Frank Jones

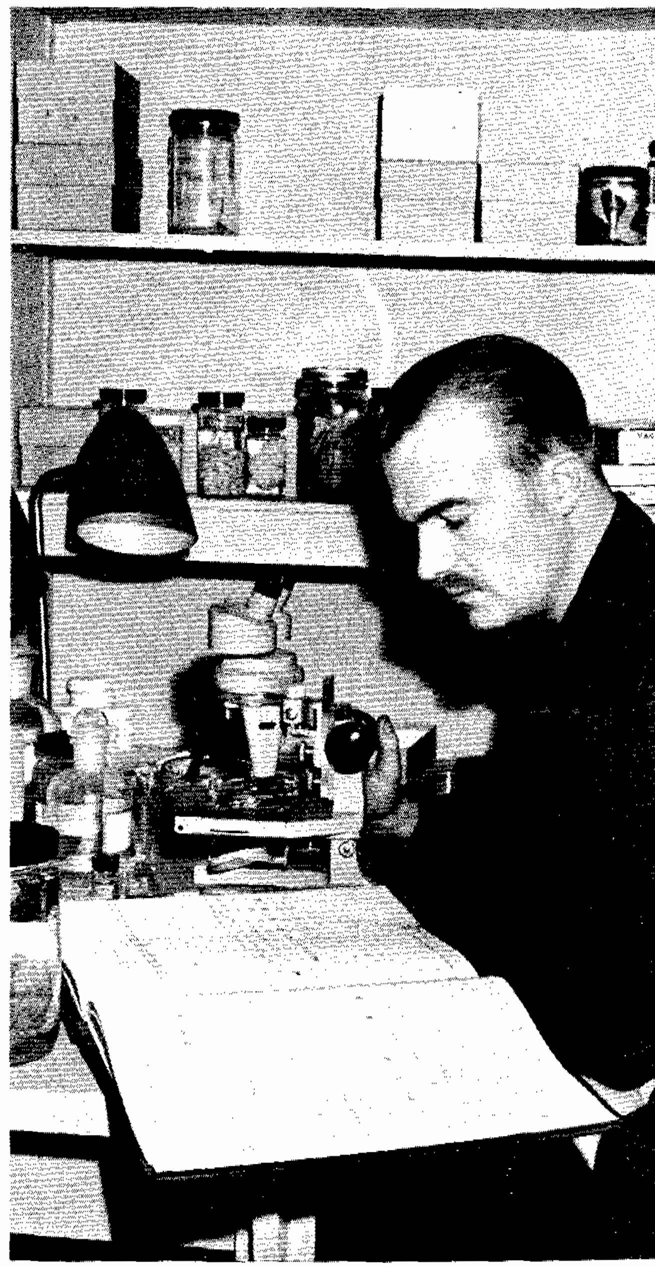
ALASKA DEPARTMENT OF FISH & GAME

1960-61 Pittman-Robertson Project Report

DIVISION OF GAME VOLUME II, NO. 11

PARASITE AND DISEASE INVESTIGATIONS

Work Plan L



Juneau, Alaska

Disease and parasites contribute to the natural loss of game animals. The Department of Fish and Game conducts studies to determine the importance of such losses to the health and welfare of our game populations. (Photo by Ron Skoog)

A lungworm, Dictyocaulus sp., found in moose (3x). (Photo by Ken Neiland)

Alaska Department of Fish and Game parasitologist identifies parasites collected by biologists during a field operation. (Photo by Amos Burg)

Volume II, Number 11 1960-1961

ANNUAL REPORT OF PROGRESS, 1960-1961

FEDERAL AID IN WILDLIFE RESTORATION PROJECT W-6-R-2

GAME INVESTIGATIONS OF ALASKA

STATE OF ALASKA

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Alaska Department of Fish and Game

Clarence L. Anderson, Commissioner

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Reports of Investigations

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ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: M Disease and Parasite Investigations

Job No: 1 Title: Survey of Parasitic Fauna of Alaskan Game Animals and Birds

PERIOD COVERED: July 1, 1960 to June 30, 1961

ABSTRACT:

During the past year a total of 478 vertebrates, including 46 host species, have been at least partially examined for adult and larval parasites. The host animals included four big-game species (moose, black-tailed deer, caribou and brown bear), six land fur-bearers (mink, marten, land otter, fox, wolf and wolverine), five marine mammals (sea otter, fur seal, beluga, harbor seal and sea lion) and a variety of fish, birds and mammals potentially important as alternate or intermediate hosts of parasites of game birds and mammals. Most of the major groups of parasites (trematodes, cestodes, nematodes, acanthocephala, leeches, mites, lice, ticks, fleas and diptera) are represented among the more than 100 (estimated) species collected.

Observations of special interest are included in the following general categories: 1) the ecology of moose parasites in Southcentral Alaska; 2) acute parasitism of pelagic fur-seal pups; and 3) the parasites of the sea otter in Prince William Sound, fur-bearers of Southeastern Alaska, and the beluga in upper Bristol Bay. Because of the great diversity

it has not been possible to complete the laboratory analysis of much of the material collected from alternate host species. The parasitism observed in black-tailed deer and caribou are covered in the completion reports for Jobs No. M-2 and M-3, respectively, of this series.

OBJECTIVES:

To determine the increase and distribution of parasites in Alaskan fur and game mammals, game birds, and in alternate host species; the extent that parasitism may contribute to mortality in these species, and the extent that such parasitism may depreciate the value of these animals for use as food by humans or domestic animals.

TECHNIQUES:

The major part of the material was collected in cooperation with other P-R projects conducted on particular species of big-game, predatory or fur-bearing mammals by other members of the Department. Alternate host species were collected as time allowed. In a few instances, both collection and examination of host species were performed by other staff members in the field.

The field autopsy techniques and laboratory procedures employed were routine parasitological methods and will not be further elaborated at this time.

RESULTS:

The host species and parasites collected are given in Table 1. It was impossible to treat all of the material in a definitive fashion. In many cases insufficient specimens were available for accurate identification. It is expected that as adequate coverage of host or parasite groups is accomplished, the material will be summarized in a detailed fashion for publication. However, because of their special interest, the laboratory analysis of certain host-parasite combinations was carried out in greater detail. These are treated separately below.

Table 1. Host-parasite relationships of animals examined during July 1, 1960 - June 30, 1961.

HOST SPECIES	NUMBER EXAMINED	NUMBER OF PARASITE SPECIES
MAMMALIA:		
ARTIODACTYLA:		
Alces a. gigas	262	4
Odocoileus hemionus sitkensis	25	6
Rangifer tarandus stonei	20	4
CARNIVORA:		
Callorhinus ursinus cynocephalus	1	6
Canis lupus	3	2
Enhydra lutris	2	3
Eumetopias jubata	3	4
Gulo gulo	7	1
Lutra canadensis	4	0
Martes americana	3	1
Mustela vison	24	2
Odobenus rosmarus divergens	2	1
Phoca vitulina richardii	3	4
Ursus arctos	1	0
Vulpes vulpes	1	2
CETACEA:		
Delphinapterus leucas	7	7
RODENTIA:		
Castor canadensis	1	1
Citellus undulatus	4	0
Clethrionomys rutilus	12	3
Microtus coronarius	1	0
Microtus sp. (?)	5	1
Peromyscus maniculatus	8	0
Tamiasciurus hudsonicus	1	1
LAGOMORPHA:		
Oryctolagus cuniculus	2	0
INSECTIVORA:		
Sorex obscurus malitiosus	6	7
CHIROPTERA:		
Myotis sp. (?)	3	1

Table 1. (Continued).

HOST SPECIES	NUMBER EXAMINED	NUMBER OF PARASITE SPECIES
AVES:		
PASSERIFORMES:		
Iridoprocne bicolor	1	2
CHARADRIIFORMES:		
Arenaria melanocephala	4	3
Ereunetes pusillus	6	2
Erolia alpina pacifica	2	2
Larus canus brachyrhynchus	1	3
L. glaucescens	1	3
Limnodromus g. griseus	9	4
Lobipes lobatus	2	0
Sterna paradisea	1	2
Totanus melanoleucas	1	2
PELECANIFORMES:		
Phalacrocorax auritus	1	3
P. pelagicus	8	4
GAVIFORMES:		
Gavia arctica	2	2
PISCES:		
Oncorhynchus nerka	2	2
O. tshawytscha	3	3
Osmerus dentex	8	4
Raja binoculata	1	3
Raja sp. (?)	1	2
Salmo gairdnerii	3	4
Salvelinus malma	10	7
TOTAL = 46	478	*100

* This is an approximate figure. Accurate identification of all of the species collected has not been completed.

A. The ecology of moose parasitism in Southcentral Alaska.

During the special antlerless moose seasons held in the Kenai (Area A), Palmer-Wasilla (Area B) and Willow-Talkeetna (Area C) localities it was possible to collect at least partial incidence data on 262 animals. Because of the large volume of specimens and the comparative lack of time and facilities, it was judged necessary in advance to restrict our attention to the examination of specific organs which were known to harbor important parasites of moose. These (lungs, abomasum, upper small intestine, caecum and liver, when available) were collected at the kill-sites by other members of the staff and brought in to a central field laboratory where they were routinely examined with the following results.

Four species of parasites were encountered: *Echinococcus granulosus* (larval stage), *Nematodirella longispiculata* (tentative identification), *Taenia hydatigena* (larval stage) and *Moniezia benedini* (tentative identification). These were found in the lungs, small intestine, liver and small intestine, respectively. The data are especially interesting both in regard to what was or was not found, as well as to the variation in incidence among the three hunt areas. Although in excess of 200 lungs, abomasa and caeca were examined, these organs failed to yield a single nematode specimen. This was particularly unexpected in Area B in which large numbers of domestic animals are maintained. Since a case of lungworm, (*Dictyocaulus viviparous*, nematode) has been found in Area B in moose, one can only conclude that it is present in very few animals. Although *Oesophagostomum venulosum* is known to infect moose elsewhere (British Columbia, Minnesota, etc.) it has never been reported from Alaskan moose and was not found in any of the caeca examined. Stomach (abomasum) worms are not uncommon in moose elsewhere. The presence of large numbers of domestic stock in Area B should favor the infection of moose by this type of helminth, at least in that area. No stomach worms were encountered. The incidence data for the helminths observed (except *Taenia hydatigena*) are shown in Table 2. *Taenia hydatigena* is a tapeworm of canines which in the larval form locates in the liver of the intermediate host. It is known that sportsmen during the hunt took out livers that were obviously infected with this worm, in addition of course, to most of the uninfected ones. Accordingly, no accurate measure of incidence was possible.

Table 2. Incidence of moose parasitism in Southcentral Alaska.

Helminth species	AREA A % Infected	AREA A # Examined	AREA B % Infected	AREA B # Examined	AREA C % Infected	AREA C # Examined
Echinococcus granulosus	1.7	144	25 *	68 *	23 *	26 *
Nematodirella longispiculata	26.0	95	38 *	65 *	26 *	23 *
Moniezia benedini (sp.?)	2.0	95	3.1 *	65 *	0 *	23 *

* These figures are incomplete since material from both Areas B and C were brought in together and some of the specimens were only identified with the hunter's name and permit number. This information will be completed when the results of jaw analysis are made available in the near future. It is not expected that this will materially affect the incidence rates.

A perusal of Table 2 yields the conclusion that E. granulosus is about 12 times more frequent in Areas B and C than in Area A. This is quite likely related to a difference in existing numbers of canines between Area A and the other two areas. Since it appears likely that domestic dogs are the most numerous canine species present in all of Area B and at least part of Area C, and probably exceed in number by far those present in Area A, it is not surprising that the parasite is much more common where the canine, the final host, is equally more common. It should be recognized that although coyotes are present in approximately similar numbers in both Areas A and B, this species apparently is not a suitable host for the adult parasite.

The incidence rate for N. longispiculata, is about 50 per cent greater in Area B than in Areas A or C, and most likely reflects the usual effect of the presence of relatively large numbers of domestic stock in association with game animals. This circumstance consistently results in higher rates of helminthiases in the associated wildlife.

Of the infections observed, only some of those by E. granulosus could be classed as severe. One infection in a very old cow (12-14 years ?) was comprised of about 50 large (golf ball to tennis ball) cysts in each lung. However, there were no apparent signs of acute parasitism and the animal was fertile during the previous rut. What the chronic effects of this sort of parasite burden might be can only be speculated. While the total volume of the lung plus parasite tissue appeared to be approximately equivalent to the lung volume (not air capacity) of similar aged, but uninfected lungs, it appears likely that there was almost as much parasite tissue (by volume) as lung tissue. Accordingly, it may be assumed that an infection of such severity might greatly reduce the ability of the animal to perform long periods of vigorous activity.

Although the infection of N. longispiculata appeared to be of light to moderate intensity, and therefore of negligible effect on the animals involved, these intestinal helminths can produce harmful reactions when they are present in large numbers. This would be especially true of heavy infections in young animals and might be a contributing factor to calf mortality.

It is expected that it will be possible to collect additional data on moose parasitisms in December 1961, during a special antlerless moose hunt to be held in the Fairbanks area. It is hoped that it will eventually be possible to obtain similar data in Southeastern Alaska (especially on the Yakutat herd). When this additional information is available it will be worked up in definitive form for publication.

B. Acute parasitism of a pelagic fur-seal pup.

Mortality of fur seal pups on the Pribilof Island rookeries involves a significant proportion of those born each year (Kenyon and Scheffer, 1954). The hookworm, *Uncinaria lucasi* Stiles, 1901, appears to be of considerable importance in the death of pups on the rookeries and is the only helminth found in them prior to their migration out to sea (Olsen, 1958). It is estimated that as many as 400,000 fur seals of all age classes may be lost between mid-August and the following mid-June from natural causes other than uncinariasis (Kenyon and Scheffer, *loc. cit.*). During this period the fur seal leaves the rookery to feed and is subject to a variety of lethal factors. Relatively little is known in detail about the agencies involved in nonrookery mortality.

During early January 1961, three fur seal pups took up residence in the small boat harbor at Valdez, Alaska. They apparently were attracted by schools of herring which had entered the harbor and on which they actively fed. A few days after their first appearance one of them, an eight month old male, crawled out on the shore in a very weakened condition and shortly thereafter died. Post mortem examination of the animal revealed that the pup was extremely emaciated, lacking any significant amount of subcutaneous fat, and that it was heavily infected with seven species of helminths. The helminths with numbers and location of each in parentheses are as follows:

TREMATODA: *Pricetrema zalophi* (Price, 1932) (more than 1000 in the small intestine); *Phocitrema fusiforme* Goto and Ozaki, 1930 (one specimen in the small intestine); *Cryptocotyle jejuna* (Nicoll, 1907) (four in the intestine).

CESTODA: Diphyllobothriid, genus and species unknown. (eight immature specimens in the small intestine).

NEMATODA: Phocanema decipiens (Krabbe, 1878) Myers, 1959 (about 200 larvae and 4 adults in the stomach, 25 larvae in the small intestine and 85 larvae free in the abdominal cavity).

ACANTHOCEPHALA: Corynosoma strumosum (Rudolphi, 1802) (six in the small intestine); Corynosoma sp. (seven in the small intestine).

Two of the foregoing species probably contributed to the pathology and eventual death of the animal. The larvae of P. decipiens which were present in the abdominal cavity had obviously penetrated the wall of the alimentary tract. Although specific lesions were not readily apparent, the outer surfaces of the stomach and small intestines were inflamed. The presence of a black, tarry material within the small intestine probably indicates a hemorrhagic condition. Migration within the definitive host of ascaridid larvae of a number of different genera are known to occur, frequently with severe effects on the host. The presumed pathogenic effects of the larvae of P. decipiens were no doubt aggravated by the presence of large numbers of the minute, heavily spined, heterophyid fluke, Pricetrema zalophi. Species of a number of different genera of this family of flukes are known to cause considerable mechanical damage to the epithelial lining of the small intestine. Willey and Stunkard (1942), have described in detail the pathology in dogs of infections of the heterophyid Cryptocotyle lingua (Creplin, 1825). The small numbers of the other species of helminths present precludes the possibility that they were involved to any significant extent in the apparent pathology.

To the best of the writer's knowledge, Pricetrema zalophi and Cryptocotyle jejuna have not been previously reported from the fur seal.

The preceding observations have been accepted for publication in the Journal of Parasitology. It is hoped that it will be possible to examine additional fur seal pups in order to accurately determine the incidence of potentially fatal parasitism in this valuable animal.

C. The parasites of sea otter in Prince William Sound.

The sea otter is potentially one of the world's most valuable fur-bearers. Its population densities in some areas of Alaska are again reaching levels which may allow limited harvest. Acute helminthiasis has been implicated in the die-off of otters in areas of high numbers in the Aleutians, (Rausch and Locker, 1951; Rausch, 1953). Information regarding parasitism of sea otters, except in the Aleutians, is essentially completely lacking. The writer had the opportunity to examine two sea otters (a female and her pup) collected by another staff member for the Hastings Museum. Three species of parasites were encountered.

1) *Microphallus pirum* (Afanas'ev, 1941) (intestinal fluke).

This fluke was first found in sea otters taken at the Commander Islands of the Aleutian Chain. It was more recently implicated in the die-off of numbers of sea otters at Amchitka. Both the adult and juvenile sea otters examined by the writer were infected with large numbers (1000?) of this very small (less than 1 mm.) fluke. There was no obvious sign of intestinal damage, although in the Amchitka specimens pathologic damages in the intestinal lining were reported. It appears likely that this parasite is potentially most harmful when local areas become overpopulated with otters resulting in increased opportunity for infection and poorer nutrition.

2) *Orthosplanchnus fraterculus* (Odhner, 1905) (gall-bladder fluke)

This worm, first reported from the Atlantic walrus in Norway, is a common parasite of sea otters in the Aleutians particularly in older animals. It was observed in relatively large numbers (60) in the adult otter from Prince William Sound. Infection by this fluke results in a typical host reaction in which the walls of the gall bladder become very thick and much less elastic resulting in reduced bile storage capacity. There was no apparent deleterious effect on the otter.

3) *Corynosoma* sp. (intestinal thorny-headed worm).

From the adult otter examined by the writer, 60 specimens of a new species of *Corynosoma* were recovered.

This worm is distinctive in its relatively large size and various other characteristics; 28 species of this genus are so far known to science. The addition of this new species will raise the number to nine of species of *Corynosoma* known from Alaska marine mammals. The specific details of the life cycle of the worm are unknown but, like other *Corynosoma*, undoubtedly involve crustaceans and fish as the first and second intermediate hosts, respectively. There were no obvious signs of pathology in the one case observed.

The new species of *Corynosoma* discussed above and comparable material from belugas is the basis for a paper which has been submitted to the Journal of Parasitology for publication.

D. *The parasites of Southeastern Alaska fur-bearers*.

Through the cooperation of personnel carrying out a "pelt-primeness" study in Southeastern Alaska, a number of mink, marten and land otter carcasses have been available for examination. Although it has not been possible to complete the examination of all the carcasses, it is doubtful that the additional data, when available, will require substantial revision of the conclusions which may be drawn at this time.

Southeastern fur-bearers, particularly the mink, are surprisingly free of parasites. Only 2 of 24 mink harbored helminths and then only in small numbers. By contrast, Senger and Neiland (1955) found 10 of 11 Oregon mink infected with large numbers of 6 species of parasitic worms. Each of the two infected mink were hosts to a single, different species of parasite. *Corynosoma strumosum* (Rudolphi, 1802) is a common, acanthocephalan parasite of marine mammals that has been occasionally reported from mink elsewhere. *Soboliphyme baturini* Petrow, 1930, a peculiar nematode previously recorded in Central Alaskan marten (Bezdek, 1942), has not been reported before from mink anywhere. This parasite was also present in small numbers in each of the three marten which were available for autopsy. Four land otters were free of helminths, as were six Oregon otter reported by Senger and Neiland (1955).

Apparently the restricted habitat of mink in

Southeastern Alaska (primarily the "beach strip") is an unexpectedly poor source of mink parasites. On the other hand, it may be that biological conditions in Alaska as a whole are unfavorable for mink parasites. Since the literature dealing with Alaskan parasites does not include even a single record of mink parasites, it appears highly desirable to obtain carcasses from other areas, especially north of the "panhandle."

E. The parasites of the beluga in Bristol Bay.

Through the cooperation of other personnel working on the biology of the beluga, a relatively important food animal and salmon predator, the writer had the opportunity to examine seven of these interesting marine mammals taken from the Kvichak River which flows into Bristol Bay. Because massive downstream migrations of red salmon smolts are known to take place in the Kvichak River, it was of special interest to determine whether or not the beluga was serving as a source of infection of larval parasites which presumedly might affect the survival of the smolts. Preliminary studies on the parasites of the beluga in Bristol Bay have yielded only four species of parasites from this animal: two species of nematodes (round worms) and one species each of acanthocephala (thorny-headed worm) and trematoda (fluke). These are treated separately below.

1) Hadwenius seymori (Price, 1932) (intestinal fluke).

Two of seven belugas harbored about 10-60 specimens, respectively, of this relatively large fluke (1 inch long x 1/8 inch diameter). There are no signs that the infections observed were of more than very slight harm to the host. The life cycle of this kind of fluke is unknown and therefore one can not speculate whether or not a valuable prey species may be involved. This is a relatively common beluga parasite in both Alaskan and Siberian waters.

2) Corynosoma sp. (intestinal thorny-headed worm)

Acanthocephala have not been previously recorded from the beluga in Alaskan waters. One of the four species found was of common occurrence and proved to be a previously unknown form which is described along with another new species of this genus from the sea otter in a paper submitted to the Journal of Parasitology. All of the animals examined harbored many specimens of this species, a heavy infection amounting to approximately 500-1,000 individuals. Even in a heavy infection it was not obvious that the host animal was seriously infected. However, in a very heavy infection, perhaps 5,000-10,000 individuals, the host would probably suffer severe intestinal disorder, possibly death. Corynosoma semerme (Forssell, 1904), C. strumosum (Rudolphi, 1802) and C. wegeneri Heize, 1934, were present in small numbers only in one host specimen along with many individuals of the new species.

It was possible to make some observations on part of the larval development of this worm which suggests the probable means whereby the beluga acquires the parasite. Knowing that other species of Corynosoma undergo the latter part of their larval growth in various species of fish, plus the observation that the belugas were feeding extensively on the spawning runs of rainbow smelt (Osmerus dentex) in the Kvichak River, prompted the writer to examine the smelt for larval acanthocephala. Larval specimens of what appears to be the same species of Corynosoma as that in the beluga were found regularly in the body cavity of the smelt. Based on information available on the life cycle of other Corynosoma it is anticipated that the early larval development of this worm takes place in some small crustacean (planktonic) found in Bristol Bay or its watershed.

3) Anisakis sp. (?) (stomach roundworm)

Various species of this genus of parasitic round worm are commonly found without geographical limits in marine mammals. Although they have never previously been recorded for the beluga in Alaskan waters they are known from this host species elsewhere. Anisakis physeteris Baylis, 1923, has been reported from the sperm whale in the Aleutians and the larval stage of an undetermined species of this genus has been commonly found in adult red and pink salmon throughout Alaskan waters.

The writer observed this kind of parasite commonly in the beluga examined in the Bristol Bay area. Although what could be considered heavy infections were not encountered, nevertheless infections in excess of 200-300 worms were observed. It appears likely that this parasite damages the stomach lining of the host, but only to a limited extent in the relatively light infections observed. However, female worms of this general category of roundworms can produce large numbers of eggs over extended periods of time and thus even light host infections could result in extensive infection of the intermediate host species (prey animal: fish) in which the worm's larval development takes place.

4) Stenurus arcticus (?) (Cobb, 1888) (lung roundworm)

Lungworms were found only in one animal and are probably of relatively low occurrence. The species encountered has only been tentatively identified, but it appears likely that it is the same one reported by Cobb in 1888 from the beluga in eastern Canadian waters. The life cycle of this kind of worm is unknown, but judging from the known cycles of more or less closely related forms, it does not appear likely that fish are involved as an intermediate host.

Considering the known effects of various species of lungworms on other species of animals, it is possible that the one encountered in the beluga is of greater potential damage to the beluga than any of the other parasites found. One of the most important types of parasites of big-game and domestic animals is the lung worm which includes various species.

RECOMMENDATIONS:

Because of the ecological and faunistic diversity of Alaskan wildlife and the comparative lack of appropriate information, Job No. M-1 should be put on a continuing basis.

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Volume 2 Report No. M-2

ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: M Disease and Parasite Investigations

Job No: 2 Title: Parasitism in the Sitka Black-tailed Deer

PERIOD COVERED: July 1, 1960 to June 30, 1961

ABSTRACT:

The examination of a limited number of Southeastern deer has demonstrated the presence of six species of parasites of this host animal. These are: CESTODES: *Moniezia benedeni* and *Taenia hydatigena* (larval stage); NEMATODES: *Dictyocaulus viviparus* (lung worm), *Oesophagostomum venulosum* (caecal worm) and *Setaria cervi* (body cavity threadworm); and ARTHROPODA: *Cephenemyia jellisoni* (nose bot) and a tick (sp.) The available data are not adequate for drawing any firm conclusions regarding the correlation of parasitism with other factors involved in the welfare of Southeastern deer. However, the data on hand suggest that parasites are quantitatively and qualitatively more common in young, male animals.

OBJECTIVES:

To determine the interaction of parasitism with other biological forces and the effect thereof on deer.

TECHNIQUES:

In order that information obtained during the course of this project be of maximum value, the collecting is being done in three specific areas (Coronation Island, Woronkofski Island and the mainland between Horn Cliffs and the Wilkes Range) on the first two of which deer nutrition studies are under way. A few animals which were collected in areas other than those cited above have been available for examination. Records of these have been included in Tables 1, 2 and 3 along with those of the animals in the study areas. During late July and part of August 1960, a temporary field camp was established on Coronation Island and through the co-operation of other P-R biologists an adequate sample of deer was obtained. A limited amount of collecting was accomplished on the mainland area, but because of other field work commitments it was not possible to spend any time on Woronkofski Island during the past season. Work in these two areas is expected to be completed this summer.

The collecting and laboratory analysis of specimens involved routine parasitological procedures. The qualitative and quantitative aspects of the observed parasitisms will ultimately be evaluated when all of the data have been collected along with the following variables:

1) Age, sex, size, fecundity and apparent physical condition of the host species.

2) Range condition of study areas.

3) Population density of the host species on the study areas.

4) Predation.

5) Presence of other species of big-game herbivores (summer range of goats and deer overlap on the mainland).

FINDINGS:

The data are summarized in Tables 1 and 2 and tabulated in detail in Table 3. Because adequate numbers of samples are not available at this time, it is not possible to form any conclusions of more than a very tentative nature. Accordingly, the data have been analyzed only for variations of

Table 1. Geographical variation of parasitism.

PARASITE SPECIES	NUMBER INFECTED/NUMBER EXAMINED					
	Horn Cliffs, Mainland	Douglas Island	Kupreanof Is.	Kuiu Island	Coronation Is.	Total Incidence
CESTODA:						
Moniezia benedeni	1/4	0/1	0/1	0/1	0/17	1/24
Taenia hydatigena (larvae)	3/4	0/1	1/1	0/1	1/17	5/24
NEMATODA:						
Dictyocaulus viviparus	0/4	*1/1	0/1	0/1	2/17	3/24
Oesophagostomum venulosum	1/4	0/1	0/1	1/1	6/17	8/24
Setaria cervi (sp.?)	1/4	0/1	0/1	0/1	0/17	1/24
ARTHROPODA:						
Cephenemyia jellisoni **	0/4	1/1	0/1	0/1	0/17	1/24
Tick (*Dermacentor* sp.)	0/4	0/1	0/1	0/1	1/17	1/24

* Apparent cause of death verminous pneumonia.

** The incidence values for this species are not comparable to those given for the other species. See text for explanation.

Table 2. Variation of parasitism with sex and age (all areas).

Age	Sex	Number Examined	Incidence (%)	Coefficient of Parasitism*	Relative Parasitism**
Under 1 year	M	1	100	4.0	4.0
	F	-	-	-	-
1 - 2 years	M	5	100	1.2	1.2
	F	3	0	-	-
2 - 3 years	M	2	100	1.0	1.0
	F	-	-	-	-
3 - 4 years	M	1	100	1.0	1.0
	F	3	0	-	-
4 - 5 years	M	1	100	1.0	1.0
	F	2	0	-	-
Over 5 years	M	1	100	1.0	1.0
	F	4	100	1.0	1.0
All age Classes	M	11	100	1.36	1.36
	F	12***	33	1.00	0.33

* The coefficient of parasitism is simply the average qualitative parasitism of infected animals and is calculated by dividing the number of occurrences of all species of parasites by the number of parasitized animals. See the text for further discussion of this concept.

**The relative parasitism is directly proportional to the absolute or specific parasitism of a population, age class, etc., and is calculated by multiplying the coefficient of parasitism by the decimal equivalent of the incidence. See the text for further discussion of these concepts.

***Data from one of the animals included in Table 1 is not included above because the age is not known.

Table 3. Summary of autopsy records.

Autopsy Record (#)	Sex	Age: Years	Age: Months	Locality	Date	Parasite Species
9	M	-	10	Horn Cliffs, Mainland	Feb.1960	*Moniezia benedeni* *Oesophagostomum venulosum* *Setaria cervi* (sp.?) *Taenia hydatigena*
10	F	3	6	" "	" "	None
155	M	2	6	" "	Nov.1960	*T. hydatigena*
156	M	1	6	" "	" "	*T. hydatigena*
98	M	9-10		Coronation Is.	Aug.1960	Tick
99	M	1	2	"	" "	*Dictyocaulus viviparus*
100	F	3	2	"	" "	None
101	F	3	2	"	" "	None
103	F	7-8		"	" "	*O. venulosum*
104	F	1	2	"	" "	None
105	M	3	2	"	" "	*O. venulosum*
107	M	4	2	"	" "	*O. venulosum*
108	F	1	2	"	" "	None
109	M	2	2	"	" "	*O. venulosum*

Table 3. Summary of autopsy records (cont.).

Autopsy Record (#)	Sex	Age Years	Age Months	Locality	Date	Parasite Species
110	F	5-6		Coronation Is.	Aug.1960	_T_. _hydatigena_
111	F	4	2	"	" "	None
122	F	4	2	"	" "	None
123	F	6-7		"	" "	_O_. _venulosum_
129	M	1	2	"	" "	_D_. _viviparus_
130	F	6-7		"	" "	_O_. _venulosum_
131	F	1	2	"	" "	None
153	M	1	5	Kupreanof Is.	Oct.1960	_T_. _hydatigena_
154	F	?		Kuiu Island	Oct.1960	_O_. _venulosum_
500	M	1	11	Douglas Is.	April 1960	_D_. _viviparus_* _Cephenemyia jellisoni_

* Natural mortality, apparent cause verminous pneumonia.

parasitism with geographical distribution (Table 1) and with sex and age (Table 2). These are briefly discussed below.

A. Geographical variation of parasitism.

Keeping in mind the inadequacy of the data, the following tentative conclusions may be drawn from Table 1.

1) *Moniezia benedeni* may be restricted to or is much more common in mainland than in insular animals. If this be the case, one possible explanation may involve the presence of an alternate host (mountain goat) in the area which may serve as a better host of the parasite and as a more stable source of infection.

2) The presence of larval *Taenia hydatigena* in three of four mainland deer suggests that there may be more wolves per unit of useable deer range on the mainland than in other areas.

3) *Dictyocaulus viviparus* and *Oesophagostomum venulosum* probably have wide, general distribution in southeastern game ranges. The latter species is likely the most common parasite of deer in this area.

4) *Cephenemyia jellisoni* (nose bot) is likely more common than the data indicate. This parasite is relatively difficult to detect except during late spring (April and May) during which period only one deer has been available for examination. The nose bot is known (various personal communications) to occur widely in Southeastern Alaska.

5) Ticks are apparently unknown on big-game animals in Alaska. One specimen, possibly a species of *Dermacentor*, was found on a deer collected on Coronation Island. Unfortunately, the specimen was lost during the field operations.

B. Variation of parasitism with sex and age.

The pertinent data are summarized in Table 2. One can only tentatively conclude that parasitism is more common in males than females (incidence and relative parasitism values, all age classes) and probably is qualitatively more diverse in young animals (coefficient of parasitism values). The "all or none" incidence values are undoubtedly a "coincidence born of inadequate data."

The value of the coefficient of parasitism is that one can quantitatively compare the qualitative diversity of parasite faunas. The concept of relative parasitism numerically recognizes the extent of occurrence of a complex (more than one species) parasite fauna in a host population. A general intensity factor, which takes into account the numerical occurrence of individual species and their relative "pathogenicity", may be used to calculate the specific parasitism of a host population. The assignment of values for relative "pathogenicity" will involve a certain degree of subjectivity and may require revision as additional information is taken into account. However, since we are primarily concerned with the quantitative comparison of different populations of the same host species and not with predicting the critical level of parasitism in individual animals, subjective error will, to a certain extent, cancel out. These concepts will be further developed in a future report. Unfortunately, the data available for this report are not extensive enough to adequately illustrate the comparative value of this method.

RECOMMENDATIONS:

Until adequate data are available, Job No. M-2 should be continued.

SUBMITTED BY:

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ANNUAL REPORT OF PROGRESS
INVESTIGATIONS PROJECT
COMPLETION OF 1960-1961 SEGMENT

State: Alaska

Project No: W-6-R-2 Name: Alaska Wildlife Investigations

Work Plan: M Disease and Parasite Investigations

Job No: 3 Title: The Parasites and Diseases of the Barren-Ground Caribou

PERIOD COVERED: September 1960 to April 1961

ABSTRACT:

During mid-April 1961, 20 caribou (15 females and 5 males) were collected from the Nelchina herd in the vicinity of Old Man Lake near Lake Louise. Data on the incidence of warbles, nose bots, *Taenia hydatigena* and *Echinococcus granulosus* were obtained. Of the 20 animals collected, 18 were in good or excellent condition and 2 were in only fair condition. One of the latter was a 7-9 year old, barren female which was only moderately parasitized. The other animal was a yearling male which harbored relatively heavy infestations of warbles (350) and nose bots (109). Considerably more data are needed in order to draw any firm conclusions regarding the correlation of parasitism with age, sex, fecundity and condition of the caribou.

OBJECTIVES:

To evaluate the influence of disease and parasitism on the welfare of the barren-ground caribou.

TECHNIQUES:

Complete data on size, condition and fecundity were taken on all animals. Those collected during April 1961, were carefully examined for evidence of disease and all parasites exclusive of those that occur in the alimentary tract. Because of the conditions under which the work was done, it was not practical to attempt to recover parasites of the digestive tract. Blood samples were taken for examination for brucellosis by the staff of the Arctic Health Research Center.

The procedures employed for the examination of the carcasses are routine parasitological methods.

All of the field work was carried out in cooperation with Ronald O. Skoog, the P-R Biologist assigned to the Nelchina caribou project.

Originally it was intended that the study be carried out on the Arctic herd. However, personnel changes and other developments necessitated focusing efforts on the Nelchina herd. An attempt to collect during September 1960, was unsuccessful because the herd had moved out of the area available from the highway system.

RESULTS:

All of the data on parasites and age, sex, fecundity and apparent condition are given in detail in Table 1. The relationship between parasitism and age, sex and fecundity is summarized in Table 2. There does not appear to be any appreciable difference between the sexes or age classes in incidence of parasitism. One of 15 females was not pregnant. This animal was one of the two which was judged to be in only fair condition; however, the specific parasitism involved was moderate (see Table 1). The other animal, a yearling male, was infested by a very large number of warbles (350) and nose bots (109). Additional data may reveal a correlation between the incidence of these parasites and the general condition of caribou. Unfortunately, we were unable to get to the area in which the main herd was located and were therefore unable to collect a sufficiently large, representative sample of different age classes and

Table 1. Parasite incidence and characteristics of caribou collected in vicinity of Old Man Lake near Lake Louise, April 18, 1961 to April 20, 1961.

Autopsy No.	Sex	Age Class	Pregnant	Warbles	Nose Bots	Liver Taenia	Lung Echinococcus	Condition
505	♀	4-6	Yes	20	42	7	1	Excellent
506	♀	4-6	Yes	62	36	0	0	Excellent
507	♀	7-9	No	146	25	3	0	Fair
508	♀	7-9	Yes	82	45	1	0	Excellent
509	♀	3	Yes	72	88	2	0	Excellent
510	♀	7-9	Yes	42	51	0	0	Excellent
511	♂	1	-	86	22	0	0	Good
512	♂	1	-	350	109	0	0	Fair
513	♀	4-6	Yes	120	-	1	0	Excellent
514	♂	1	-	154	31	0	0	Good
515	♂	2	-	38	4	0	0	Good
516	♂	3	-	90	60	0	0	Good
517	♀	7-9	Yes	88	28	0	0	Excellent
518	♀	7-9	Yes	131	63	0	0	Excellent
519	♀	10+	Yes	61	127	0	0	Good
520	♀	7-9	Yes	38	28	1	0	Excellent
521	♀	7-9	Yes	26	4	1	0	Excellent
522	♀	4-6	Yes	35	26	0	0	Excellent
523	♀	4-6	Yes	18	8	1	0	Excellent
524	♀	10+	Yes	98	79	0	0	Excellent

Table 2. Variation of parasitism with age, sex and fecundity.

Age (Years)	Sex & No. Examined	% Pregnant	PARASITE NUMBERS* Warbles Range (av.)	Warbles Incidence	Nose Bots Range (av.)	Nose Bots Incidence	T. hydatigena Range (av.)	T. hydatigena Incidence
Less than 4	M-5	-	38-350(144)	100	4-109(55)	100	-	0.0
	F-1	100	72		88		2	
4 - 6	M-0	-	-	-	-	-	-	-
	F-5	100	18-120(51)	100	0-42(22)	80	0-7(2)	60
7 - 9	M-0	-	-	-	-	-	-	-
	F-7	87	26-146(79)	100	4-63(35)	100	0-3(1)	58
10+	M-0	-	-	-	-	-	-	-
	F-2	100	61-98	100	79-127	100	-	0.0
All Ages	M-5	-	38-350(144)	100	4-109(55)	100	-	-
	F-15	93	18-146(69)	100	0-127(43)	93	0-7(1.2)	47

* The larval stage of Echinococcus granulosus was found only once.

A 4-6 year old, pregnant animal carried a single hydatid cyst in her lungs.

sexes. The results of the blood analysis are not yet available for consideration.

RECOMMENDATIONS:

It is recommended that Job No. M-3 be continued until adequate data are available for all of the major caribou herds.

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