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BALD EAGLES CONSUME EMPEROR GEESE DURING LATE-WINTER IN THE ALEUTIAN ARCHIPELAGO

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KEY WORDS: *Bald Eagle*; Haliaeetus leucocephalus; *Emperor Goose,* Chen canagica; *food habits*; *Alaska*; *Aleutian Archipelago.*

Emperor Geese (*Chen canagica*) are a species of concern because their population has declined rapidly since the mid-1960s and continues to remain below management objectives (Petersen et al. 1994). Emperor Geese are restricted primarily to Alaska and exhibit an east-west migration pattern, whereby most birds begin breeding on the Yukon-Kuskokwim Delta by mid-May, stage on the Alaska Peninsula by late September, and migrate westward to winter in the Aleutian Archipelago from late November to mid-April (Eisenhauer and Kirkpatrick 1977, Petersen et al. 1994). Demographic and movement studies have been conducted on breeding grounds and staging areas (e.g., Schmutz et al. 1994, 1997); however, the winter ecology of Emperor Geese is poorly understood due in part to the extremely remote nature of the Aleutian Archipelago (Petersen et al. 1994).

Bald Eagles (*Haliaeetus leucocephalus*) are ubiquitous, year-round residents throughout the most of the Aleutian Archipelago (Murie 1959) and obtain most of their prey from the nearshore marine environment (Anthony et al 1999). We predict that Bald Eagles should prey on wintering Emperor Geese if available because eagles depredate other species of geese in southern latitudes (Frenzel and Anthony 1989, Watson et al. 1991, McWilliams et al 1994). However, the existing information on Bald Eagle predation of Emperor Geese appears contradictory. Sherrod et al. (1976) suggested geese may be too large for Bald Eagles to kill efficiently, and other studies rarely reported Emperor Geese as Bald Eagle prey in the Aleutians (Murie 1940, White et al. 1971, Sherrod et al. 1976) Conversely, Eisenhauer and Kirkpatrick (1977) stated that Bald Eagles are perhaps the dominant avian predator of wintering Emperor Geese, and cite the observa-

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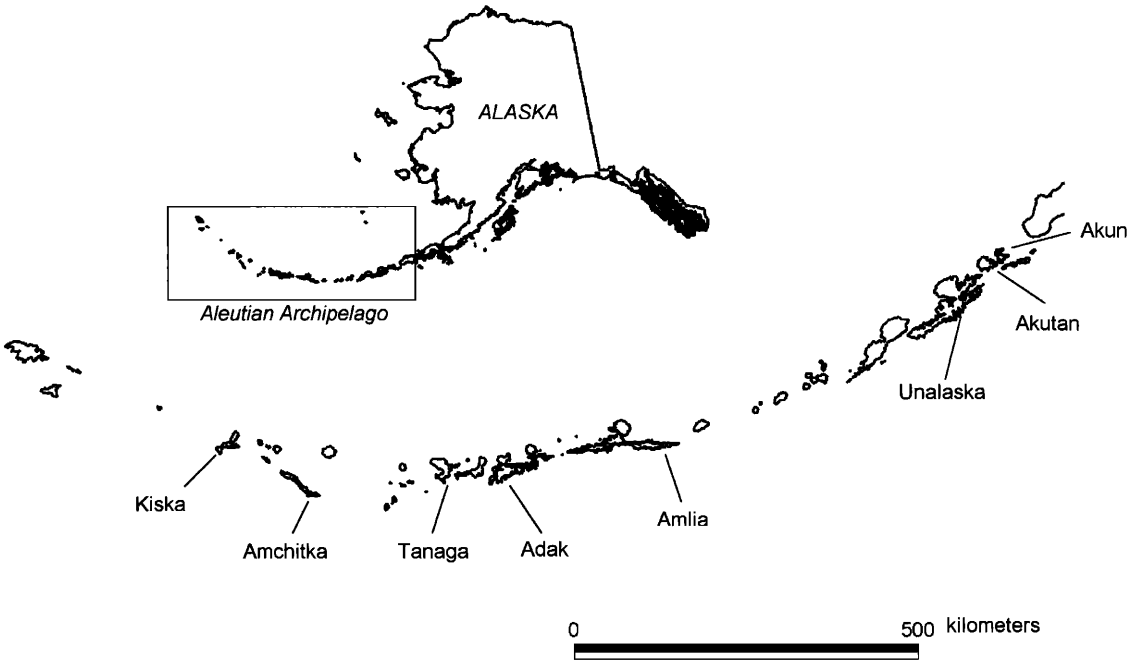

Figure 1. Map of the Aleutian Archipelago indicating islands where Bald Eagle nest surveys occurred, April–May 2000–01.

tions of Williamson et al. (1975) of frequent eagle predation of Emperor Geese on Amchitka Island in the western Aleutian Archipelago. Furthermore, Gill and Kincheloe (1993) observed Bald Eagles depredating Emperor Geese on the Alaska Peninsula. Because almost the entire population of Emperor Geese winters in the Aleutian Archipelago, a need for information on sources of winter mortality exists (Gill and Kincheloe 1993). Emperor Geese have relatively low overwinter survival compared to other goose species, which may play a pivotal role in their demography (Schmutz et al. 1994, 1997). Herein, we describe Bald Eagle diets and the occurrence of Emperor Geese remains in Bald Eagle nest sites during late winter–early spring.

METHODS

We surveyed nesting eagles on Unalaska, Akutan, Akun, and Adak islands from 15 April–3 May 2000, and Amlia, Adak, Tanaga, Amchitka, and Kiska from 20 April–28 April 2001 (Fig. 1). We surveyed ca. 1150 km of shoreline from inflatable skiffs with at least two observers visually searching for nesting eagles. Our surveys coincided roughly with the onset of Bald Eagle egg laying (Sherrod et al. 1976) and the end of the Emperor Goose overwintering period (Eisenhauer and Kirkpatrick 1977). We searched a maximum of 16 climbable nests per island. We searched for prey remains in and around nests and recorded the minimum number of individual prey items (Mollhagen et al. 1972, Anthony et al. 1999). We only counted prey remains from occupied nests that appeared to be from the current year's nesting attempt, which excluded remains that appeared obviously weathered and deeply soiled. We identified most unknown prey remains by comparison with museum specimens housed at the Alaska Maritime National Wildlife Refuge, Adak, AK.

We calculated the percent of Bald Eagle nests containing prey remains, and then the percent of those nests containing Emperor Geese remains by island and year We estimated Bald Eagle diets by dividing the minimum number of prey items for each prey taxa by the total number of prey items across all islands and years.

RESULTS

We visited 94 Bald Eagle nests during the course of our study. Sixty percent (N = 18) of these nests contained prey during 2000, and 89% (N = 57) during 2001. No Bald Eagle nests with prey remains contained any identifiable Emperor Geese remains during 2000. However, 39% (N = 22) of nests with prey remains contained identifiable remains of Emperor Geese during 2001. Emperor Geese were most frequent (eight of 15 nests) on Kiska, which was the most western island sampled in our study. Emperor Geese occurred in five of 13 nests with prey remains on Tanaga, four of 13 nests on Amchitka, three of 12 nests on Adak, and two of four nests on Amlia.

We collected 191 prey items comprising 19 identifiable

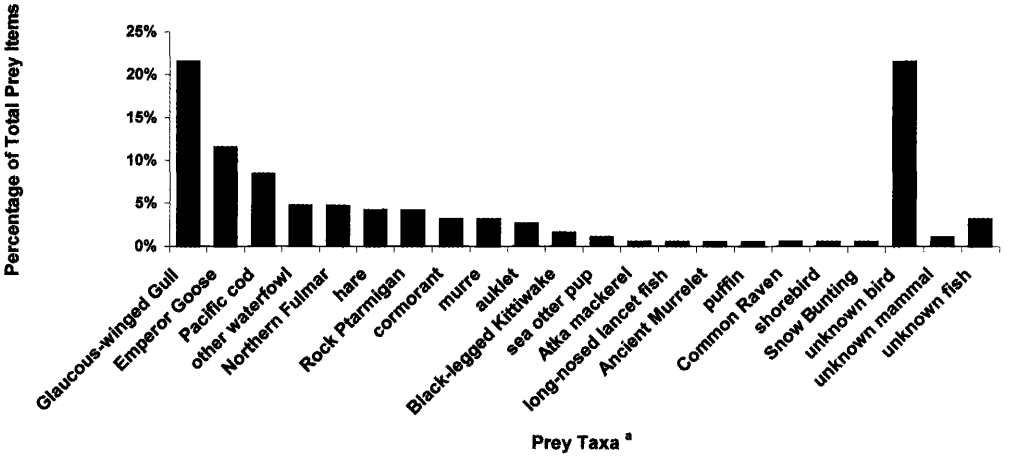

Figure 2. Percent of individual prey items from 191 total prey items found in Bald Eagle nests in the Aleutian Archipelago, April–May 2000–01.[a]

[a] Scientific names of prey taxa not mentioned in text: Northern Fulmar (*Fulmarus glacialis*), Rock Ptarmigan (*Lagopus mutus*), cormorant (*Phalacrocorax* spp.), murre (*Uria* spp.), auklet: (*Aethia* spp.), Black-legged Kittiwake (*Rissa tridactyla*), Atka mackerel (*Pleurogrammus monopterygius*), long-nosed lancet fish (*Alepisaurus ferox*), Ancient Murrelet (*Synthliboramphus antiquus*), puffin (*Fratercula* spp.), Common Raven (*Corvus corax*), Snow Bunting (*Plectrophenax nivalis*), shorebird (Scolopacidae). Other waterfowl include Mallard (*Anas platyrynchos*), Northern Pintail (*A. acuta*), Harlequin Duck (*Histrionicus histrionicus*), Red-breasted Merganser (*Mergus serrator*), and unknown waterfowl.

and three unidentifiable prey taxa, indicating that Bald Eagles consumed a variety of prey during our study. However, the distribution of identifiable prey items in eagle diets was skewed towards Glaucous-winged Gulls (*Larus glaucescens*) and Emperor Geese, which composed 21% and 12% of all prey items, respectively (Fig. 2). All other identifiable avian and mammalian prey composed <5% of all prey items. Fish occurred infrequently with the exception of Pacific cod (*Gadus macrocephalus*). Fish and mammalian prey were usually identifiable to species, but 21% of all prey items consisted of unidentifiable avian prey.

DISCUSSION

Emperor Geese remains occurred in Bald Eagle nests and were the second most frequent prey item in Bald Eagle diets. Bald Eagles likely consumed most of these geese at the end of their overwintering period. Our observations provide empirical evidence that Bald Eagles consume Emperor Geese more extensively than previously reported, and help resolve conflicting accounts of Bald Eagle predation on Emperor Geese in the literature. However, the absolute magnitude of eagle predation is unknown because we cannot partition depredated from scavenged Emperor Geese.

Bald Eagle diet breadths are likely constrained throughout winter and early spring because of the absence of anadromous fish and several species of seabirds such as alcids and procellariformes available during summer (White et al. 1977, G. Byrd and J. Williams unpubl data). Mammalian prey also are relatively scarce because introduced hares (*Lepus* spp.) occur only in the eastern Aleutians, and sea otters (*Enhydra lutris*) have experienced a 75–88% decline throughout the Aleutians (Doroff et al. 2003). Thus, Emperor Geese may be an important alternative winter food source for Bald Eagles, regardless of how they are acquired (i.e., predation or scavenging). Emperor Geese are available to Bald Eagles because they inhabit protected nearshore reefs and lagoons where eagles forage (Petersen et al. 1994). The harsh Aleutian winter and lack of agricultural foods available to most other species of wintering geese in southern latitudes may weaken Emperor Geese (Schmutz et al 1994), thereby further increasing their vulnerability to predation or eventual scavenging by Bald Eagles. However, we cannot determine the absolute frequency of Emperor Geese in Bald Eagle diets from our data because birds and large bony fish are often over-represented in samples of prey remains collected from eagle nests (Todd et al. 1982, Mersmann et al. 1992), and a high proportion of unknown birds occurred in our sample.

Emperor Geese remains did not occur in Bald Eagle nests searched during 2000. Temporal variation in Bald Eagle nesting chronology likely explains year-year differences. Eagle nesting was delayed apparently in the eastern Aleutians during 2000 because only 26% of eagle

pairs nested by late April–early May (R. Anthony unpubl. data). Spring migration of Emperor Geese usually peaks by mid-April (Eisenhauer and Kirkpatrick 1977), so Emperor Geese likely migrated before eagles began to nest. Conversely, 83% of eagle pairs surveyed in the central and western Aleutians during 2001 nested by late April, thus increasing the probability that depredated or scavenged Emperor Geese would be brought back to eagle nest sites and detected in our searches.

Reported nesting densities of eagles in the Aleutians range from one pair per 7–20 km of coastline(G. Byrd and J. Williams unpubl. data), and we observed over 350 breeding pairs during our surveys (R. Anthony unpubl. data). Assuming that (1) eagle densities are similar during winter which is reasonable given that adults in the Aleutians are likely non-migratory (Murie 1959, White et al. 1971), although sub-adult movements are largely unknown; (2) our results are representative of consumption of Emperor Geese by Bald Eagles during the entire overwintering period for Emperor Geese; and (3) at least some proportion of geese are depredated rather than scavenged, Bald Eagles may contribute more to Emperor Goose mortality than previously thought.

RESUMEN.—Las causas de mortalidad del ganso emperador migratorio (*Chen canagica*)una especie de manejo especial en Alaska, se conocen pobremente. Evaluamos la relativa frecuencia del consumo por parte del águila calva (*Haliaeetus leucocephalus*) de gansos emperadores a lo largo de las islas del archipiélago Aleutiano, identificando restos de presas de 94 nidos de águilas calvas durante Abril–Mayo, 2000–01. Encontramos partes no identificables de gansos emperador en el nido de águilas calvas con restos de presas (N = 18) durante 2000. Inversamente, 39% de los nidos con restos de presas (N = 57) contenian gansos emperador durante 2001. El ganso emperador constituyó 12% de todos los ítem presa individuales encontrados en los nidos de águila calva durante 2000–01. Aunque nuestros métodos no pueden distinguir depredación de alimentación por carroña y los restos de presa fueron evaluados al final del periodo de sobre invernación del Ganso emperador, las águilas calvas pueden ser una fuente significativa de mortalidad para el ganso emperador durante el invierno en las islas Aleutianas. Además, el ganso emperador puede ser un componente importante de la dieta para las águilas calvas que pasan el invierno en los mismos territorios donde se reprodujeron.

[Traducción de César Márquez]

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SURVIVAL AND BEHAVIOR OF A ONE-FOOTED MADAGASCAR FISH-EAGLE IN THE WILD

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KEY WORDS: *Madagascar Fish-Eagle*; Haliaeetus vociferoides; *amputation*; *dominance hierarchy*; *longevity*.

The ability of a one-footed raptor to survive long-term in the wild has been considered questionable (Cooper et al. 1980, Durham 1981). While there are accounts of the survival of one-legged raptors in captivity (Cooper 1985) and of those admitted from the wild to a raptor clinic (Durham 1981), we could only locate two published accounts detailing the known survival of one-footed raptors in the wild. Blodget et al. (1990) document the 2-yr survival in the wild of a one-footed immature Bald Eagle (*Haliaeetus leucocephalus*) and Eggenhuizen (1995) documents the 1-mo survival in the wild of a one-legged adult Eurasian Kestrel (*Falco tinnunculus*), killed ultimately by impact with a vehicle. Avian anatomical constraints (McKeever 1979, Cooper 1985) and species-specific foraging strategies (Cooper et al. 1980) suggest that one-footed raptors have a diminished capacity for long-term survival in the wild. Here, we report the 7-yr survival, in the wild, of a one-footed adult male Madagascar Fish-Eagle (*Haliaeetus vociferoides*) and document his behavior and social status within a polyandrous breeding trio.

STUDY AREA AND METHODS

The Peregrine Fund initiated the Madagascar Fish-Eagle Conservation Program on Madagascar's western seaboard in 1991, to study the species' ecology and breeding behavior (Watson et al. 1993). Through 2001, over 100 Madagascar Fish-Eagles were trapped and banded with a uniquely numbered embossed aluminum band and a series of colored plastic or colored aluminum bands for individual identification. The majority of fish-eagles were trapped at lakes in the Manambolomaty River floodplain (19°00′S, 44°30′E) in the Antsalova region of western Madagascar, ca. 300 km west of the capital, Antananarivo The habitat is dominated by tropical, deciduous, dry forest containing several lakes (with areas of 3.1–4.9 km^2) that support 11 fish-eagle territories (Rabarisoa et al. 1997).

On 8 November 1996, a one-footed adult male Madagascar Fish-Eagle was trapped in a territory on Lake Befotaka known as "Befotaka 2." The eagle's right foot was missing, severed at the distal tip of the tarsometatarsus, which had healed over to form a flat-based stump measuring 30 mm × 27 mm. There were no signs of infection and we evaluated the eagle as being in otherwise good condition. An aluminum band (0118) was fitted to the left leg and the eagle was released. A one-footed adult male fish-eagle with an aluminum band on its left leg was resident in the Befotaka 2 territory throughout 1997 and 1998 and was assumed to be the same bird (Kalavah 1997, 1998).

During the 1999–2001 breeding seasons (May–Septem-

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