

Pathogens, Parasites, and Disease in Wildlife

Every living organism has parasites and wild animals are no exception. Parasitism is the most common consumer strategy and can impact the ecology and evolution of all interactions. Parasites have coevolved with the animals which host them and they can strongly influence ecosystem dynamics. Increasing interactions between wildlife, livestock, and humans have been observed due to globalization of society, human population growth, and human-caused landscape changes. This facilitates increased transmission of zoonotic parasites. Understanding the impact of pathogens on wildlife is key to a broader knowledge of how an ecosystem functions. A good knowledge of the system is important in making management decisions about how we can mitigate these interactions.

Below is a brief overview of the key terms related to pathogens, parasites, and diseases. Some of the most common and important pathogens that impact wildlife are also described. Each description will also give you a brief introduction on how this pathogen is impacting the ecosystem in which it is found and management issues.

Important Terms

Parasitism – an interaction of species populations in which one (typically smaller) organism (known as the parasite) lives in or on another (known as the host). Parasites come from a wide variety of animal groups, including but not limited to viruses, bacteria, platyhelminths (flatworms), nematodes (roundworms), and arthropods (ticks, lice, fleas). The parasite obtains food, shelter, or other requirements from its host. A predator obtains energy by killing their host (living on the capital) whereas a parasite does not (living on the interest). Parasitism generally implies some harm to the host, but this is often only observed with the addition of other stressors on the host. The effects of the parasite on the host may range from nothing to severe illness and eventual death. The effects of the parasite may vary by species or even individual. Parasites can be obligate (only live as a parasite) or facultative (may live as a parasite or independently).

Ectoparasites – parasites that live externally on the host

Endoparasites – parasites that live within the host

Pathogen – any parasite (e.g. virus, bacteria, nematode, platyhelminth, etc.) or prion that causes disease

Disease – an abnormal condition which affects the body of an organism. It may be caused by an external source such as a pathogen (i.e. parasite) or internal dysfunctions (e.g. autoimmune diseases).

Zoonosis – A pathogen that can be transmitted from animals to humans and vice versa

Pathogen Examples

Borrelia burgdorferi (Lyme disease)

Borrelia burgdorferi is a bacterium that causes the illness, lyme disease. It is spread through the bite of *Ixodes* ticks (which by themselves are ectoparasites). The *Ixodes* ticks, also known as deer ticks, most often feed on the white-footed mouse, white-tailed deer, and certain other mammal hosts.

Symptoms: Symptoms in humans occur in three stages: (1) distinctive red rash at site of tick bite (erythema migrans) (2) Fatigue, chills and fever, headache, muscle and joint pain, swollen lymph nodes, and skin lesions (3) joint pain (and arthritis), meningitis, Bell's palsy, irregular heart rhythm, depression, memory problems, sensation of numbness. In dogs it commonly presents as arthritis.

Hosts: White-tailed deer, humans, dogs, livestock, and other endotherms

Treatment: Antibiotics (Doxycycline)

Management Concerns: Ticks live varied habitats, including wooded regions and open edge habitats. They become infected when they feed on mice or other small animals (that can carry the bacteria). The bacteria are then spread to other hosts which may include other wildlife, humans, livestock, or pets. As white-tailed deer are one of the important hosts in this parasite lifecycle, increased movement of white-tailed deer in to urban areas may increase exposure to pets and humans. Further, if the range of white-tailed deer overlaps with those of livestock, it may increase the risk of infection in the livestock.

Red fox are important in reducing the prevalence of *B. burgdorferi* in a region. As an important predator of white-footed mouse, the red fox is key to keeping their population down. By reducing the white-footed mouse, an important host for *Ixodes* ticks and the transmission of the bacteria, the red fox reduces the prevalence of *B. burgdorferi* in the area.

Bovine Tuberculosis

Bovine tuberculosis (TB) is a disease caused by the bacteria *Mycobacterium bovis*. It usually infects the lungs, but it can infect the kidneys, spine, and brain. It is transferred between hosts through direct contact, contact with excretions, and inhalation of aerosols.

Symptoms: Cough, weight loss, and weakness

Hosts: Deer (white-tailed deer and mule deer), elk, cattle, llamas, pigs, cats, carnivores (fox, coyotes, wolves), mustelids, rodents, and humans

Treatment: None

Management Concerns: TB is a contagious disease that can be transferred from wildlife to livestock, such as cattle. In some regions where there is large amount of accessible feed that is used by both livestock and white-tailed deer or elk, infected saliva can contaminate the food and TB can be transferred from one host to the other.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a prion disease that affects many species of cervids (e.g. deer and moose). Prions are abnormally folded proteins that resist all attempts to be broken down. The transmission route of CWD still unknown.

Symptoms: Behavioural changes (hyperexcitability, nervousness, decreased interactions, listlessness, lowering of the head, and repetitive walking in set patterns)

Hosts: Mule deer, white-tailed deer, Rocky Mountain elk, and moose

Treatment: No treatment, fatal disease

Management Concerns: CWD is a fatal disease that affects many species of cervids. It is of major concern to hunters and wildlife managers as it has the potential to substantially decrease cervid populations. Further, as the transmission route is still unknown it is difficult to manage the spread of the disease.

Echinococcus spp.

Echinococcus spp. is a tiny species of tapeworm that is transmitted trophically (through the food web) from an intermediate host (species of ungulate or small mammal) to a definitive host (species of carnivore) back to an intermediate host and the cycle continues. *Echinococcus* is commonly transmitted between wolves and moose. In the wolf the tapeworm lives in the intestine (endoparasite) and is transmitted to the moose through the accidental consumption of the wolf feces. In the moose the tapeworm lives in cysts (cavity containing a liquid) in the organs (such as lungs). It is passed to the wolf when it eats the moose.

Symptoms: In moose, cysts occur most frequently in the lungs. It reduces the moose's ability to run away from predators, increasing their chances being killed. Organ damage can occur in the intermediate host. Weight loss may occur in the definitive host if the infection is large.

Hosts: Carnivores (wolves, coyotes, foxes, cats, hyenas), ungulates (white-tailed deer, moose, caribou, elk), small mammals (mice, voles, and rats) and accidental hosts such as humans

Treatment: Surgery to remove cysts

Management Concerns: Overlap with wild canids (e.g. wolves, coyotes, or foxes) can lead to transmission of *Echinococcus* spp. to accidental hosts (through contaminated feces) which can

cause cystic echinococcus. The accidental hosts may include livestock (e.g. cattle, goat, etc.), pets (e.g. dogs, horses), and humans. The development of cysts in organs can cause damage and the rupture of this cyst can cause an allergic reaction and death. Alveolar echinococcus is another disease caused by infection by *Echinococcus multilocularis* which is much more serious. It can infiltrate entire organs, including the brain.

Giardia lamblia

Giardia lamblia is a protozoan parasite that causes giardiasis, which is also known as 'beaver fever'. It is found on surfaces, or in the soil, food, or water that has been contaminated with feces from infected animals.

Symptoms: Diarrhoea, flatulence, abdominal cramps, nausea, dehydration, weight loss

Hosts: Beavers, dogs, cats, sheep, cattle, and humans

Treatment: Prescription drugs

Management Concerns: *Giardia* is a zoonotic parasite that can be transmitted from wildlife to humans, humans to wildlife, wildlife to livestock, etc. Although it is rarely fatal, it can cause severe dehydration in some infected hosts.

Rabies Virus

The rabies virus is transmitted through the saliva or nervous tissues of an infected animal. Rabies is usually transferred when an infected animal bites another animal. Since it is transmitted by exposure to infected saliva, if infected saliva gets into a cut, wound, or a mucosal membrane (e.g. nose, eyes, or lining of mouth) an animal can become infected.

Symptoms: Irregular behaviour (increased aggression, depression, lethargy, lack of fear), paralysis (muscle weakness) particularly in the hind legs or throat, and excessive drooling

Hosts: Humans, domestic mammals (e.g. pets (cats, dogs, etc.), livestock), and wild animals (e.g. skunks, foxes, bats, etc.)

Treatment: Vaccinations pre- and post- exposure if treated before symptoms set in. Once an animal (including a human) is symptomatic no treatment is available. A few humans have been able to survive due to some novel treatments but this is rare.

Management Concerns: Rabies virus is a zoonotic pathogen that can be very dangerous for humans and their pets. One should avoid contact with wildlife or handling wild animals. Appreciate them from a distance. If you find an animal, such as a bat, skunk, fox, or raccoon, dead or alive, do not touch it with your bare hands.

White-nose syndrome

White-nose syndrome (WNS) is a disease caused by the fungus, *Geomyces destructans*, which appears on the muzzle and other body parts of hibernating bats. Little is known about how it is transferred between hosts.

Symptoms: Uncharacteristic behaviours (e.g. flying out during the day, clustering near the entrances of hibernacula)

Hosts: Bats

Treatment: None

Management Concerns: WNS has been associated with extensive mortality of bats in primarily eastern North America. It was first documented in the winter of 2006-2007 and has spread rapidly. It has killed more than 6.7 million bats in eastern North America and in some hibernacula (areas where bat colonies hibernate during the winter) between 90-100% of the bats have died. Researchers are still trying to figure out how it is transmitted and how to control its spread.

Winter Tick (*Dermacentor albipictus*)

Winter tick, also known as moose tick or elk tick, takes a blood meal from its host (mostly ungulates) while attached. The engorged tick then detaches itself from its host and falls to the ground. They attach to their hosts during the winter and usually detach in early spring. If only a few ticks infest a host, such as a moose, then the moose does not suffer any disease. It is only when (on average) over 30 000 ticks are present that disease sets in.

Symptoms: Loss of hair and very poor body condition (emacipated)

Hosts: Moose, caribou, elk, cattle, white-tailed deer, mule deer, bison, horses

Treatment: Grooming to remove the ticks

Management Concerns: Winter tick can cause mild to severe disease in moose, caribou, and elk. It can substantially reduce their survival through the winter. High infestations with winter ticks appear to increase the amount of energy the host requires and cause the host to starve.

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