hawk nest. The magpies represented only 0.5% of the hawk's prey items (n = 433; Ueta 1992), suggesting that the risk of nesting close to a hawk nest may be outweighed by the benefits of enhanced nest defense.

Azure-winged Magpies generally nested in places with less leaf cover when nesting in association with a hawk. Although the nests with less leaf cover were vulnerable to nest predation in the areas far from a hawk nest, they were not depredated around a hawk nest. Magpies breed in sites close to hawk nests, even if they are less concealed, in order to avoid nest predation by exploiting the defending behavior of the hawk effectively.

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LEUCOCYTOZOON SIMONDI IN EMPEROR GEESE FROM THE YUKON-KUSKOKWIM DELTA IN ALASKA[1]

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Abstract. We surveyed Emperor Geese (*Chen canagica*) in western Alaska for avian hematozoa. Blood smears were collected from 134 adults and goslings in late July 1996, on their breeding grounds on the Yukon-Kuskokwim Delta. One of 134 (0.7%) Emperor Geese harbored *Leucocytozoon simondi,* representing a new host record for this parasite. No other hematozoa were detected. This is one of few reports of avian blood parasites from the arctic tundra.

Key words: Alaska, Chen canagica, *Emperor Geese,* Leucocytozoon simondi.

Avian blood parasites have been documented from many species throughout the world, particularly in temperate and warm climates where vector populations are abundant (Atkinson and van Riper 1991). How-

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ever, reports of hematozoa in birds from arctic regions are scarce. No parasites were found in blood smears collected from 149 individuals of 23 bird species on Prince of Wales Island, Northwest Territories, Canada (Laird 1961). Bennett and MacInnes (1972) found that only 2.9% of the geese they sampled in the open tundra of the McConnell River Delta, Northwest Territories, Canada were infected with hematozoa. Bennett et al. (1992) reported that, of four avian species inhabiting the treeless tundra on Melville Peninsula, Northwest Territories, Canada, none were infected with hematozoa. In a survey of the literature and several thousand unpublished reports from the International Reference Centre for Avian Malaria Parasites, Greiner et al. (1975) reported that birds inhabiting coastal regions of northern Alaska and Canada had the lowest prevalence of hematozoa in North America.

The Emperor Goose (*Chen canagica*) is an arctic species that nests in the coastal marshlands of western Alaska and northeastern Russia, and winters primarily on the Aleutian and Commander islands (Eisenhauer and Kirkpatrick 1977). Occasional vagrants sometimes are seen as far south as northern California (Petersen et al. 1994, Rockwell et al. 1996). From the 1960s through the mid-1980s, the Emperor Goose population in Alaska declined from 139,000 to 42,000. Although diseases and parasites have not been identified as contributors to this decline, they have received little study (Petersen et al. 1994). As part of a health evaluation of Emperor Geese, we collected blood samples from birds on the breeding grounds in western Alaska to determine if they are infected with hematozoa.

METHODS

In late July 1996, we collected blood samples from 134 Emperor Geese on the breeding grounds adjacent to the Manokinak (61°10′N, 165°10′W) and Kashunuk (61°20′N, 165°30′W) rivers, Yukon-Kuskokwim Delta, Alaska. The habitat in both areas is quite flat and contains many rivers and tidal sloughs, with tidal fluctuations sometimes greater than 3 m. Interspersed with sloughs, but not usually connected with them, are many shallow ponds. The physical characteristics and vegetation of this treeless area are described by Kincheloe and Stehn (1991) and Babcock and Ely (1994).

Flightless adults and goslings were herded into corrals, sexed by cloacal examination, and bled by jugular venipuncture. Blood samples were collected from 40 adults (28 males, 12 females) and 40 goslings (23 males, 17 females) at the Manokinak River, and from 20 adults (13 males, 7 females) and 34 goslings (18 males, 16 females) at the Kashunuk River. Blood smears were prepared, air dried, and fixed with methanol in the field. Smears were later stained with Giemsa and coverslipped. Each slide was examined for 10 min by light microscopy, using a 40× objective, for the presence of protozoa and microfilariae.

RESULTS

An intracellular apicomplexan parasite (Fig. 1) belonging to the genus *Leucocytozoon* (Haemosporida, Apicomplexa) was found in one adult male Emperor Goose captured at the Kashunuk River, for an overall prevalence of 0.7%. Elliptical micro- and macrogametocytes were the predominant forms of gametocytes observed and the parasite was morphologically identified as *Leucocytozoon simondi*. Microgametocytes were scarce and the average size of two specimens was 18 × 6 μm. The mean (± SD) size of six macrogametocytes was 17 (± 2.2) × 8 (± 1.2) μm. The host cell nucleus was seen as a narrow ribbon and was displaced along one edge of the host cell–parasite complex. Cytoplasmic horns appeared on both ends of the complex. In addition, occasional round forms of gametocytes were seen; in these, the host cell nucleus was seen as a cap adjacent to the parasite. The infection was of low parasitemia (one parasite per thousand red blood cells) in the positive bird.

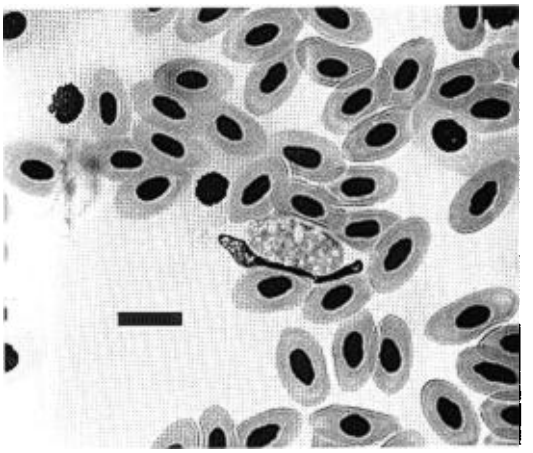

FIGURE 1. Gametocyte of *Leucocytozoon simondi* in peripheral blood of infected Emperor Goose. Scale bar = 10 μm.

DISCUSSION

Our finding of *L. simondi* is the first report of a blood parasite in the Emperor Goose and the first record of an avian hematozoan from the Yukon-Kuskokwim Delta in Alaska (Bennett et al. 1982, Bishop and Bennett 1992). Second to *Haemoproteus, Leucocytozoon* is the most commonly reported genus of avian hematozoa in North America (Greiner et al. 1975), and *L. simondi* is the only leucocytozoid reported from Anseriformes (Bennett and Squires-Parsons 1992). Bennett et al. (1982) reported 42 geographically widespread species of ducks and geese as hosts of this parasite. However, in the few reported surveys of birds in the North American arctic, blood parasites have been rare or absent (Laird 1961, Bennett and MacInnes 1972, Bennett et al. 1992).

Leucocytozoon spp. are transmitted by black flies (Simuliidae), vectors that are active during the spring and summer in northern regions (Greiner 1991). Infective stages of some *Leucocytozoon* spp. increase in number in the peripheral blood during the spring, which enhances parasite transmission when suitable vectors are present (Greiner 1991). Although few black flies exist at high latitudes (Crosskey 1981), at least one reportedly ornithophilic species (*Prosimulium pleurale*) occurs in western Alaska (Peterson 1970). During the collection of the samples in the Yukon-

Kuskokwim Delta, we observed black flies near the breeding sites of the Emperor Geese. Some of these insects may be potential vectors of leucocytozoonosis, and local transmission of parasites may occur. Since Emperor Geese are rarely seen outside their breeding and wintering grounds in the Arctic, it is probable that the infected male acquired the *Leucocytozoon* infection on the breeding grounds.

Leucocytozoon simondi has been implicated in disease and mortalities in anatids, especially in juvenile birds (Greiner 1991, Bennett et al. 1993). Anemia has accompanied *L. simondi* infections in ducks (Kocan and Clark 1966) and geese (Desser and Ryckman 1976), and a large-scale mortality of Canada Goose (*Branta canadensis*) goslings on the breeding grounds in upper Michigan was attributed to *L. simondi* (Herman et al. 1975). Because little is known about avian blood parasites in arctic regions, the possibility of *Leucocytozoon* transmission in the breeding areas of Emperor Geese is of interest and warrants monitoring of this species for disease and mortality.

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