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SURVEY OF BLOOD PARASITES IN ROSS' AND WHITE-FRONTED GEESE IN SOUTHERN TEXAS

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ABSTRACT—Blood parasites have been known to cause morbidity and mortality in waterfowl, particularly in Canada geese (*Branta canadensis*). However, little is known about blood parasites infecting Ross' geese (*Chen rossii*) and greater white-fronted geese (*Anser albifrons*). This study examined wintering Ross' and white-fronted geese for blood parasites. Blood smears from 16 Ross' geese (13 juveniles, 3 adults) and 46 white-fronted geese (21 juveniles, 25 adults) collected in Kleberg County, Texas, during winter 1999–2000 were examined for blood parasites. *Leucocytozoon simondi* was found in 2 juvenile white-fronted geese; density of infection was <1 parasite/2,000 erythrocytes. Additionally, 3 adult and 1 juvenile white-fronted geese had microfilaria. No blood parasites were observed in Ross' geese. We concluded that low prevalence and density of *L. simondi* gametocytes circulating in host blood precluded or greatly reduced transmission of this parasite on the wintering grounds in southern Texas.

RESUMEN—Se sabe que los parásitos de sangre causan morbosidad y mortalidad en aves acuáticas, particularmente en gansos canadienses (*Branta canadensis*). Sin embargo, se sabe muy poco sobre parásitos de sangre infectando gansos de Ross (*Chen rossii*) y gansos frente blanca (*Anser albifrons*). Este estudio examinó gansos de Ross y gansos frente blanca durante el invierno para parásitos de sangre. Muestras de sangre de 16 gansos de Ross (13 juveniles, 3 adultos) y 46 gansos frente blanca (21 juveniles, 25 adultos) colectadas en el condado de Kleberg, Texas, durante el invierno de 1999–2000 fueron examinadas para parásitos de sangre. Se encontró *Leucocytozoon simondi* en 2 gansos frente blanca juveniles; la densidad de infección fue <1 parásito/2,000 eritrocitos. Adicionalmente, 3 gansos frente blanca adultos y 1 juvenil tenían microfilarios. No se observaron parásitos de sangre en ningún ganso de Ross. Concluimos que la baja frecuencia y densidad de gametocitos *L. simondi* circulando en la sangre de los ejemplares imposibilitan o grandemente reducen la transmisión de este parásito en los terrenos invernales del sur de Texas.

Numerous studies have been conducted to determine factors affecting survival and recruitment of waterfowl in North America. One factor that might negatively affect waterfowl is blood parasites. At least 9 blood protozoan and 2 microfilarid species have been reported from Canada geese (*Branta canadensis*) and snow geese (*Chen caerulescens*) in North America (Bennett et al., 1982). Morbidity and mortality in Canada geese have occurred on the breeding grounds from *Leucocytozoon simondi* infections (Herman et al., 1975). Unfortunately, little is known about which species of blood parasites infect other goose species or their impact on host individuals and populations on the breeding or wintering grounds. For example, no published studies have examined Ross' geese (*Chen rossii*) for blood parasites, and in the only study of white-fronted geese (*Anser albifrons*), 5 birds from California were examined (Wood and Herman, 1943).

Vectors presumably are absent during winter in temperate regions, thereby breaking the infection-transmission cycle. However, Fedynich and Rhodes (1995) found high prevalence of *Leucocytozoon smithi* (100%) and *Haemoproteus meleagridis* (54%) during winter in a population of wild turkeys (*Meleagris gallopavo*) from South Carolina, suggesting continued transmission. Additionally, Atkinson et al. (1988) used sentinel turkeys to demonstrate that infections with *H. meleagridis* can occur yearround in warm climate areas, such as southern Florida. Geese wintering at the southernmost extension of their range might similarly be exposed to blood parasite infections if temperatures permit vector activity. To learn more about blood parasite infections during winter, we surveyed Ross' and white-fronted geese for blood parasites in southern Texas during winter 1999–2000.

Geese were collected by shooting during the hunting season in Kleberg County, Texas, from 3 November 1999 through 20 January 2000. Heart blood from each bird was used to make thin smears on 2 microscope slides within 10 min of host death. Blood samples were collected between 0600 and 1100 h to increase the probability of *Leucocytozoon* detection, as at least 1 species of this genus is known to demonstrate daily cyclic activity (Noblet and Noblet, 1976). Smears were fixed in 100% methanol for 1 min, air dried, and stained with Diff-Quik. Each smear was scanned 15 min (30 min for each bird) for blood parasites with a microscope at 1,000× magnification. Leucocytozoids were identified using the descriptions of Bennett and Squires-Parsons (1992). To quantify density of blood protozoa, 1 slide was selected (based on stain quality and density of erythrocytes appropriate for viewing) and 2,000 erythrocytes were counted and examined in 20 replicates of 100 erythrocytes each, following the recommendations of Godfrey et al. (1987). Although the protocols of Godfrey et al. (1987) were developed for *Haemoproteus,* they have been successfully applied to *Leucocytozoon* (Fedynich and Rhodes, 1995; DeJong et al., 2001). No satisfactory techniques have been developed to estimate density of microfilaria using blood smears; consequently, only prevalence data are reported for microfilaria.

Sixteen Ross' geese (13 juveniles, 3 adults) and 46 white-fronted geese (21 juveniles, 25 adults) were collected and examined for blood parasites; *L. simondi* was found in 2 juvenile white-fronted geese (Table 1). Density in each of the 2 birds was <1 parasite/2,000 erythrocytes. Additionally, 3 adult and 1 juvenile white-

TABLE 1—Numbers of Ross' and white-fronted geese examined, numbers infected with blood parasites, and parasite prevalence (%) in heart blood during winter 1999–2000 in southern Texas.

Host species	Number examined	*Leucocytozoon simondi*	Microfilaria	Total
Ross' goose				
Adult	3	0	0	
Juvenile	13	0	0	
White-fronted goose				
Adult	25	0	3 (12)	3 (12)
Juvenile	21	2 (10)	1 (5)	3 (14)
Total	62	2 (3)	4 (6)	6 (10)

fronted geese were infected with an unknown species of microfilarid. No blood parasites were found in the 16 Ross' geese (Table 1).

Transmission of blood protozoa is dependent upon adequate numbers of susceptible hosts, vectors, and infective parasite gametocytes circulating in the blood. Although many susceptible waterfowl hosts occur in Kleberg County during winter, it is uncertain what potential vectors occur in this region or if they are active during winter due to the typically mild temperatures. Mean monthly ambient temperatures recorded in November 1999, December 1999, and January 2000 at the nearest weather station (Kingsville, Texas) to our collection sites were 19.3°C (mean monthly minimum/maximum range: 11.8 to 26.8°C), 14.9°C (7.8 to 21.9°C), and 17.4°C (10.3 to 24.4°C), respectively. These temperatures suggest that limited vector activity was possible.

We could find only 1 insect survey that was conducted during summer in nearby Victoria County (Johnson, 1982). Of the dipteran families known to transmit *Haemoproteus, Plasmodium,* and *Leucotytozoon,* numerous species of Culicidae, 2 species of Ceratopogonidae, and no Simuliidae were found (Johnson, 1982). However, none of these dipteran species have been implicated as vectors of waterfowl blood protozoa. Additionally, infective gametocytes were not readily observable as only 1 blood protozoan (*L. simondi*) was found, which occurred at extremely low prevalence and density in white-fronted geese, and no blood parasites were found on smears from Ross' geese. A representative specimen of *L. simondi* was deposited in the Queensland Museum-International Reference Center for Avian Hematozoa Collection, South Brisbane, Queensland, Australia; Number G463709.

Our findings are similar to those of other studies that examined blood parasites in ducks during winter (Kocan et al., 1979; Fedynich et al., 1993). Collectively, these studies support the notion that low prevalence and density of blood parasites during winter in temperate regions likely represents an adaptive strategy by parasites to limit production of gametocytes when vector density is insufficient to maintain the transmission phase of the host-parasite-vector cycle (Greiner, 1991).

Lack of blood parasites in Ross' geese was unexpected, as snow geese are infected with several species of blood protozoa and a microfilaria (Bennett and MacInnes, 1972). Both Ross' and snow geese often co-occur on the breeding grounds (Kerbes et al., 1983), providing Ross' geese with the opportunity to be exposed to the same blood parasites as snow geese. Furthermore, our sample of Ross' geese had a high proportion of juveniles, which are thought to be more susceptible than adults (Wehr and Herman, 1954). It is possible that our sample size of Ross' geese, coupled with apparently low prevalence and density of blood parasites during winter in southern Texas, reduced the probability of detection.

It was evident in our study that the lack of gametocytes, or low densities of gametocytes circulating in host blood, precluded or greatly reduced the possibility of transmission on the wintering grounds in southern Texas. Consequently, health risks associated with protozoa inhabiting erythrocytes and leucocytes during the gametocyte phase of their life cycle were minimal for these 2 goose species wintering in southern Texas during 1999–2000.

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SUBTLE RECENT DISTRIBUTIONAL SHIFTS IN GREAT PLAINS BIRD SPECIES

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ABSTRACT—Changes in geographic distributions of 5 bird species endemic to the Great Plains of North America were examined over the last few decades based on the United States Breeding Bird Survey. Examining the mean latitude of individuals of each species, 3 species showed significant or near-significant northward shifts, and 1 a significant shift southward. Over all 5 species examined, colonization events were concentrated in the northern part of the distributions of the species; in 3 species, extinctions were concentrated in the southern part of the distributions of the species. The conclusion is that significant distributional changes have taken place, but they have been subtle, and might be associated with global climate change.

RESUMEN—Se examinaron los cambios en la distribución geográfica de 5 especies de aves en las Grandes Planicies de Norteamérica a través de las últimas décadas con base a datos del United