *hyperboreus*; its bill, although lighter toward the base, was not distinctly bicolored as typical of first-year *hyperboreus* (see Fig. 1D for photo of young with similar characteristics). The primaries and bill of the second were characteristic of *hyperboreus* (see Grant 1982: photos 324, 326 for similar types).

At the Escape Reef colony, where I found 90 active nest sites, 3 of 52 adults had intermediate HI's: 1.5, 2.0, and 3.0 (Table 1); all other adults appeared to be pure *hyperboreus*. Of 119 fledglings, 7 had sooty-colored primaries, and at least 15 did not have distinctly bicolored bills. One dead fledgling had primary pigmentation corresponding to a Munsell value of N3, i.e. more like *argentatus* than *hyperboreus*.

The evidence suggests that interbreeding between *hyperboreus* and *argentatus* occurs regularly but at a low frequency in the vicinity of the Mackenzie Delta. Hybridization in this region may not be surprising. Although *hyperboreus* are primarily coastal breeders and *argentatus* breed mainly in the interior, the Mackenzie Delta offers both habitats. Furthermore, the Mackenzie human population has increased several-fold during the past 15 years because of extensive Beaufort Sea oil exploration, and this has probably increased the availability of refuse to gulls. A resultant increase in the gull population and colonization of new locations, or attraction of *argentatus* to favorable feeding areas near the coast, or both, would increase the latter's contact with *hyperboreus*. Although

evidence suggests that interbreeding was occurring at least occasionally before the recent change in the human population (see Ingolfsson 1970, Jehl MS), there is increasing evidence that human activity is an important factor facilitating breakdown in mechanisms that prevent interbreeding (see Smith 1966 for review of isolating mechanisms). For example, human activity is thought to be primarily responsible for the mass immigration of *argentatus* to Iceland, which resulted in extensive hybridization with *hyperboreus* (Ingolfsson 1970). Similarly, hybridization between *argentatus* and Glaucous-winged Gulls (*L. glaucescens*), another coastal breeder, is most common near human settlements associated with Alaskan fisheries (Williamson and Peyton 1963, Patten 1980). Further study of isolating mechanisms and continued monitoring of phenotype frequencies are needed, however, to identify and assess all factors responsible for interbreeding between these species.

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Histological Evidence for the Systematic Position of *Hesperornis* (Odontornithes: Hesperornithiformes)

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In his original description of *Hesperornis*, O. C. Marsh (1880) noted similarities between this Cretaceous toothed "diver" and modern ratites (Struthioniformes). Subsequently, Heilmann (1927) correctly demonstrated the ecomorphological similarity of *Hesperornis* to loons (Gaviiformes), but, in so doing, he incorrectly renounced the similarities of *Hesperornis* and ratites. Eventually, Gingerich (1973) described *Hesperornis* as possessing a paleognathous palate, but, from Gingerich's own reconstruction, the palate of *Hesperornis* did not satisfy the criteria that collectively diagnose the paleognathous palate as described by Bock (1963) (Brodkorb 1976, McDowell

1978, Cracraft 1980, Balouet 1983). Cracraft's treatment of *Hesperornis* is exemplary of the uncertainty that still exists about its systematic position. Cracraft (1982) concluded that *Hesperornis* was a member of a monophyletic clade that includes the neognathous loons and grebes (Podicipediformes), but, more recently, he (in press) considered it as the sister group of *Ichthyornis* plus Neornithes.

I examined the histological structure of *Hesperornis* bone as part of an effort to determine the correct polarity of histological characters in the bones of paleognathous and neognathous birds, which I treated elsewhere (Houde in press a). I was surprised to find