

## CASPIAN TERNS NESTING IN ALASKA: PROPHECY, SERENDIPITY, AND IMPLICATIONS FOR REGIONAL CLIMATE-RELATED CHANGE

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In 1982, Richard Mewaldt and I suggested that the Caspian Tern (*Hydroprogne caspia*), with its current rate of population expansion along the Pacific Coast, could soon be found nesting in Alaska (Gill and Mewaldt 1983). And indeed it was, but not until 1996 (McCaffery et al. 1997), and then in a region of the state far removed from the Copper River delta, where numerous observations had suggested actual nesting may have occurred since the early 1980s (Gibson and Kessel 1992, Lohse et al., this issue)—hence the prophecy part of this story.

On 30 July 2005, while studying shorebirds in western Alaska, I heard the unmistakable—and for me unforgettable—alarm call of a Caspian Tern. I was on a small (3 ha), low-relief (<1 m above mean high tide) barrier island in outer Angyoyaravak Bay (61.272° N, 165.811° W), ~4 km offshore from the coast of the central Yukon–Kuskokwim delta and ~60 km south of Cape Romanzof, near where McCaffery et al. (1997) had observed the terns nesting on a similar island in 1996. Upon searching where I was standing when I first heard the tern, I found a nest with two cold eggs and a dead adult with two newly hatched but dead chicks beneath it (Figure 1). Colleagues accompanying me then found three other cold eggs and a nest with three warm eggs, all within a 3-m radius of the dead adult. The most adults seen in the air at any time that day was five. I next visited the island on 4 August when I found a three-week-old chick and the same three-egg clutch being incubated, and on 11 August when I saw a single volant juvenile being tended by two alarm-calling adults. Despite over 30 field seasons in south-central and western Alaska, I have seen Caspian Terns in the state on only one other occasion, that involving an adult flying over another very unusual place—my home in Anchorage on 6 July 1991 (Tobish and Isleib 1991). This observation from the Yukon–Kuskokwim Delta represents one of five confirmed nesting sites in Alaska (see Lohse et al., this issue). Although we weren't the first to fulfill the prophecy, being involved in documenting the third nesting site for the state certainly can be described as serendipitous.

The Caspian Tern is clearly now an established nesting species in south-central Alaska (Lohse et al. this issue), but observations suggest the northern and western extent of the population's breeding range in Alaska may be limited by habitat and stochastic events. Cuthbert and Wires (1999) concluded that the primary factor limiting Caspian Tern populations appears to be the availability of high-quality nest sites protected from storms and free of mammalian and avian predators. Alaska has extensive systems of barrier islands suitable for nesting by Caspian Terns (USFWS 2006), but most support nesting colonies of large gulls (i.e., the Glaucous, *Larus hyperboreus*, or Glaucous-winged, *L. glaucescens*)—known predators of tern eggs and chicks—or are accessible to foxes (*Vulpes vulpes*, *Alopex lagopus*), more serious predators of ground-nesting birds. Among all of the barrier islands along Alaska's west coast, those off the Yukon–Kuskokwim delta appear unique in that they are far enough offshore that foxes rarely reach them when the water is open. Nevertheless, these islands have such low relief that storm-driven tides occasionally inundate them. The former factor would promote nesting by many species of birds, including terns, but the latter introduces a major element of unpredictability in terms of nesting effort and reproductive success.

For instance, during my initial visit in July 2005 there was evidence that the island had recently been flooded with enough water to displace eggs from scrapes. I suspect

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the same event killed the two day-old chicks found tucked into the dead adult's brood patches. Both the chicks and the adult appear to have died from hypothermia. No Caspian Terns were observed at this island in summer 2006, when there was evidence that it had been washed over by waves in early July and early August. In 2007, I did not visit the island until 18 August, when I neither saw nor heard terns, but did note that recent storm-driven tides had washed completely over the island, clearing it of all drift logs and what sparse vegetation (the grass *Leymus mollis*) had managed to become established there. During that visit I also found several dead downy Common Eiders (*Somateria mollissima*) that I assume had been hatched on the island but had died from hypothermia, probably when the island was flooded during a recent storm. Later that summer, however, biologists (D. Ruthrauff pers. comm.) did observe adult Caspian Terns in the area (an adult with a volant juvenile on 4 and 6 September), but it is not known if they were associated with earlier nesting attempts on the island or were from a nesting site elsewhere (e.g., just north, McCaffery et al. 1997).

Though based largely on anecdotal evidence, the ephemeral nature of the barrier islands and hence tern nesting habitat off the Yukon–Kuskokwim delta is apparent. Whether or not this has always been the case is unknown, but what has been documented recently is an accelerated rate of coastal erosion—a presumed effect of climate change—in western and northern Alaska (Fienup-Riordan 1999, Mars and Houseknecht 2007, Jones 2008). Several recent global climate-change models are predicting an increase in both the frequency and intensity of storms in the North Pacific and Bering Sea (e.g., Salathé 2006, Pinto et al. 2007, Raible 2007, Löptien



Figure 1. Biologists inspecting a dead adult Caspian Tern that attempted to nest on a low-relief barrier island off the coast of the central Yukon–Kuskokwim River Delta, Alaska, 30 July 2005. One of two small downy chicks found dead under the adult rests next to the adult's head and two eggs from another scrape appear in the foreground near the adult.

Photo by Robert E. Gill, Jr.

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et al. 2008), while other studies have documented an increase over the last 50 years in the frequency of flooding of low-lying coastal areas in western Alaska (Mason et al. 1996, Jorgenson and Ely 2001, Hinzman et al. 2005). As long as the population of Caspian Terns on the Pacific coast of North America continues to grow there will be pioneering attempts to nest in marginal habitat like that I describe here, but it seems unlikely that these terns can continue to expand their range in Alaska, or maintain what they have established, under current and projected changes in environmental conditions.

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