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SURVEY FOR *SARCOSYSTIS* SPP. IN WILDLIFE

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Final Report
Federal Aid in Wildlife Restoration
Projects W-21-1 and W-21-2, Job 18.3R

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FINAL REPORT (RESEARCH)

State: Alaska

Cooperator: Kenneth A. Neiland

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Job No.: 18.3R Job Title: Survey for Sarcocystis spp. in Wildlife

Period Covered: June 21, 1979 to December 15, 1980

SUMMARY

Five hundred and thirty-eight big game, furbearers, or marine mammals were examined histologically for the presence of *Sarcocystis*. The most commonly infected species was caribou (about 95% prevalence). No sarcocysts were found in marine mammals or furbearers. About three-quarters of the Dall sheep, one-third of the moose, one-fifth of the black-tailed deer, and one-eighth of the bison were lightly or moderately infected.

An extensive bibliography on the occurrence of *Sarcocystis* in wildlife and pathologic effects and life cycles in all host species is included.

CONTENTS

BACKGROUND

During the principal, asexual stage (i.e. sarcocyst) of their life cycle, the members of this coccidial-like genus of protozoan parasites infect various prey animals (e.g. wild ruminants, lagomorphs, rodents, etc.).

The definitive or sexual stages of their life cycle develop like one-host coccidia (e.g. *Eimeria* spp.) in the gut of various predators (e.g. canids, felids, birds of prey, and other carnivores).

Even though the asexual sarcocyst stage was first recognized in domestic animals over a century ago and in the ensuing years has been commonly seen in various domestic and wild animals, it was not until within the past 5 years that the full, two-host cycle was discovered. It has been this belated discovery that has provided the experimental and technical basis for a 180-degree change in scientific opinion regarding the pathogenicity of at least some commonly and widely occurring species of *Sarcocystis*. The situation in respect to domestic animals has been well summarized by Frelier et al. (1977):

> Historically the finding of *Sarcocystis* cysts in a high percentage of slaughtered domestic animals has been regarded with interest, but little concern has been shown because the parasite appeared nonpathogenic (1) and its life cycle was unknown except for the intramuscular cyst stage.... This outbreak should focus attention on the economic impact of acute sarcocystosis causing death in food-producing animals, and on the economic loss due to poor growth rates.

The first clear evidence of the pathogenicity of *Sarcocystis* spp. in a wild animal (mule deer) was reported by Hudkins and Kistner (1977). They summarized the general results of their studies as follows:

> Eleven mule deer fawns orally inoculated with these sporocysts became infected and 9 of 11

> died between post-inoculation days (PID) 27 and 63. Clinical signs of anorexia, weight loss, pyrexia, and weakness were evident prior to death.... Uninoculated control animals consisting of three mule deer fawns, two lambs, and one calf remained healthy during the experiment.

Similarly, Fayer (pers. comm.) has demonstrated the pathogenicity of a species of *Sarcocystis* found in eastern white-tailed deer which undergoes sexual reproduction in domestic dogs.

These reports have strongly stimulated our own interest in species of *Sarcocystis* in Alaskan wild ruminants and carnivores. Caribou are of special interest not only because of the apparently high prevalence, but also because the infections seen are much more intense. We have demonstrated that canids (beagles experimentally, probably wolves naturally) are the definitive host in which sporocysts which infect caribou are formed. Infection of a short-yearling reindeer (which might have been previously exposed) with moderate numbers of sporocysts produced in a beagle dog fed raw caribou heart tissue did not produce clinical signs of pathology. The experiment should be extended to several younger fawns reared from birth in isolation to prevent pre-experimental exposure. Several dose levels should be used in order to ensure that in at least several animals significant symtomology is produced, though not so severe that the animal dies before the parasite can be recognized in affected tissues and serum antibodies are formed.

OBJECTIVES

To evaluate the effects of enzootic diseases on Alaskan wildlife populations and on the utilization of wild animals in various conservation programs.

To determine the prevalence of species of *Sarcocystis* in wild ruminants and carnivores.

To prepare a bibliography on *Sarcocystis* in wildlife.

PROCEDURES

Tissues were collected statewide whenever possible from hunter kills, road kills, or scientific collections of wild ruminants. These were histologically prepared at a commercial laboratory and examined microscopically.

FINDINGS

The results of the histologic examination of tissues for sarcocysts of 538 individuals of 14 species of wildlife (12 Alaskan) are summarized in Table 1. All big game, ruminant

Table 1. Prevalence[1] of *Sarcocystis* spp.[2] in Alaskan wildlife.[3]

Species	Locality	Number Examined	Number Infected	Percent Infected
Alces alces gigas	Stikine River	9	1	11.1
	White River	3	2	66.6
	Unit 13	10	6	60.0
	Seward Peninsula	89	2	2.2
	Interior	6	1	16.6
	Holitna River	13	1	7.7
Alces gigas, calves	Nelchina-McKinley Park	6	-	-
	cumulative total (average)	136	13	9.5
Bison bison	Chitina River	3	-	-
	Delta Junction	108	15	13.9
	cumulative total (average)	111	15	13.5
Canis lupus, pups	Ketchikan area	7	-	-
Eumetopias jubata		10	-	-
Marmota caligata	Kantishna	2	-	-
Odocoileus hemionus sitkensis	Baranof Island and vicinity	54	9	16.6
	Ketchikan	1	1	100.0
Oreamnos americana	Ketchikan area	8	1	12.5
Ovibos moschatus	Nunivak Island	5	4	80.0
Ovis dalli	Dry Creek, Alaska Range	28	27	96.4
	Tok Study Area	21	10	47.6
	Sheep Creek	2	1	50.0
	Wrangell Mountains	2	2	100.0
	Brooks Range	8	7	???
	McCumber Creek	1	1	100.0
	cumulative total (average)	62	48	77.4

Table 1. Continued.

Species	Locality	Number Examined	Number Infected	Percent Infected
Ovis nivicola	Taigonos Peninsula, Siberia	2	1	50.0
Phoca hispida		10	-	-
Phoca vitulina	Kodiak area	10	-	-
Rangifer tarandus granti	Western Arctic Herd	79	78	98.7
Rangifer tarandus, fawns	Western Arctic Herd	18	-	-
	Porcupine Herd	6	6	100.0
	Delta Herd	3	3	100.0
	Wrangell Mountains	9	7	77.8
	Nelchina Herd	5	5	100.0
	Izembek Herd	14	13	92.9
	Adak Herd	9	2	22.2
	Hoholitna River Herd	1	1	100.0
"reindeer"	Greenland	1	1	100.0
	cumulative total (average)	120[4]	114[4]	95.0[4]

[1] Negatives based on heart muscle only. Positives include other muscles.
[2] Number of species involved unknown.
[3] Unless otherwise noted, data include yearlings or older animals only.
[4] Includes neither Adak nor fawn data.

prey species were found infected. The prevalence and apparent intensity were lowest in bison (13% and 1-3 parasites per tissue section, respectively) and highest in caribou (96% and 20+ parasites per tissue section, respectively). The substantial variation in prevalence of sarcocysts in a given species from different areas (e.g. moose, Unit 13 vs. Stikine River or Seward Peninsula Dall sheep, Dry Creek vs. Tok Study Area; caribou, mainland Alaska vs. Adak Island) must be related to exposure to infection, i.e. predator densities. This assumes that the species of *Sarcocystis* in moose, sheep, or caribou are the same, at least for that species, in the game ranges being compared. The predator involved in the life cycles of these species of *Sarcocystis* probably is the wolf in most areas. However, the occurrence of this parasite in caribou on Adak (low prevalence and intensity) suggests the possibility that foxes may also serve as final hosts. The presence of sarcocysts in muskoxen from Nunivak Island (Table 1) also supports this hypothesis. It seems likely that coyotes are also involved, as are loose dogs, in some areas. Perhaps there is some variation in the efficiency of these different species of canids as final hosts of *Sarcocystis*. The prevalences and/or intensities of infection are highest in a given species where wolves are common and lowest where they are absent.

Another factor which no doubt influences exposure, and therefore prevalence and intensity of sarcocyst infections in the intermediate host, is that of feeding behavior. Grazers (except bison) are more commonly infected than browsers (i.e. moose) (note: all of our black-tailed deer data are from areas lacking wolves). The infective oocysts of *Sarcocystis* spp. pass out of canids with the feces and therefore contaminate decumbent vegetation eaten by grazers. Browsers (e.g. moose) probably are exposed to infection when they eat aquatic vegetation.

The literature on infections and the effects of *Sarcocystis* spp. in various species of wildlife was reviewed in a previous report (Neiland 1978). Interested parties are referred to this source for further details. An extensive bibliography on *Sarcocystis* in wildlife is presented in the following section.

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