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COCCIDIA OF ALEUTIAN CANADA GEESE [1]

ELLIS C. GREINER,[2] DONALD J. FORRESTER,[2] JAMES W. CARPENTER [3] and DAN R. YPARRAGUIRRE [4]

Abstract: Fecal samples from 122 captive and 130 free-ranging Aleutian Canada geese *(Branta canadensis leucopareia)* were examined for oocysts of coccidia. Free-ranging geese sampled on the spring staging ground near Crescent City, California were infected with *Eimeria hermani, E. truncata, E. magnalabia, E. fulva, E. clarkei* and *Tyzzeria parvula.* Except for *E. clarkei,* the same species of coccidia were found in geese on their breeding grounds in Alaska. Most of the coccidial infections in captive geese from Amchitka Island, Alaska and Patuxent Wildlife Research Center, Maryland consisted of *Tyzzeria.*

INTRODUCTION

The Aleutian Canada goose *(Branta canadensis leucopareia),* a small subspecies of Canada goose that once bred in the thousands on the Aleutian Islands, was declared an endangered species in 1967. Although hunting and habitat modification probably have played a role in reducing the number of these birds, the principal factor has been predation by arctic foxes introduced to the Aleutians for fur-farming purposes.[10] In an attempt to restore the Aleutian Canada goose to a secure status within its historical range, programs to produce these birds for release on fox-free islands were established at the Patuxent Wildlife Research Center, Maryland, in 1966 and on Amchitka in the Aleutians in 1976.[1,2,9,10]

Hanson, *et al.*[5] summarized the literature on the coccidia in geese from North America, including 6 of the 11 subspecies of the Canada goose. No reports from Aleutian Canada geese were included. They pointed out that some species of coccidia were widely distributed and some were parasites of more than one species of anatid, listing seven species of coccidia from *B. canadensis* that also infect species of *Anser.*

Little is known about the pathogenicity of coccidia in geese. Todd and Hammond[11] discussed the pathogenicity of coccidia in waterfowl and noted that although nothing was known about the pathogenicity of most species, *Eimeria truncata* and *E. fulva* do produce pathogenic responses in their hosts. Renal coccidiosis caused by an undetermined species of *Eimeria* in free-ranging ducks has been reported from the prairies of Saskatchewan.[8,13] In addition, another coccidian, *Eimeria aythyae,* was suspected of causing spring die-offs of lesser scaup in Iowa[4] and Nebraska.[12] Since reduction in suitable habitat concentrates geese and ducks on overwintering ranges, staging grounds and breeding grounds, these birds would have a greater opportunity for exposure to diseases such as coccidiosis.

The purpose of this study was to determine the prevalence of coccidia in free-ranging and captive Aleutian Canada geese. To this end, geese were sampled on their breeding grounds, the major spring

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staging area and at two captive propagation sites.

MATERIALS AND METHODS

Fecal samples were collected during 1977 and 1979 from the ground shortly after being voided by Aleutian Canada geese. The population sampled on the spring staging grounds near Crescent City, California was 99% Aleutian Canada geese, together with a few cackling *(B. c. minima)* and Taverner's Canada geese *(B. c. taverneri)*. The flock was flushed and fresh samples were collected immediately. The samples from the free-ranging breeding geese were taken from an area on Buldir Island, Alaska on which only Aleutian Canada geese were present. Samples were collected from pens holding captives at Patuxent Wildlife Research Center, Laurel, Maryland and from four clutches and a group of older geese on Amchitka Island in the Aleutians. Feces were placed in 2% potassium dichromate and were aerated periodically to facilitate sporulation.

Aliquots of the sporulated samples were centrifuged, decanted and the pellet resuspended in Sheather's sugar solution. The sugar solution was added until a slight positive meniscus formed, a coverslip was placed on top of the tube and the sample was centrifuged as above. The coverslip was removed from the tube and placed on a microscope slide for examination. The complete coverslip was scanned at 100×, with critical observations and measurements made under 430× and 1000×.

RESULTS

Six species of *Eimeria* and one of *Tyzzeria* were recovered (Table 1). Free-ranging geese on Buldir, Alaska and near Crescent City, California, harbored more species of coccidia than the captive geese.

Tyzzeria parvula was the only coccidian common to all collection times and areas. It was the only species collected from the Amchitka captives and the 1979 Patuxent captives. *Tyzzeria* was detected in two broods over 40 days of age, but not in two broods less than 40 days old. Oocysts were subspherical, 11 to 15 by 10 to 13 μm (13.3 by 11.7 μm) (N=106), lacked a micropyle, and contained eight naked sporozoites and an oocyst residuum.

Eimeria hermani was detected in samples from free-ranging geese, with a prevalence of 20 to 80% depending on the sample. Oocysts were ovoid, 24 to 30 by 15 to 20 μm (27.6 by 18.4 μm) (N=63), and contained a prominent micropyle with granules in association, a sporocyst residuum, and a Stieda body.

Eimeria truncata, found only in free-ranging geese, was the second most common species of *Eimeria*, ranging from 7% to 36% in prevalence. Its oocysts were similar to *E. hermani* although a bit more flattened at the micropyle end and were consistently smaller, ovoid, 20 to 23 by 15 to 19 μm (22 by 17 μm) (N=85), with a micropyle present, and a sporocyst residuum present. *Eimeria truncata* occurred in mixed infections with *E. hermani* in six fecals from Buldir and the 1979 spring staging area, whereas they were present independently of each other 30 times in samples from these same localities.

Two species with distinctive oocysts, *E. magnalabia* and *E. clarkei,* were detected in free-ranging geese and the 1977 sample from the Patuxent captives. *Eimeria magnalabia* did not occur in more than 10% of any sample, whereas 30% of the sample from the spring staging ground in 1979 had the more sporadically occurring *E. clarkei.* The oocysts of *E. magnalabia* were ovoid, 20 to 23 by 16 to 18 μm (21.6 by 17.0 μm) (N=8), contained a prominent micropyle, a pitted wall, and a sporocyst residuum. The oocysts of *E. clarkei* were round-

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TABLE 1. Coccidia recovered from Aleutian Canada geese at two captive propagation centers, the spring staging area, and the breeding range.

Site	#Exam.	#Pos.	Number Infected by Species of Parasite						
			T. parvula	*E. hermani*	*E. truncata*	*E. magnalabia*	*E. clarkei*	*E. fulva*	*E. crassa*
CAPTIVES									
Patuxent									
Oct., 1977	24	10	9	0	0	1	1	0	1
Patuxent									
July, 1979	30	3	3	0	0	0	0	0	0
Amchitka									
Aug., 1979									
1 year	28	20	20	0	0	0	0	0	0
51-55 days*	10	10	10	0	0	0	0	0	0
43-44 days*	10	5	5	0	0	0	0	0	0
37-38 days*	10	0	0	0	0	0	0	0	0
28-30 days*	10	0	0	0	0	0	0	0	0
FREE-RANGING									
Crescent City									
April, 1979	50	30	25	10	18	2	15	0	0
Crescent City									
April, 1977	60	51	40	48	4	0	0	1	0
Buldir									
Sept., 1979	20	15	7	9	6	2	0	2	0

*Age of broods when sample was collected.

bottomed, flask-shaped to lemon shaped, 23 to 28 by 16 to 22 μm (26.4 by 18.4 μm) (N=65), possessed a prominent micropyle with a single granule in association, and a sporocyst residuum.

The final two species, *E. fulva* and *E. crassa*, were uncommon. *Eimeria fulva* had large ovoid oocysts, 27 to 34 by 20 to 26 μm (31.2 by 22.4 μm) (N=10), had a prominent micropyle with granules in association, a Stieda body, and a sporocyst residuum and the wall was pitted. The oocysts of *E. crassa* were ovoid, 23 to 28 by 16 to 21 μm (25.4 by 19.7 μm) (N=11), lacked a micropyle, and possessed a Stieda body and a sporocyst residuum.

Table 2 compares the prevalence of each coccidian species and the collection sites and times. This comparison indicated that *T. parvula*, *E. hermani*, *E. truncata*, *E. magnalabia*, and possibly *E. clarkei* and *E. fulva* were normal components of the parasitic fauna of *B. c. leucopareia*. These species were present at times just prior to migration, thus allowing dissemination of the parasites both northward from California and southward from the Aleutian Islands. *Eimeria crassa* at the Patuxent Center appeared to be a contaminant, possibly from some wild anatid.

TABLE 2. Prevalence (percentage infected) of coccidia recovered from Aleutian Canada geese feces at each collection site.

	Buildir 1979	Crescent City 1979	Crescent City 1977	Patuxent 1977	Patuxent 1979	Amchitka 1979
T. parvula	35	50	67	38	10	22
E. hermani	45	20	80	—	—	—
E. truncata	30	36	7	—	—	—
E. magnalabia	10	4	—	4	—	—
E. clarkei	—	30	—	4	—	—
E. fulva	10	—	2	—	—	—
E. crassa	—	—	—	4	—	—

DISCUSSION

The resemblance between the unidentified kidney coccidian reported elsewhere[8,13] and *E. clarkei* as detailed in our study was remarkable. The shape was very distinctive and the lengths recorded were nearly identical except that the coccidian found in Saskatchewan was somewhat narrower, and according to Wobeser,[13] resembled *E. truncata*. *Eimeria clarkei* was described from unsporulated oocysts and the site of endogenous development was not determined.[5] The taxonomy of the coccidia in this group of birds is confused, partly due to our lack of understanding the host specificity of these parasites and the fact

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that no one has adequately described or illustrated *E. truncata*. Whether *E. clarkei* is a renal form or not is unanswered, but the parasites being attributed to *E. truncata* in the present study are distinct from the forms illustrated previously.[8,13]

The prevalences of coccidia recorded herein from the wild Aleutian Canada geese were similar to other subspecies of the Canada goose and other species of geese.[5] *Tyzzeria* was the most ubiquitous coccidian recorded,[5] as in the present study. It should be pointed out that Levine[6] evidently used the incorrect subspecies name for the lesser Canada goose when stating *E. brantae* was described from *B. c. leucopareia*, whereas *E. brantae* was actually described from *B. c. parvipes*.[7] Thus the first records of coccidia in this endangered subspecies are reported herein as well as extending the western geographical range of these species.

The low prevalence of *Tyzzeria* sp. and the lack of *Eimeria* spp. in the samples obtained from geese at the Patuxent Center in 1979, when compared to that noted in 1977, was a reflection of management changes. In late 1978, the birds were moved to a new facility that permitted pen rotation and more hygienic procedures. Coccidiostats were not administered to the geese examined herein. The absence of *Eimeria* spp. in the captive flocks in the 1979 samples evidently reflected the change in management procedures employed.

Studies are needed to determine the life cycles of these coccidia, the degree of their host specificity and their pathogenicity to more adequately assess their impact on waterfowl populations. Some of the species of *Eimeria* that infect the Aleutian Canada goose are pathogenic.[11] In fact 10 of 20 wild goslings shipped to the Patuxent Center in 1975 died from coccidiosis shortly after arrival.

Although husbandry procedures for captive Aleutian Canada geese have been reassessed, resulting in a reduction in the prevalence of coccidial infections, it is unlikely that coccidia will be entirely eliminated from these captive birds. A low prevalence of coccidia, however, in combination with the environmental conditions and the suppressing effects of coccidiostats should permit a low-grade infection and a gradual development of immunity without clinical disease. If coccidia are ever eliminated from the captive geese, it might be advisable to expose the birds to the parasite in a guarded, controlled manner as had been done in poultry.[3] Intentionally exposing geese in this manner and controlling the clinical development of the disease would enable immuno-competent birds to develop resistance to this parasite, thereby increasing their chances of survival upon release to the wild.

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