

**PARASITES AND DISEASES OF THE FISHER
(*MARTES PENNANTI*)
BACKGROUND RESEARCH FOR THE INTRODUCTION
OF THE SPECIES**

by

James S. Clowater
Co-op Student
University of Victoria
Victoria, British Columbia

for

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1. INTRODUCTION

Porcupine feeding damage to timber stocks has been recognized as a problem to the forest industry since the early 1900's (Curtis, 1941). As forests become more intensively managed, conditions are created that promote the expansion of porcupine populations. Such management techniques as clearcutting, single species and even-age cultivation, fertilization and thinning promote conditions that are favourable to the success of the porcupine (Sullivan and Chung, 1981; Dodge, 1982). By removing old growth timber, forestry interests are also destroying the preferred habitat of the fisher (*Martes pennanti*) which is one of the few predators of the porcupine (Racey and Hessey, 1989; Douglas and Strickland, 1987; Powell, 1982; Allen, 1983).

Since the 1970's, there has been an increasing problem of porcupine damage to merchantable timber in British Columbia, especially in the North Coast and Kalum Forest Districts of the Prince Rupert Forest Region (Sullivan, 1988). Forest managers have considered the conventional methods of porcupine population control consisting of: trapping, hunting, predation, and the use of poison baits (Hooven, 1971; Dodge, 1959; 1982; Sullivan, 1986; 1988; 1989). Of these recognized methods, predation of porcupines by the fisher (*Martes pennanti*) appears to be the most promising. Methods such as hunting and trapping have not proven to have a long term effect (Cook and Hamilton, 1957). Hunting is nonsystematic because of the large areas inaccessible to the hunter and the long periods of time when weather discourages the search for porcupines (Krefting, 1962). Trapping, as well as impacting other species, is difficult because the porcupine lacks a predictable daily behaviour pattern and does not respond to traditional baits (Hooven, 1971). The use of poison baits such as strychnine and sodium arsenite, although once considered successful (Hooven, 1971; Dodge, 1959), are now unacceptable because of the extreme hazard to other wild and domestic species. They may also cause danger to the public and the crews that handle them (Sullivan, 1988; Henigman, 1990).

The problem of damage to timber stocks may also be approached by researching porcupine biology and behaviour, then manipulating silviculture techniques to minimize or restrict attractive porcupine habitat (Sullivan, 1988; Eglitis and Hennon, 1986). This approach has disadvantages in that it requires intensive forest management and expense. The use of natural predation by restocking a native carnivore species has the advantage of relatively lower expense and, if successful, providing a long term inexpensive solution. Forestry management practices will still have to adjust to insure that adequate fisher habitat is maintained (Ministry of Environment, 1990; Racey and Hessey, 1989; Banci, 1989).

2. DISCUSSION

2.1 Fisher Introductions

The introduction of the fisher to locations in North America is summarized in Table 1. There is some indication that there may be other attempts at introducing the fisher that are not sufficiently documented, such as an unsuccessful attempt occurring in Maine (Distefano, 1987), and another program said to have taken place in Alberta (Jackson, 1990). In most instances the justification for these projects was threefold: to reintroduce a native species to former range; to restock the fisher as a valuable furbearing resource; and to introduce the fisher as a control to increasing porcupine populations. The available published records of these projects are lacking in detailed description of the processes and considerations of the managers involved. All but one of these projects were considered successful at re-establishing the fisher. In that incidence, four years after the release of eight fishers in the Khutzeymateen Inlet region of British Columbia, there was evidence of increased porcupine damage (Jackson, 1990; Sullivan and Cheng, 1989; Sullivan, 1988).

Once the decision is made to initiate a restocking program, much research is required to ensure the success of the project. Modern forestry and wildlife managers recognize the need to consider the many complex interrelationships that bind the forest community together.

The following is a list of guidelines that have been expressed by wildlife managers concerning wildlife introductions:

- The habitat must be suitable to the biology and behaviour of the species to be introduced (Robinson and Boyle, 1984).
- It must be determined whether there is an existing native population of the subject species in the target area. If there is, then it is often better to attempt to promote the expansion of native populations than to introduce new stock.
- The genetic integrity of subspecies should be considered and maintained. Care should be taken in evaluating the genetic diversity of the introduced stock, and the consequences of interbreeding with native populations should be considered (Robinson and Boyle, 1984; Cowan, 1966).
- Introducing a species into range not previously occupied by the species usually involves extensive disturbance to existing native predator and prey species and may precipitate the exclusion of a previously established species. For example, the introduction of the black-tailed deer in the Queen Charlotte Islands contributed directly to the extirpation of the indigenous caribou of that region (Cowan, 1966).

- Diseases and parasites known to infect the introduced species must be researched to predict the potential impact they may have on the target community (Cowan, 1966; Robinson and Boyle, 1984). This information will also facilitate the organization of veterinary examinations and quarantine procedures.

2.2 Parasites and Diseases of the Fisher

Although a certain amount of disease is normal in wild populations, wildlife managers are compelled to monitor their levels for three important reasons:

- Wild animals may serve as reservoirs for disease that may eventually effect domestic stock or humans.
- As the quality and quantity of good wildlife habitat decreases, wildlife populations become more concentrated causing stress and predisposition to epizootic eruptions of disease.
- Disease must be considered as part of a holistic approach to management of wildlife species. The diseases of wildlife are as much a part of the biology of the species as nutritional requirements, reproductive behaviour, population cycles, and habitat requirements (Robinson and Bolen, 1984).

A list of the parasites and diseases known to infect fishers is given in Table II. In addition to this, an expansion of this list, supplying further information on the individual parasites and diseases is given in Appendix A. The majority of the species listed are endoparasitic worms (helminths), and although there are 22 species represented, the infection of fishers by these parasites is considered to be light (Coulter, 1966; Douglas and Strickland, 1987; Addison et al, 1987). Unless the animal is very young and heavily infested, or under other physiological stress, the disease will usually remain asymptomatic (Levine, 1968).

A host is typically infected by ingesting the viable larvae or eggs of the helminth parasite. These may be consumed directly from the environment, or as in the case of an omnivore or carnivore, the host may ingest viable larvae present in cysts within an intermediate host. After completing a life cycle within the host, the eggs or larvae are transmitted into the environment in the feces or urine. One exception to this theme is the hookworm *Uncinaria stenocephala* in which the female worm migrates to the outer tissue layers creating an ulcer in the surface of the skin. At this point, the female waits for the host to enter water, then she sheds her eggs. An animal infected with helminth parasites is continually shedding eggs and larvae into the environment where they may infect other intermediate and definitive hosts. (Levine, 1968; Olsen, 1973; Dunn, 1978)

There are three protozoan parasites that have been documented to infect fishers. The effects on the wildlife hosts vary from mild to severe, depending on the species involved and the intensity of infection. The genera *Toxoplasma*, *Isopora*, and *Sarcocystis* are all known to infect humans. (Olsen, 1973; Cox, 1982). Although human infection with these protozoans is generally mild and self-limiting, the effects of *Toxoplasma gondii* on a developing foetus or an immune suppressed person is devastating (Chandler, 1955; Olsen, 1973). Cysts can occur in the eyes, heart, and central nervous system; and prenatal infection can cause blindness, mental retardation, hydrocephalus, still birth, and abortion (Olsen, 1973).

Of the helminth parasites of fishers, six are known to infect humans. The cases are usually very rare and the circumstances of infection such that they can be considered of little risk to humans (Addison, et al, 1987).

Among the diseases known to infect fishers, two are viral, aleutian disease, and canine distemper; and one is caused by a bacterium, leptospirosis. The pathogenicity of these diseases in wild populations is considered to be slight, except for canine distemper which may cause as much as 50% mortality in susceptible species (Addison et al, 1987). In addition to these diseases known to infect fishers, there are two more that must be mentioned because of their ability to infect this species if exposed.

The first of these diseases is tularemia which is an acute plague-like disease that effects primarily lagomorphs and rodents, but has a host list that includes many other animals (Bell and Reilly, 1981). The disease is caused by the bacterium *Francisella tularensis*. There are two types of the disease caused by two subspecies of *F. tularensis*; these are Type A caused by *F. tularensis* and Type B caused by *F. tularensis palearctica* (Addison, et al, 1987).

Type A is a disease of dry habitats, and is spread by biting arthropods such as ticks, tabanids, and biting flies and fleas. This disease is maintained in wild ground squirrels and lagomorphs. Type B is a disease of wetland habitats, and is primarily spread in water. The primary targets of this disease are voles, muskrats, beavers, and snowshoe hares. Type A tularemia is generally more virulent than type B and has the potential to cause serious and occasionally fatal disease in humans. (Addison, et al, 1987).

Since tularemia has the potential to infect both Mustelid species and prey species and has a geographic distribution which includes the range of the fisher in North America (Bell and Reilly, 1981), it should also be considered by management interests.

The second disease merits inclusion in the list of diseases of fishers because it is infectious and fatal to almost all mammals including humans. This disease is rabies, caused by a *Rhabdovirus* which attacks the brain and spinal chord. Any warm-blooded animal may carry and transmit the disease until it succumbs to the virus, but the only true reservoirs of rabies are many species of insectivorous bats which do not themselves become victims of the disease. (Robinson, and Bolen, 1984).

It is evident while examining the biology of the various disease organisms that as an inherent part of their strategy for survival they have evolved many mechanisms that function to disperse and proliferate their species. A common theme for the survival of parasitic organisms with complex life cycles is to produce vast quantities of offspring and to disperse them widely in the environment. The inadvertent introduction of disease organisms into a new range within even only a few host animals can quickly lead to contamination of the terrestrial and aquatic environments (Cowan, 1966).

3. CONCLUSIONS

"Both in introduction and reintroductions too little attention has been paid to the possibility of transporting disease organisms with the host (Cowan, 1966)." One prime example of this was the movement of the plains bison of Wainright, Alberta, to the last remaining habitat of the wood bison. The transplant introduced tuberculosis into the new range and had a devastating effect on the native species (Cowan, 1966).

While, in general, the research indicates that fisher populations are relatively unaffected by infections of most parasite and disease organisms, consultation must be made with parasitologists and pathologists to establish the effects of these organisms on other resident species and to determine appropriate quarantine and screening procedures.

It is now recognized by modern wildlife and forest managers that they can no longer deal with complex ecosystem management problems with the simple mechanistic approach that historically has been applied (Dufus, 1990). As part of a thorough approach initiated by B.C. Forest Service, this paper provides the background material necessary to evaluate problems associated with the diseases and parasites known to infect fishers. With the necessary consideration given to preliminary research and planning, the prospects will be good for the successful reintroduction of fishers into target ranges in British Columbia.

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TABLE 1: SUMMARY OF FISHER INTRODUCTIONS

YEAR	TO	SOURCE (n)	REFERENCE
1947 - 1948	Nova Scotia	Ranch (12)	Powell, 1982; Banci, 1989; Dodds and Martell, 1971; Irvine, et. al., 1965; Benson, 1959.
1957-1963	Ontario	Ontario (97)	Douglas and Strickland, 1987; Banci, 1989
1956-1963	Wisconsin	New York (18)	Powell, 1982; Irvine, et. al., 1964.
1956-1963	Wisconsin	Minnesota (42)	Powell, 1982; Irvine, et. al., 1964.
1959-1960	Montana	British Columbia (36)	Powell, 1982; Banci, 1989; Weckworth, and Wright, 1968; Morse, 1961.
1959-1967	Vermont	Maine (124)	Powell, 1982; Wharton, 1983.
1961	Oregon	British Columbia (24)	Powell, 1982; Morse, 1961.
1961-1963	Michigan	Minnesota (61)	Powell, 1982; Brander and Brooks, 1973; Irvine et. al., 1964.
1962-1963	Idaho	British Columbia (39)	Powell, 1982; Morse, 1961.
1963-1968	Nova Scotia	Maine (80)	Powell, 1982; Banci, 1989; Dodds and Martell, 1971
1966-1967	Wisconsin	Minnesota (60)	Powell, 1982.
1966-1968	New Brunswick	New Brunswick (25)	Dilworth, 1975; Banci, 1989.
1969	West Virginia	New Hampshire (23)	Powell, 1982; Banci, 1989; Pack and Cromer, 1981; Cottrell, 1978.
1976	New York	New York (40)	Powell, 1982; Hamilton & Cook, 1955.
1979-1982	Ontario	Ontario (57)	Douglas and Strickland, 1987.
1985	British Columbia	British Columbia (8)	W. Jackson, 1990.

TABLE II: PARASITES OF THE FISHER

ORGANISM	INCIDENCE (%)	SOURCE
NEMATODES:		
<i>Arthrodephalus lotoris</i>	1	Hamilton & Cook 1955
<i>Baylisascaris devosi</i>	5	de Vos 1955
	32	Dick and Leonard 1979
<i>Ascaris mustelarum</i>	25	Meyer and Chitwood 1951
	25	Coulter 1966
<i>Cipillaria</i> spp.	5	Coulter 1966
<i>Capillaria mustelorum</i>	35	Hamilton and Cook 1955
<i>Capillaria plica</i>	-	Butterworth and
<i>Capillaria putorii</i>	-	Beverly-Burton 1980/81
<i>Crenosoma</i> spp.	3	Coulter 1966
	3	Meyer and Chitwood 1951
<i>Crenosoma petrowi</i>	15	Craig and Borecky 1976
<i>Diectophyma renale</i>	-	Coulter 1966
		Douglas and Strickland
<i>Dracunculus</i> spp.	-	Coulter 1966
<i>Dracunculus insignis</i>	13	Hamilton and Cook 1955
		Fyvie and Addison 1979
		Douglas and Strickland
		Crichton and Beverly-Burton
<i>Molineus patens</i>	5	Hamilton and Cook 1955
	1	Dick and Leonard 1979
<i>Physaloptera</i> spp.	5	de Vos 1952
	6	Dick and Leonard 1979
<i>Physaloptera maxillaris</i>	11	Hamilton and Cook 1955
<i>Skrjabingylus</i> spp.	-	Addison, et al. 1988
<i>Sobolevingylus</i> spp.	2	Craig and Borecky 1976
<i>Soboliphyme baturini</i>	-	Morgan 1943
		Erickson 1946
<i>Trichinella spiralis</i>	5	Dick et al. 1986
	6	Strickland et al. 1982
		Worley et al. 1974
		Dick and Leonard 1979
<i>Trilobostongylus biocrai</i>	21	Craig and Borecky 1976
		Anderson 1963
<i>Uncinaria stenocephala</i>	2	Hamilton and Cook 1955
		Chitwood 1932

TABLE II (cont'd): PARASITES OF THE FISHER

ORGANISM	INCIDENCE (%)	SOURCE
CESTODES:		
Mesocestoides variabilis	24	Coulter 1966
	5	deVos 1952
	6	Hamilton and Cook 1955
	50	Meyer and Chitwood 1951
Taenia spp.	9	Coulter 1966
	15	Dick and Leonard 1979
Taenia sibirica	-	Dick and Leonard 1979
TREMATODES		
Alaria spp.	6	Coulter 1966
Alaria mustelae	1	Dick and Leonard 1979
Alaria canis	-	Pearson 1956
Metorchis conjunctus	1	Dick and Leonard 1979
PROTOZOA		
Isopara spp.	-	deVos 1951
Sarcocystis sp.	-	Dubey 1982
Toxoplasma gondii	-	Tizard et al. 1976
ECTOPARASITES		
Ixodes cookei	-	deVos 1952
Ixodes texanus	-	Darsie and Anastos 1957
Oropsylla arctomys	-	Holland 1950
Sarcoptes scabiei	-	O'Meara et al. 1960
		Coulter 1966
DISEASE		
Aleutian disease	3	Douglas and Strickland 1987
		Strickland et al. 1982
		Addison et al. 1987
leptospirosis	6	Douglas and Strickland 1987
		Strickland et al. 1982
toxoplasmosis	41	Douglas and Strickland 1987
		Strickland et al. 1982
		Tizard et al. 1976
canine distemper	-	Monson and Stone 1976
		Addison et al. 1987
		Budd 1981

APPENDIX A: Summary of parasites and diseases of fishers

The following account expands on the list of parasites and diseases of fishers as listed in Table II. This is not a definitive record of the diseases listed, but is intended to give a brief introduction and summary of each of the diseases known to infect fishers, and to serve as a resource for further research.

The information listed is based on the references as quoted, but often details concerning geographic locations and affected species that do not occur in North America are often omitted. Entries which are preceded by *** are those which have not been documented to occur in the fisher (*Martes pennanti*).

NEMATODES

1. Genus: *Arthrocephalus*
Species: *A. lotoris*
Other names: hookworm

Geographic Distribution: North America

Primary host: *Ursus americanus* (black bear)
Martes pennanti (fisher)

Site: Stomach and intestine

Method of infection: Directly through skin, or by ingestion of larvae

Method of transmission: Eggs passed in feces

Impact on host: Mechanical damage to intestine due to minute lacerations

References:

Hamilton, W.J. Jr., and A.H. Cook, 1955
Crum, J.M., *et al.*, 1978
Cole, R.A., and W.L. Shoop, 1987

2. Genus: *Baylisascaris*
Species: *B. devosi*

Geographic distribution: Worldwide

Primary host: *Martes pennanti* (fisher)
Martes americana (marten)
Mustela vison (mink)
Mestela erminea (shorttail weasel)
Gulo gulo (wolverine)

Site: Lungs and somatic tissues

Intermediate hosts: Rodents and Insectivora

Method of infection: Ingestion of eggs

Method of transmission: eggs passed in feces

Impact on host: Damage to intestine, lymph nodes, capillaries, and lungs
as a result of migration of larvae

Comments: "...may eventually be discovered in human tissues
(Sprent, 1965)."

"Recently the first human cases of probable
Baylisascaris ocular larvae migrans were uncovered;
one person had had contact with pet raccoons (Kazacos,
1982)."

References:

- Addison, E.M., *et al.*, 1987
deVos, 1952
Dick, T.A., and R.D. Leonard, 1979
Kazacos, K.R., 1982
Levine, N.D., 1968
Olsen, O.W., 1973
Sprent, J.F.A., 1952, 1954, (1965), 1968

3. Genus: *Ascaris*
Species: *mustelarum*
Other names: *A. martes* Gmelin 1790
- Geographic distribution: Worldwide
- Primary host: *Martes pennanti* (fisher)
- Site: Small intestine
- Intermediate hosts: Possibly invertebrates
- Method of infection: Ingestion of eggs
- Method of transmission: Eggs passed in feces
- Impact on host: Not highly pathogenic, but tissue damage can occur from larval migration

References:

Meyer, M.C., and B.G. Chitwood, 1951
Coulter, M.W., 1966
Sprent, J.F.A., 1952
Dunn, A.M., 1978

4. Genus: *Capillaria*
Species: *C. plica*
- Other names: *Trichosoma plica* Rudolphi, 1819
Trichosoma canis vulpes Rayer, 1843
Calodium plica Dujardin, 1845
Trichosomum (Calodium) plica Diesing, 1851
- Geographic distribution: North America, Europe, USSR
- Primary host: *Canis familiaris* (dog)
Felis domestica (cat)
Vulpes fulva (red fox)
Procyon lotor (raccoon)
Mephitis mephitis (striped skunk)
Martes americana (marten)
Martes pennanti (fisher)
Canis lupus (timber wolf)
Canis latrans (coyote)
Taxidea taxus (badger)

Site: Urinary bladder, sometimes kidney pelvis

Intermediate hosts: Earthworms

Method of infection: Ingestion of viable larvae in intermediate host
or direct ingestion of larvae

Method of transmission: Eggs passed in urine

Impact on host: "...only slightly, if at all, pathogenic in dogs... in
young foxes, may retard growth... may predispose to
bacterial infection (Levine, 1968)."

References:

Butterworth, E.W., and M. Beverly-Burton, 1980; 1981
Levine, N.D., 1968
Olsen, O.W., 1973

5. Genus: *Capillaria*
Species: *C. putorii*

Other names: *Trichosoma putorii* Rudolphi, 1819
Trichosoma erinacei Rudolphi, 1819
Trichosomum entomelas Dujardin, 1845
Calodium alatum Molin, 1858
Capillaria mustelorum Cameron & Parnell, 1933
Aonchotheca putorii (Rudolphi, 1819)
Lopez-Neyra, 1947
Capillaria mustelae

Geographic distribution: Europe, USSR, North America (Ontario)

Primary host: *Mustela putorius* (ferret)
Martes pennanti (fisher)
Mustela vison (mink)
Mustela novaboracensis (weasel)
Ursus americanus (black bear)

Site: Small intestine and stomach

Intermediate hosts: Earthworm

Method of infection: Ingestion of larvated eggs, or ingestion of
intermediate host

Method of transmission: Eggs passed in feces

Impact on host: "May cause a hemorrhagic enteritis, particularly in mink. (Levine, N.D., 1968)."

Comments: Not known to infect humans

References:

Hamilton, W.J. Jr., and A.H. Cook, 1955
Levine, N.D., 1968
Butterworth, E.W., and M. Beverley-Burton, 1980, 1981
Crum, J.M., *et al.*, 1978

6. Genus: *Crenosoma*
Species: *C. petrowi*
- Other names: *C. schulzi* (Craig and Anderson, 1972)
- Geographic distribution: Worldwide
- Primary host: *Martes pennanti* (fisher)
Mustela vison (mink)
Mephitis mephitis (striped skunk)
Experimentally in *Vulpes fulva* (red fox)
Procyon lotor (raccoon)
Canis lupus (timber wolf)
Taxidea taxus (badger)
Gulo gulo (wolverine)
- Site: Bronchi and bronchioles
- Intermediate hosts: Terrestrial molluscs
- Paratenic host: Garter snake, frogs, toads, lizards
- Method of infection: Ingestion of viable larvae
- Method of transmission: Larvae passed in feces
- Impact on host: May cause bronchitis and bronchiolitis, also secondary bacterial infections

References:

Anderson, R.C., 1971
Cheatum, E.L., 1949
Coulter, M.W., 1966
Craig, R.E., and R.C. Anderson, 1972
Craig, R.E., and R.A. Borecky, 1976
Levine, N.D., 1968
Meyer, M.C., and B.G. Chitwood, 1951

7. Genus: *Diectophyma*
Species: *D. renale*

Other names: Giant kidney worm

Geographic distribution: Temperate and subarctic areas. Collected in Manitoba, Ontario, Quebec, and N.W.T. Dick (1979) notes an absence of kidneyworms from fishers in Manitoba, possibly because of a lower consumption of fish.

Primary host: *Mustela vison* (mink)
Also occurs in *Canis latrans* (coyote)
Canis lupus (timber wolf)
canis familiaris (dog)
Felis domestica (cat)
Vulpes fulva (red fox)
Procyon lotor (raccoon)
Mustela novaboracensis (weasel)
Lutra canadensis (otter)
Martes americana (marten)
Martes pennanti (fisher), and various
other carnivores
Humans also occasionally affected

Site: Kidney parenchyma, abdominal cavity

Intermediate hosts: Branchiobdellid annelids, crayfish, frogs, bullheads
or other fish

Method of infection: Ingestion of intermediate host or direct ingestion
of larvae in water

Method of transmission: Eggs passed in urine, and may remain viable for at
least 5 years

Impact on host: Complete destruction of infected kidney. Usually infects only one kidney, and may remain asymptomatic.

Comments: "...most important and highly endemic area is Canada... (Dunn, 1978)".

"There is no risk to humans.
Addison, E.M., et al., 1987)".

References:

Addison, E.M., *et al.*, 1987
Coulter, M.W., 1966
Dick, T.A., and R.D. Leonard, 1979
Douglas, C.W., and M.A. Strickland, 1987
Dunn, A.M., 1978
Fyvie, A., 1971
Levine, N.D., 1968
Olsen, O.W., 1973

8. Genus: *Dracunculus*
Species: *D. insignis*
Other names: Guinea worm

Geographic distribution: Africa, Middle East, Indo-Pakistan, and eastern Asia, United States, Canada (Ontario). Eradicated from Asiatic Russia (Dunn, 1978).

Primary host: *Procyon lotor* (raccoon) may serve as reservoir
Canis familiaris (dog)
Martes pennanti (fisher)
Vulpes fulva (red fox)
Mustela vison (mink)
Ondatra zibethica (muskrat)
Mephitis mephitis (striped skunk)
Mustela erminea (shorttail weasel)
Taxidea taxus (badger)
Didelphis marsupialis (opposum)
Lutra canadensis (otter).

Site: Gut, subcutaneous and intramuscular connective tissue especially legs

Intermediate hosts: Copepods (*Cyclops* spp.), frogs

Method of infection: Ingestion of intermediate host

Method of transmission: Larvae are released from an ulcer in the skin into water

Impact on host: May incite local swelling in the legs

Comments: "The Guinea worms of North American furbearers pose no threat to humans or domestic animals" (Addison, E.M., *et al.*, 1987).

References:

Addison, E.M., *et al.*, 1987
 Coulter, M.W., 1966
 Crichton, V.F.J., and M. Beverly-Burton, 1974
 Douglas, C.W., and M.A. Strickland, 1987
 Dunn, A.M., 1978
 Fyvie, A., and E.M. Addison, 1979
 Hamilton, W.J. Jr., and A.H. Cook, 1955
 Levine, N.D., 1968
 Olsen, O.W., 1973

9. Genus: *Molineus*
 Species: *M. patens*

Other names: *M. americanus* Sprehn, 1932
M. eurpaeus Zunker, 1929
M. sibericus (Dujardin, 1845)

Geographics distribution: Asia, Europe, USA, USSR

Primary host: *Mustela frenata* (longtail weasel)
M. erminea (ermine)
M. rixosa (dwarf weasel)
M. nivalis (least weasel)
Mustela vison (mink)
Putorius putorius, *Taxidea taxus* (badger)
Vormela samatica, *Martes pennanti* (fisher)
M. foinea (stone marten)
M. zibellina (sable)
Gulo gulo (wolverine)
Gulo luscus, *Lutreola lutreola*, *Mephitis mephitis* (striped skunk)
Ursus arctos (brown bear)
Vulpes fulva (red fox)

Site: Intestine

Method of infection: Ingestion of viable larvae

Method of transmission: Eggs passed in feces

References:

Levine, N.D., 1968

Olsen, O.W., 1973

Rausch, R.L., *et al.*, 1979

10. Genus: *Physaloptera*
Species: (*P. rara*)

Other names: Stomach worm

Geographic distribution: Africa, Asia, North America, South America

Primary host: Canines and felines
Occurs in *Martes pennanti* (fisher)
Canis latrans (coyote)
Procyon lotor (raccoon)
Canis lupus (timber wolf)
Vulpes fulva (red fox)
Felis domestica (cat)
Canis familiaris (dog)

Site: Stomach

Intermediate hosts: Cockroach, beetles, and crickets

Paratenic hosts: frogs, snakes, birds, mice

Method of infection: Ingestion of intermediate host

Method of transmission: Eggs passed in feces

Impact on host: Cause ulceration of the stomach

References:

de Vos, 1952
Dick, T.A., and R.D. Leonard, 1979
Douglas, C.W., and M.A. Strickland, 1987
Dunn, A.M., 1978
Hamilton, W.J. Jr., and A.H. Cook, 1955
Olsen, O.W., 1973

11. Genus: *Skrjabinylus*
Other names: Lungworms

Geographic distribution: Scandinavia, Great Britain, Europe, USSR,
North America (Manitoba)

Primary host: *Martes pennanti* (fisher)
Mustela erminea (shorttail weasel)
Mustela frenata (longtail weasel)
Mustela vison (mink)
Mustela putorius (ferret)
Mephitis mephitis (striped skunk)

Site: Frontal sinuses

Intermediate and paratenic hosts: terrestrial gastropods, sorcids, white mice,
toads, garter snakes, frogs, and catfish

Method of infection: Ingestion of viable larvae

Method of transmission: Larvae passed in feces

Impact on host: Cause lesions in the frontal bones

References:

Addison, E.M., *et al.*, 1988
Anderson, R.C., 1971
Olsen, O.W., 1973

12. Genus: *Soboliphyme*
Species: *S. baturini* (also three other species in gastrointestinal tract of carnivores and insectivores)

Other names: *S. sahaliensis*

Geographic distribution: Eastern USSR and North America

Primary host: *Martes pennanti* (fisher)
martes americana (marten)
Vulpes fulva (red fox)
ferret
various mustelid carnivores

Site: Stomach and intestine

Method of infection: Ingestion of viable larvae or intermediate host

Method of transmission: Eggs passed in feces

References:

Craig, R.E., and R.A. Borecky, 1976
Erickson, A.B., 1946
Levine, N.D., 1968
Morgan, B.B., 1943
Swartz, L.G., 1968

13. Genus: *Trichinella*
Species: *T. spiralis*

Other names: Trichinae

Geographic distribution: World wide, but less common in the tropics, and absent from Australia

Primary host: Carnivores, and omnivorous mammals, including humans

Site: Adults in small intestine, larvae in striated muscle

Intermediate hosts: Infected mammals carry larvae

Method of infection: By predation, cannibalism, or carrion feeding.
Ingestion of flesh containing larvae, or swallowing
viable cysts passed in feces.

Method of transmission: By ingesting flesh containing larvae, swallowing viable
cysts passed in feces resulting from meals of trichinous
meat, prenatal infection from larvae in the blood, or post
natal infection from larvae in mother's milk.

Impact on host: Larvae within the muscle cause little disturbance

References:

Dick, T.A., and R.D. Leonard, 1979
Dick, T.A., *et al.*, 1986
Dunn, A.M., 1978
Levine, N.D., 1968
Olsen, O.W., 1973
Worley, *et al.*, 1974
Zimmermann, W.J., 1971. in PDWM

14. Genus: *Trilobstrongylus*
Species: *T. biocrai*

Other names: Lungworm

Geographic distribution: North America (Ontario)

Primary host: *Martes pennanti* (fisher)

Site: Lung tissue

Intermediate hosts: Terrestrial molluscs

Method of infection: Ingestion of viable larvae or intermediate host

Method of transmission: Larvae passed in feces

Impact on host: Predispose host to other infections

References:

Anderson, R.C., 1963, 1971
Craig, R.E., and R.A. Borecky, 1976

15. Genus: *Uncinaris*
- Species: *U. stenocephala*
- Other names: Northern hookworm
- Geographic distribution: Most common in temperate and colder areas of the world. As far north as the arctic circle.
- Primary host: *Canis familiaris* (dog)
Felis domestica (cat)
Martes pennanti (fisher)
Vulpes fulva (red fox)
Canis spp. (wolves) and related carnivores
Can infect humans
- Site: Small intestine
- Intermediate hosts: Possibly insects
- Method of infection: Directly through skin, or by ingestion of larvae
- Method of transmission: Eggs passed in feces
- Impact on host: Mechanical damage to intestine due to minute lacerations
- Comments: "Hookworms are perhaps the most pathogenic parasites of young dogs or cats...due to loss of blood. (Levine, N.D., 1968)"
"the infective larvae of the dog hookworms can penetrate human skin and cause cutaneous larva migrans (Unruh, D.H.A., 1973)."
- References:
- Chitwood, B.C., 1932
Dunn, A.M., 1978
Hamilton, W.J. Jr., and A.H. Cook, 1955
Levine, N.D., 1968
Noble, E.R., and G.A. noble, 1971
Unruh, D.H.A., *et al.*, 1973

CESTODES

1. Genus: *Mesocestoides*
Species: *M. variabilis*

Other names: Tapeworm
M. corti
M. maneri

Geographic distribution: World wide

Definitive hosts: *Canis latrans* (coyote)
Lynx rufus (bobcat)
Martes pennanti (fisher)
Mephitis macroura (hooded skunk)
M. mephitis (striped skunk)
Mus musculus (house mouse)
Procyon lotor (raccoon)
S. putorius (spotted skunk)
Urocyon cinereoargenteus (gray fox)
U. littoralis (gray fox)
Vulpes macrotis (kit fox)

Site Small intestine

Intermediate hosts:

- I. Coprophagous beetles and oribatid mites
- II. Amphibians, reptiles, small mammals, birds

Method of infection: Ingestion of intermediate host

Method of transmission: Eggs passed in feces

Impact on host: Intestinal blockage, general toxic or allergic reactions,
deprivation of nutrients, bacterial infections

Comments: "...through either direct or indirect means, carnivores play a significant role as ecological avenues in the transmission of tapeworms to human and domestic animals (Leiby and Dyer, 1971)."
As of 1971 there were two cases of human infection in North America.

References:

- Coulter, M.W., 1966
deVos, A., 1952
Dunn, A.M., 1978
Hamilton, W.J. Jr., and A.H. Cook, 1955
Leiby, P.D., and W.G. Dyer, 1971
Meyer, M.C., and B.G. Chitwood, 1951

2. ***Genus: ***Taenia***
 Species: ***T. msutelae***

Other names: ***Halysis mustelae***
 Taenia mustelae vulgaris
 Cysticercus talpae
 T. tenuicollis
 T. brevicollis
 T. tenuicollis armata
 T. joyeauxiana.

Geographic distribution: North America

Definitive hosts: ***Mustela erminea*** (shorttail weasel)
 M. frenata (longtail weasel)
 M. vison (mink)
 Martes americana (marten)

Site: Small intestine, larvae may also migrate throughout body tissues

Intermediate hosts:

Aplodontia rufa (mountain beaver)
Citellus franklini (Franklin ground squirrel)
Clethrionomys gapperi (southern red-backed vole)
C. rutilus (northern red-backed vole)
Tamias minimus (least chipmunk)
Lemmus trimucronatus (brown lemming)
Marmota monax (woodchuck)
Mircotus miurus (Alaska vole)
M. oeconomus (tundra vole)
M. pennsylvanicus (meadow vole)
Ondatara zibethica (muskrat)
Peromyscus leucopus (white-footed mouse)

P. maniculatus (deer mouse)
Synaptomys borealis (northern bog lemming)
S. dooperi (southern bog lemming)
Tamias striatus (Eastern chipmunk)
Zapus hudsonicus (meadow jumping mouse)

Method of infection: Ingestion of intermediate host containing larvae

Method of transmission: Eggs passed in feces

Impact on host: Infection may be fatal, depending on location and number of migrating larvae.

Comments: Larvae commonly develop in the liver of intermediate hosts. A deer mouse (*P. maniculatus*) fed 1 or 2 proglottids may succumb within two weeks from excessive liver damage. (Lieby and Dyer, 1971)

References:

Leiby, P.D., and W.G. Dyer, 1971
Noble, E.R., and G.A. Noble, 1971

3. Genus: *Taenia*
Species: *sibirica*

Other names: *T. martis*, *Halysis martis*, *H. putorii*, *T. intermedia*, *T. skrjabini*

Geographic distribution: North America (NWT, Ontario)

Definitive hosts: *Martes americana* (marten)
Martes pennanti (fisher)

Site: Small intestine

Intermediate hosts: Rodents

Method of infection: Ingestion of larvae in intermediate hosts

Method of transmission: Eggs passed in feces

References:

Leiby, P.D., and W.G. Dyer, 1971
Dick, T.A., and R.D. Leonard, 1979

TREMATODES

1. Genus: *Alaria*
Species: *A. canis*

Other names: Flukes

Geographic distribution: North America and southeastern Europe

Definitive hosts: *Canis familiaris* (dog)
Canis lupis (timber wolf)
Canis latrans (brush wolf)
Vulpes fulva (red fox)
Vulpes fulva alascensis (Alaskan fox)
Lynx canadensis (lynx)
Lynx rufus (bobcat)
Martes pennanti (fisher)
Urocyon cinereogenteus (grey fox)
Mustela vison (mink)

Site: Duodenum

Intermediate hosts:

- I. Water snails (*Helisoma trivolvis*, *H. campanulata*)
- II. Tadpoles and frogs. (*Rana pipiens*, *R. sylvatica*, *Pseudacris nigrita*, *Bufo americanus*)
- III. Potential exists for the larvae to remain viable in a third, and paratenic host, until ingested by the definitive host. This has been observed in *Lutra canadensis* (otter) (Pearson, 1956).

Method of infection: Ingestion of intermediate host, or paratenic host

Method of transmission: Eggs are passed in feces

Impact on host: "The pathogenicity of this genus is slight, and infection is only detected by post mortem examination (Dunn, 1978)."

References:

- Coulter, M.W., 1966
Davis, J.W., and K.G. Libke, 1971
Dunn, A.M., 1978
Olsen, O.W., 1973
Pearson, J.C., 1956

2. Genus: *Alaria*
Species: *mustelae*

Geographic distribution: America, southeastern Europe

Definitive hosts: Coyote
Martes pennanti (fisher)
Mustela vison (mink)
Mestela novaboracensis (weasel)
Ondatra zibethica (muskrat)
Mustela putorius (ferret)
Canis familiaris (dog)
Felis domestica (cat)

Site: Duodenum

Intermediate hosts:

- I. *Planorbula armigera*
- II. *Rana palustris*, *R. catesbiana*, *R. clamitans*, *R. pipiens*
- III. Snakes, *Peromyscus leucopus* (deer mouse), *Mustela vison* (mink),
Procyon lotor (raccoon)

Method of infection: Ingestion of intermediate host, or paratenic host

Method of transmission: Eggs passed in feces

Impact on host: "Pathogenicity of this genus is usually slight.
(Dunn, 1978)."

References:

Davis, J.W., and K.G. Libke, 1971
Pearson, J.C., 1956
Dunn, A.M., 1978

3. Genus: *Metorchis*
Species: *M. conjunctus*

Other names: fluke

Geographic distribution: North America

Definitive hosts:

Martes pennanti (fisher)
Canis familiaris (dog)
Felis domestica (cat)
Vulpes fulva (red fox)
Procyon lotor (raccoon)
Mustela vison (mink)
Ondatra zibethica (muskrat)
occasionally humans

Site: Liver

Intermediate hosts:

- I. *Amnicola limosa porata* (snail)
- II. *Catostomus commersoni* (common sucker)

Method of infection: Ingestion of larvae in intermediate host

Method of transmission: Eggs passed in feces

Impact on host: "May predispose to infection producing cystic dilation of the bile ducts and hyperplasia of the mucosa of the gall bladder. Prolonged infection destroys liver parenchyma. These flukes are suspected as transport hosts of canine hepatitis (Osen, 1973)."

References:

- Dick, T.A., and R.D. Leonard, 1979
Dunn, A.M., 1978
Holmes, J.C., and R. Podesta, 1968
Olsen, O.W., 1973
Unruh, D.H.A., *et al.*, 1973

PROTOZOA

1. Genus: *Sarcocystis*
Species: spp.

Geographic distribution: Worldwide

Host: birds, reptiles, cattle, sheep, dogs, cats

Martes pennanti (fisher)

Vulpes fulva (red fox)

Lynx rufus (bobcat)

Felis concolor (mountain lion)

Ursus americanus (black bear)

Humans

Site: Small intestine. Cysts have been located in cardiac and skeletal muscle.

Intermediate hosts: Reptiles, birds, mammals

Method of infection: Ingestion of fully developed oocysts, or ingestion of infected flesh.

Method of transmission: Oocysts passed in feces

Impact on host: "Pathogenicity, if it occurs is mild (Noble and Noble, 1971)."

Comments: May be as dangerous to humans as Toxoplasmosis.

References:

Dubey, J.P., 1982

Olsen, O.W., 1973

Crum, J.M., *et al.*, 1978

Noble, E.R., and G.A. Noble, 1971

2. Genus: *Toxoplasma*

Species: *T. gondii*

Other names: *Toxoplasma cuniculi*, *T. caviae*, *T. canis*, *T. musculi*, *T. ratti*, *T. laidlawi*, *T. sciuri*, *T. pyrogenes*, *T. hominis*

Geographic distribution: Worldwide

Definitive hosts: Felids, especially cats

Site: Intestinal epithelium, lungs, liver, spleen, muscles, retina, and brain

Intermediate hosts: Birds and mammals, including humans

Method of infection: Ingestion of fully developed oocysts or intermediate host

Method of transmission: Oocysts passed in feces

Impact on host: "Infection may cause no symptoms or may kill the intermediate host (Cox, 1982)."
"In chronic infections, cysts occur in the eyes, heart, and central nervous system, producing severe effects (Olsen, 1973)."

Comments: Infections in humans are normally without symptoms except in the case of prenatal infection or in individuals with suppressed immune systems.
"Toxoplasmosis is a zoonotic infection transmitted from animals to humans. Disease manifestations during proliferating stage include fever, pneumonia, hepatitis, and involvement of lymph nodes. Prenatal infections result in stillbirths, abortion, hydrocephalus, mental retardation, and blindness (Olsen, 1973)."

References:

Chandler, C., 1955
Cox, F.E.G., 1982
Noble, E.R., and G.A. Noble, 1971
Olsen, O.W., 1973
Sanger, V.L., 1971

3. Genus: *Isospora* Species: spp.

Geographic distribution: Worldwide

Hosts: Small birds, carnivorous mammals, pigs, dog, cat, fox, humans

Site: Intestinal epithelium

Method of transmission: Infective oocysts passed in feces.

Impact on host: Complete destruction of the infected cells of the intestine. Effects vary with the severity of infection and the species involved from no visible symptoms to severe hemorrhage.

Comments: Three species of *Isopora* are known to infect man. Symptoms of human infection are mild diarrhea, abdominal distress, and eosinophilia. Infection is self-limiting and lasts only a few weeks (Chandler, 1955).

References:

Douglas, C.W., and M.A. Strickland, 1987
Olsen, O.W., 1973
Chandler, C., 1955

ECTOPARASITES

1. Genus: *Ixodes*
Species: *I. texanus*, *I. cookei*

Other names: ticks

Geographic distribution: North America

Hosts: *Procyon lotor* (raccoon)
Mephitis mephitis (striped skunk)
Martes pennanti (fisher)
Mustela vison (mink)
Mustela frenata (longtail weasel)
Martes americana (marten)
Mustela erminea (shorttail weasel)
also *Canidae*, *Felidae*, *Sciuridae*, and *Leporidae*.

Method of infection: Contact

Impact on host: Tick paralysis, caused by toxins secreted by ticks, may occasionally result in death due to respiratory or cardiac failure. Ticks serve as vectors to diseases caused by viruses, bacteria, rickettsias and protozoa.

Comments: May be natural vectors of tularaemia

References: Darsie, R.F. Jr., and G. Anastos, 1957
Noble, E.R., and B.A. Noble, 1971

2. Genus: *Sacroptes*
 Species: *S. scabiei*
- Other names: mites
- Geographic distribution: North America, Russia
- Definitive hosts: *Martes pennanti* (fisher)
Vulpes fulva (red fox)
Canis lupus (timber wolf)
Canis latrans (coyote)
Putorius putorius (ferret)
 Artiodactyla, Perissodactyla, Carnivora, Primates,
 Lagomorpha, Rodentia and Marsupialia
 Humans may also be infected
- Method of infection: Spread to new hosts by direct contact or contact with common rubbing posts.
- Impact on host: Cause lesions by burrowing into the skin. Heavy infections can cause blindness, hearing disturbances, and difficulty in eating.
- References:
 Sweatman, G.K., 1971
 Addison, E.M., *et al.*, 1988
 O'Meara *et al.*, 1960
3. Genus: *Oropsylla*
 Species: *O. arctomys*
- Other names: Flea. *Ceratophyllus arctomys* Baker, 1904
- Geographic distribution: Alaska south into British Columbia, east and southeast through Montana and to Atlantic coast
- Definitive hosts: *Martes pennanti* (fisher)
Marmota monax (marmot)
Marmota flaviventris (woodchuck)
Mephitis hudsonica (skunk)
Canis latrans (coyote)
- Method of infection: Contact

Impact on host: Can be vectors of bubonic plague (*Pasteurella pestis*), typhus (*Reckettisia prowazekii*), and tularemia (*Pasteurella tularensis*)

References: Hubbard, C.A., 1968

DISEASES

1. Genus: Leptospirosis

Species: Disease caused by many serovars (serovarieties) of spirochaetal bacterium *Leptospira interrogans*

Synonyms: "The members of the genus *Leptospira* are called serovars because their differences are determined by serologic tests (Shotts, 1981)."

Geographic distribution: North America

Hosts: *Mephitis mephitis* (striped skunk)
Procyon lotor (raccoon)
Rattus norvegicus (Norway rat)
Mus musculus (house mouse)
Ondatra ziethica (muskrat)
Vulpes fulva (red fox)
Marmota monax (woodchuck)
Microtus pennsylvanicus (meadow vole)
Blarina brevicauda (shrew)
Lynx rufus (bobcat)
Sylvilagus floridanus (cottontail rabbit)
Sciurus niger (fox squirrel)
Odocoileus virginianus (White-tailed deer)
Has been known to infect humans

Site: After dissemination in the bloodstream, organisms localize in the tubules of the kidney

Method of infection: Organisms enter the body through mucous membranes, abraded skin, or are ingested in drinking water or in contaminated prey species.

Method of transmission: Organisms are passed in urine

Impact on host: Majority of infections are mild or asymptomatic

Comments: Can be fatal in humans

References:

Addison, E.M., *et al.*, 1988

Chandler, C., 1955

Shotts, E.B., 1981

2. Disease: Aleutian Disease
Agent: Parovirus

Synonyms: Plasmacytosis

Geographic distribution: North America, Denmark

Susceptible species: *Mustela vison* (mink)

Martes pennanti (fisher)

Has been shown experimentally to infect *Mustela putorius* (ferret)

Vulpes fulva (red fox)

Procyon lotor (raccoon)

Mephitis spp. (skunk).

Site: Throughout body tissues

Method of transmission: Virus has been shown to be present in serum, whole blood, feces, urine, and saliva. Possible transmission routes include fecal-oral and saliva-aerosol-respiratory.

Impact on host: Affected mink show signs of sickness for a period of weeks or months and succumb during periods of stress.

Comments: It is uncertain whether the virus is pathogenic to man, so care should be taken when handling the AD virus (Gorham and Shen, 1981).

References:

Gorham and Shen, 1981

Douglas and Strickland, 1987

Monson, R.A., and W.B. Stone, 1976

3. Disease: Canine Distemper
 Agent: Single antigenic type virus known as viruse of Carre of the family
 Paramyxoviridae, genus *Morbillivirus*.
- Geographic distribution: Worldwide
- Susceptible species: *Canis* spp. (Wolves, coyote)
 Vulpes spp. (Fox)
 Martes pennanti (Fisher)
 Martes fiona (stone marten)
 Mustela spp. (weasels)
 Procyon lotor (raccoon)
- Site: Infects cells of the immune system, lungs, gastro-intestinal and urinary tracts,
 skin, and brain.
- Method of transmission: Aerosol or direct contact. Nasal and
 conjunctival exudates, urine, and feces
 contain virus.
- Impact on host: In mink mortality ranges from 20 to 90%. In ferrets it is
 usually fatal. Raccoons showed 50% mortality.
- Comments: Control in free-living, susceptible wild animals is achieved when
 population density is reduced so opportunity for transmission is
 limited.
 "Poses no threat to humans... (Addison, *et al.*, 1988)."
- References: Addison, E.M., *et al.*, 1988
 Budd, J., 1981
4. ***Disease: Rabies
 Agent: Rhabdo, RNA type virus
- Synonyms: Hydrophobia, rage, Tollwut, lyssa, rabbia, rabia, raiva,
 beshenstvo
- Geographic distribution: Occurs on every continent except Australia
- Susceptable species: All warm-blooded animals are susceptible
- Site: Primarily central nervous system, but is present throughout the tissues
 and concentrates in the salivary glands.
- Method of infection: Usually transmitted through bite

Method of transmission: Primarily by biting but can be transmitted by other body secretions.

Impact on host: Damage to the brain and spinal cord, almost always fatal to mammals.

Comments: "...true reservoirs of rabies may exist among the Viverridae, Mustelidae, and Chiroptera of the United States...(Sikes, 1981)."

References:

Sikes, R.K., 1981

Robinson, W.L. and E.G. Bolen, 1984

MacInnes, C.D., 1987

5. ***Disease: Tularemia
Agent: bacterium *Francisella tularensis*

Synonyms: Plaguelike disease of rodents, plaguelike lymphadenitis, conjunctivitis, tularensis, Francis's disease, deerfly fever, rabbit fever, rabbit disease, cattle-fly fever, Pahvant Valley fever or plague, glandular type tick fever, Ohara's disease, la Tularemie, and die Tularemie.

Geographic distribution: North America, Mexico, Japan, Turkey, Israel, Scandinavia, Central and Western Europe, and Tunisia

Susceptable species: Members of the following: Cervidae, Canidae, Felidae, Mestelidae (mink, ermine, badger, skunk), Procyonidae (raccoon), Hystricomorpha (porcupine), Insectivora, Lagomorpha, Rodentia, Cricetidae, Heteromyidae, Muridae, Sciuromorpha, Zapoidae, and humans.

Site: Spreads via blood and lymph nodes, to liver, spleen, and other major organs.

Method of infection: Organism may gain entrance to the bloodstream through the bite of an arthropod vector or an infected carnivore, via contaminated flesh, or contaminated water, or through an abrasion in the skin. Ticks can be vectors of the disease organism.

Impact on host: Damage to blood vessels, causing foci of dead tissue in organs such as liver, spleen, lungs, heart and intestine. Highly fatal in animals such as cottontails, jackrabbits, beavers, and muskrats.

Treatment: Streptomycin, tetracycline, or chloramphenicol

Comments: "... it may cause severe and occasionally fatal disease in humans (Addison, et al., 1987)."
"... while highly debilitating, is not contagious among humans (Robinson and Bolen, 1984)."

References:

Bell, J.F., and J.R. Reilly, 1981
Addison, *et al.*, 1987
Robinson, W.L. and E.G. Bolen, 1984

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