SIGNIFICANCE OF PARASITES IN WILDLIFE

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The commonest diseases encountered in wild animals are those produced by various parasitic organisms — viruses, bacteria, parasitic worms, arthropods, and others.

A parasite is defined as an organism which lives in or on another organism. The term thus defined includes many species of both plants and animals. The term as used nowadays usually refers to some categories of parasitic animals such as species of helminths, protozoa and arthropods. Representatives of these parasites are to be found in all members of the animal kingdom.

In an evaluation of parasitism in wild animals one may consider three main points: first, the effect and importance of the parasites on the hosts themselves; second, the transmissibility of parasites to domestic animals and, third, the relationship to public health.

In animals living in the natural state, unconfined, parasites are always present but usually in small numbers and apparently doing little damage. However, a review of the literature shows that there are many records of pathogenic action attributed to parasites. In some instances it is evident that changes in the environment or other factors (e.g. malnutrition) have favoured the establishment of a parasitic fauna and the development of a clinical condition. While in other cases the parasitic infection does not seem to affect the health of the host, it is nevertheless important because it contributes to a decrease in the economic value of the animal or may render it totally or partially undesirable to the epicurean or to the sportsman.

Quite apart from the danger and inconvenience of transmissibility to domestic animals or the public health importance, there are parasitic conditions of wild animals that are worthy of attention. A few examples of parasitic infections in the deer family will illustrate this point. Thus, Trichostrongyle nematodes, the large liver fluke *Fascioloides magna* and the lungworm *Dictyocaulus viviparus* are reported to be the cause of serious diseases in species of deer, in the elk and in the Rocky Mountain bighorn sheep on the west coast of Canada and of the United States.

In 1953, 1954 and 1955, Choquette, Whitten *et al.* (1) examined 1664 reindeers (*Rangifer tarandus*). *Cysticercus tarandi*, the larval stage of a tapeworm, *Taenia krabbei*, that lives in the intestine of dog and wolf was found

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in the heart muscle and musculature of 213, or 12.8 per cent of the animals examined. *Cysticercus tenuicollis* the larval stage of another tapeworm that lives in carnivores, was found in the liver of 425 or 25.5 per cent of the animals. Because of these infections a considerable amount of liver and muscular tissue was unusable for human consumption. Considering the role of the reindeer in the economy of the Canadian Arctic and as a source of food for the Eskimos, these two parasitic infections are a problem of some magnitude.

Another major parasitic infection of cervidae is hydatosis, due to the larval stage of the hydatid worm *Echinococcus granulosus* which lives in the intestine of canines. The larva can develop in a variety of hosts including man and hydatid cysts have been found in moose, Barren ground caribou, reindeer, wapiti or elk, coast deer and white-tailed deer. In the 1664, reindeer examined by Choquette, Whitten *et al.* (1) hydatid cysts were found in 158 or 9.5 per cent of the animals. In the cervidae the hydatid usually occurs in the lungs and in severely affected animals the condition must be detrimental if not lethal. In some areas of Canada this infection in cervidae is of great importance to the public health; it will be discussed as such at a later stage.

Birds can also be severely affected and to cite a few examples there are reports of disastrous tapeworm infections in prairie chickens, Canada geese and mallards. Swales (2) has shown that the nematode *Tetrameres crami* which develops in the crypts of Lieberkühn in several species of wild ducks, interferes with the function of the glands and impairs the digestive processes. Heavily infected birds are in poor condition as the animal fails to gain weight normally.

Fish are commonly parasitized and it is close to the truth to say that almost 100% of fish are infected. Fish are not only the definitive hosts for many species of worms, but are the intermediate hosts of species parasitic in mammals, birds, amphibians and other fish. In many cases the fish host carries its parasitic burden without apparent ill-effect, while in others a pathogenic action is manifest and often results in death, as is the case with some ectoparasitic infections in trout hatcheries and in Proteocephalid tapeworm infection in very young muskellunge. Parasitic infections are also often the cause of considerable depreciation in the value of fish as a source of food or as a game animal and, as we shall see later on, some parasitic infections of fish are of importance to public health.

Sportsmen in Eastern Canada are familiar with two parasitic conditions of fish, namely: "Black Spot" and "Yellow Grub". "Black Spot" can be found in bass, pike, perch and species of trout. It is caused by the larval stages of species of trematodes that live as adults in the intestine of aquatic birds such as the Belted Kingfisher and the Loon. The eggs of the parasites, passed with the bird's faeces into water are swallowed by snails in which asexual development takes place. The larva or cercaria which escapes from the snail pene-

trates the skin of the fish and becomes encysted. A host reaction deposits pigment around the cyst causing the "Black Spot" lesion. Some fish are so heavily infected that the entire surface of the body is covered with spots. Many sportsmen consider these fish as being unfit for human consumption. However, apart from its unattractive appearance the fish is harmless as cooking certainly destroys the parasites.

"Yellow Grub" is characterized by a little yellow-white abscess-like cyst found on the gills and other parts of the body. Heavy infection can be harmful to small fish. It is caused by the encysted larva of a trematode (*Clinostomum complanatum*) that lives as an adult in the intestine of the Great Blue Heron. "Yellow Grub" can be found in practically any species of fresh-water fish. The presence of this cyst in the fish is repulsive although, in spite of its appearance the cyst contains no pus.

The larval stage of some species of tapeworm parasites of man and animals develops in the flesh of fish such as pike, dore, perch, ciscoes, whitefish and other species of fresh-water fish. This type of infection is commonly encountered in fish in the Great Lakes District, in lakes in western Canada and the Northwest Territories. In some areas it is a problem of importance in commercial fisheries as the larvae may be so abundant in fish that meat must be condemned. Similarly, the presence of roundworm larvae in the muscles of seafish such as cod in too great numbers brings about the condemnation of the fish.

An interesting point is that there is evidence that parasites and parasitic infections play a role in the ecology of wild animals. Thus, for instance, according to Fallis (3), there appears to be a relationship between population trends and blood parasites of ruffed grouse in Ontario. Similarly, Erickson (4) showed that there is a relationship between population fluctuations and degree of parasitism in the snowshoe hare (*Lepus americanus*). Heavily or severely parasitized animals, or those harbouring particular parasites — e.g. larval cysts of tapeworm in rabbits and hares in such position as to impede their movements, or hydatid cysts in the lung of moose — have a decreased resistance and are easy prey to predators. It seems, as pointed out by Cameron (5), that parasites may thus naturally play a part in the ecology of wild animals. This is supported by Cowan (6) who secured evidence during the course of his studies on parasites and diseases of the black-tailed deer that predators selectively remove the more heavily parasitized deer.

An important aspect of parasites of wild animals is their transmissibility to domestic animals. As pointed out by Cameron (5) all domestic animals in North America, except dogs, have been originally imported by the white man and so all parasites which they harbour and which are exclusively North American, must have been acquired from our indigenous wild fauna. A good example is provided by the large liver fluke (*Fascioloides magna*) which Swales

(7) (8) showed to be normally a parasite of cervicae. In these animals a favourable host-parasite balance is established and neither the worm nor the host is apparently harmed. However, if deer are concentrated in a small area harmful effects may result from heavy infection. This parasite is transmissible to several other species of ruminants. Swales has shown that cattle, yak, and bison are able to overcome the effects of the invading parasite although serious disease may develop in cattle. In these animals the worms become imprisoned in the fibrous tissue formed around them thus making it impossible for the worms to continue their life cycle. The animals may become infected but cannot transmit the infection. On the other hand sheep do not react as strongly to the presence of liver flukes and heavy infection usually results in the death of the animal.

In 1950, Kingscote (9) reported that liver flukes were widely established in cervidae in Ontario and had caused several enzootics in domestic animals. The elk was shown to be the main reservoir of infection. Prophylactic measures then recommended and practised since include among other measures, eradication of elk herds in some areas (10).

Another example of transmissibility of parasites of wild to domestic animals is that of the fringed tapeworm *Thysanosoma actinoides*. It is a parasite of wild animals which has been secondarily acquired by sheep. It is quite common in sheep in the Canadian midwest. The parasite lives in the bile duct and causes hepatic lesions somewhat similar to those determined by flukes, although much less severe.

In North America both cattle and cervidae harbour the lungworm *Dictyocaulus viviparus*. There is reason to believe that in some areas cervidae play the role of carrier in the epizootology of parasitic bronchitis in cattle. As shown by Choquette (11) outbreaks of verminous bronchitis are known to have occurred in Nova Scotia, Quebec and Alberta in herds grazing upon pastures frequented by moose and deer. An interesting point is that in most cases the affected herds were of the Jersey breed and it is suggested that the colour of the cattle served as an attraction to the cervidae. Taylor (12) at the Weybridge Station of the United Kingdom Ministry of Agriculture has advanced the theory that *D. viviparus* is a natural parasite of deer, while it is ill-adapted in cattle. Due to a well balanced host-parasite relationship the parasite causes little if any damage in the deer, while in cattle it is often pathogenic.

While it is a fact that many species of parasites of wild animals become established in domestic animals the reverse is also true. Thus, for instance, species of nematodes living in the digestive tract of sheep and cattle are now found in many species of wild animals such as the bison, the elk, the prong-horn, the caribou and many species of deer.

Another important aspect of wildlife parasitology is its relationship to the

public health. In the last few years greater attention has been paid to the role played by wild animals as carriers of diseases transmissible to man. Some of these diseases are produced by viruses, bacteria or rickettsiae and are passed from wild animals to man by the intermediary of some animal parasite, usually an arthropod. The three most important diseases in this respect in North America are Plague, Tularemia and Rocky Mountain Spotted Fever.

In some areas in North America plague is enzootic in wild rodents and *Pasteurella pestis* is transmitted by fleas. Tularemia is a disease of rodents, such as gophers, ground squirrels, beavers, muskrats. It is transmitted to man and other animals by many species of blood sucking arthropods, insects and ticks as well as directly by contact with diseased animals. The typhus-like Rocky Mountain Spotted Fever is transmitted by ticks (e.g. *Dermacentor andersoni*) and rodents are considered to be reservoirs of infection.

Wild animals play or can play a role in the epidemiology of some helminthic infections of man. This is true in the case of the Broad Fish Tapeworm, Trichinosis, Hydatid cyst and Schistosome dermatitis.

The Broad Fish Tapeworm in its adult stage lives in the intestine of man, dog and several species of fish-eating mammals of which the most important is the bear. The infective stage of the parasite is found encysted in the flesh of species of fresh-water fish. Cooking destroys the parasite. It is only where people are in the habit of eating fish raw or improperly cooked that the infection is common. According to Wardle and McColl (13) the causal agent of fish tapeworm infection in Canada is a separate species from the classic European form, *Diphyllobothrium latum*. This view is also held by Cameron (14). Whatever is the systematic status of the Canadian form, it has been found in man and animals in every province except the Maritime Provinces. As shown by Saunders (15), Brown *et al.* (16) and Wolfgang (17), fish tapeworm infection is relatively common in man in the Northwest Territories.

The most important helminth transmissible to man from animals is the trichina worm. *Trichinella spiralis*. This is essentially a parasite of flesh-eating mammals, both wild and domesticated, but it can be transmitted to almost all species of mammals. In nature it has been found in several species of animals including martens, polecats, hedgehogs, badgers, species of foxes, brown bear, polar bear, wolf, wolverine, bearded seal walrus and white whale. Recently, Zimmerman *et al.* (18) reported this parasite in mink, fox, opossum, raccoon and coyote in Iowa. While pork is the commonest source of human infection, there are records of outbreaks of Trichinosis following the eating of the flesh of bear and other wild animals. A survey conducted in 1945 by Brown *et al.* (19) among 195 Eskimos on Southampton Island, Northwest Territories, showed that 40% gave a positive skin test and 40% had sera giving a positive precipitin test for Trichinosis. It is fair to assume that the disease was acquired

from wild animals. Most interesting are the outbreaks which occurred in western Greenland in 1947 (Thoborg *et al.* (20)). 300 native Greenlanders suffered from the disease, and of these 33 died. Although the source of infection was not ascertained, evidence pointed to walrus and possibly white whale.

Recent investigation by Sweatman (21), Miller (22), Harper *et al.* (23) have shown hydatosis caused by the larval stage of *Echinococcus granulosus* to be widely distributed in Canada. As stated previously it is frequently encountered in reindeer (Choquette, Whitten *et al.* (1)). The adult parasite lives in the small intestine of carnivora and its larva or hydatid may develop in almost any species of mammals.

Miller (22) has shown the important role of sylvatic echinococcosis in the epidemiology of the disease in man in some areas in Canada. The term sylvatic echinococcosis is used to refer to the life cycle of the parasite in wild animals. Wild carnivora known to harbour the adult worm in Canada are the wolf, the coyote, the fox and the fisher, but the wolf is undoubtedly the important definitive host in Canada and it is unlikely that a sylvatic infection could be set up in its absence. (However, recently Rausch and Schiller (24) working in Alaska, described from St. Lawrence Island under the name of *Echinococcus sibirencis,* a worm parasitic in the Arctic fox (*Alopex lagopus*) in its adult stage and in microtine rodents (and also in man according to these authors) in its larval stage. The present author (25) also found *Echinococcus* adults in 1954 in one Arctic fox from Bank's Island, Northwest Territories. More information is needed to determine its importance in Canada.) The wolf acquires *E. granulosus* by ingesting the hydatid cyst present in the herbivore prey, usually in the lung. The coyote and fox probably acquire their infection when acting as scavengers. In turn, the herbivore host becomes infected by ingesting the eggs of the adult worm which have been passed in the faeces of the definitive host. In his study of the disease in western Canada and in the Northwest Territories, Miller (22) has shown that dogs owned by Indians in these areas are frequently infected. Thus, the presence of large numbers of hydatid tapeworm eggs, leaves no doubt as to the source of infection commonly found in Indians in these areas. Dogs acquired their infection by eating infected viscera of large herbivores which have been killed by the Indians. Thus, when the Indian infects his dogs by feeding them infected viscera, he initiates a cycle in his immediate environment in which he plays the role of intermediate host. The situation is prevalent enough to constitute an important medical problem in the Indian population in some parts of Canada.

In man a parasitic condition known as "Schistosome dermatitis" or "Cercarial dermatitis" is caused by the larvae of trematodes that live in the blood vessels of the intestine of various aquatic birds, particularly species of ducks. The egg of the parasite eliminated with the faeces of the host, hatches in water and the larva penetrates a snail. In the snail the parasite undergoes a multiplica-

tive process and cercariae are produced. These emerge from the snail and normally gain access to their natural host by penetrating the skin. The parasites can also penetrate human skin and cause considerable irritation. The condition varies from a simple erythema, to large papules, red and very itchy; often the papules are secondarily infected. Man is attacked while bathing, hence the name "swimmer's itch". In western Canada it is known as "slough itch". While it is common in western Canada, the first report of the disease in eastern Canada is that of Miller and Munroe (26) who reported it from an area in the vicinity of Montreal.

This rapid and superficial survey of some parasitic conditions found in wildlife is necessarily incomplete. It nevertheless shows the importance of the subject because of its relationship to wildlife conservation, to animal husbandry and to public health. It is evident that much more information is needed on what are the parasites of wild animals and their importance in Canada.

SUMMARY

In the evaluation of parasitism in wild animals there are, among others, three points to consider: effects and importance of the parasites on the hosts that harbour them; transmissibility to domestic animals; relationship to the public health.

Animals living in the natural state are not usually severely affected. However, there are many records of definite pathogenicity attributed to parasites, as for instance, in some intestinal helminthiasis, liver fluke, lungworm and larval tapeworm infections in mammals; tapeworm and roundworm infections in birds; fluke and tapeworm infections in fish. Parasitic infections often result in a decrease in the economic or game value of the animals as is the case in cysticercosis in reindeer, "Black Spot" and "Yellow Grub" and larval tapeworm and roundworm infections in fresh-water and seafish. There is also evidence that parasites play a role in the ecology of wild animals.

Many species of parasites naturally found in wild animals are transmitted to domestic animals, often resulting in the development of clinical conditions. Such is the case, for instance, of the large liver fluke *Fascioloides magna* in domestic ruminants. There is also evidence that in some areas of Canada cervidae play a role in the epizootology of parasitic bronchitis in cattle.

The role of wild animals as carriers of diseases transmissible to man such as Plague, Tularemia and Rocky Mountain Spotted Fever or in the epidemiology of parasitic infections such as Diphyllobothriasis, Trichinosis, Hydatid cyst and Schistosome Dermatitis is also discussed.

RESUME

Dans une appréciation du parasitisme chez les animaux sauvages, il y a,

entre autres, trois points à considérer: effets et importance des parasites chez les hôtes qui les hébergent; transmissibilité aux animaux domestiques; importance du point de vue hygiène publique.

Chez les animaux à l'état naturel les parasites ne jouent habituellement qu'un rôle minime. Cependant, dans bien des cas, on a relevé le rôle nettement pathogène des parasites, par exemple, dans des helminthiases intestinales, la distomatose hépatique, la bronchite vermineuse et dans des infections par des larves de cestodes chez les mammifères; dans des infections par des nématodes et des cestodes chez les oiseaux et dans des infections par des trématodes et des cestodes chez les poissons. Les infections parasitaires produisent souvent une dépréciation de la valeur économique ou sportive des animaux comme c'est le cas dans certaines cysticercoses du renne, le "Black Spot" et le "Yellow Grub" et les infections par les larves de cestodes et de nématodes chez les poissons. Il semble bien que les parasites jouent aussi un rôle dans l'écologie des animaux sauvages.

Plusieurs espèces de parasites naturels aux animaux sauvages sont transmissibles aux espèces domestiques et ce passage entraîne souvent des troubles sérieux. Ainsi, par exemple, le cas de la grande douve du foie *Fascioloides magna* chez les ruminants domestiques. Il semble aussi que dans certaines régions du pays, les cervidés jouent un rôle dans l'épizootologie de la bronchite vermineuse des bovins.

L'auteur discute aussi du rôle des animaux sauvages en tant que vecteurs de maladies transmissibles à l'homme, comme par exemple, la peste, la tularémie, la fièvre pourprée des Montagnes Rocheuses, ou dans l'épidémiologie de certaines parasitoses de l'homme telles la bothriocéphalose, la trichinose, le kyste hydatique et la dermatite des baigneurs.

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