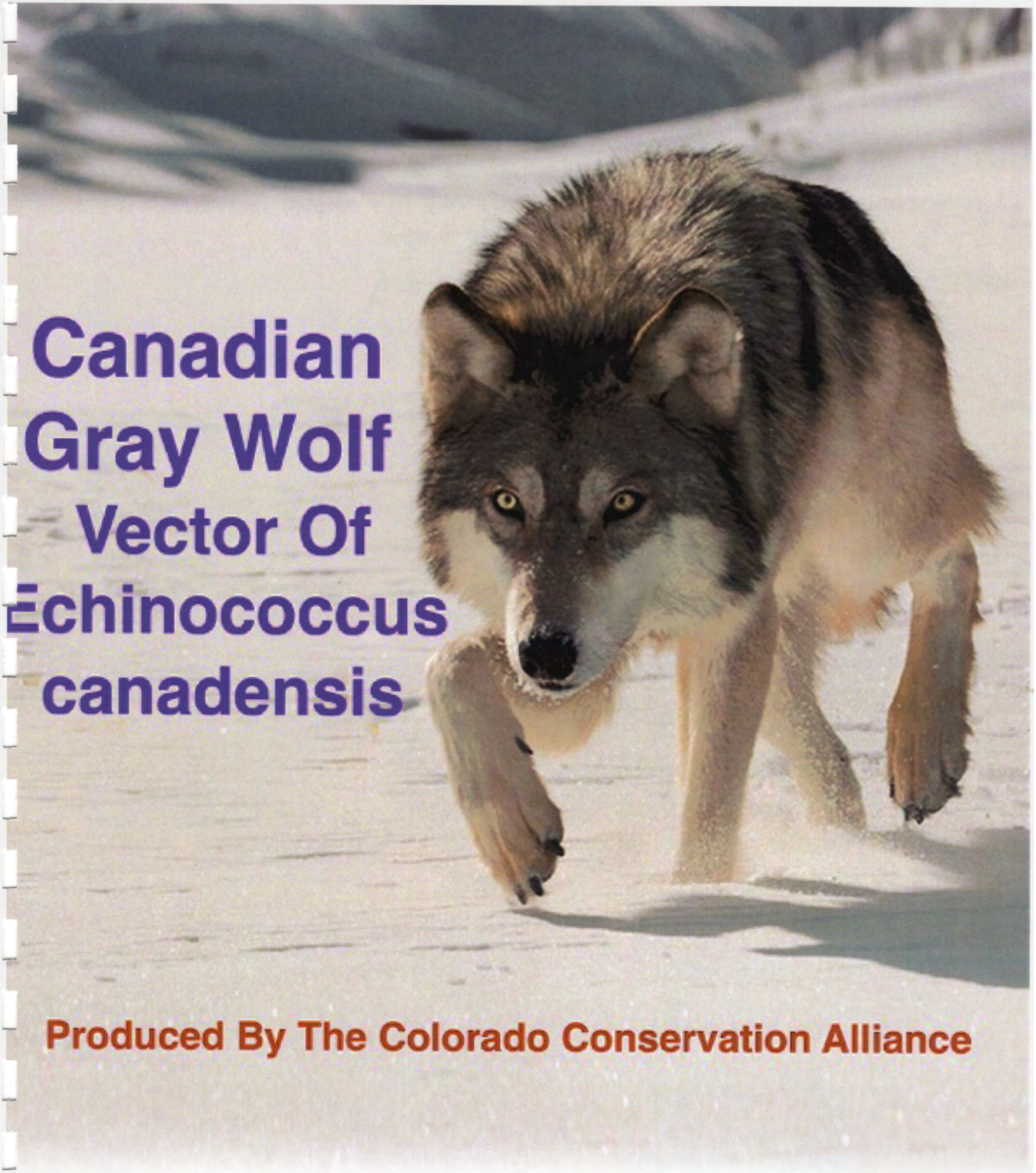

Canadian Gray Wolf Vector Of Echinococcus canadensis

Produced By The Colorado Conservation Alliance

Acknowledgements

Dedicated to the men who warned us of this dreadful disease, and the failure of the USFWS to protect our ungulate populations and the health and safety of the America Citizens.

Dr. Valerius Geist: professor emeritus of environmental science at the University of Calgary, Alberta.

Scott Rockholm: Save Western Wildlife & Rockholm Media Group

Tim Kemery: Idaho President of Western Predator Control

Dr. Rod Evans DVM: Idaho Past President of Western Predator Control

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Colorado Conservation Alliance Website: cocoal.org

Echinococcosis in the US
Jenifer Chatfield, DVM, DACZM, DACVPM

Translocation of wildlife is rarely a good idea and typically results in negative outcomes for the wildlife. Public health consequences can be significant and are frequently cited as the basis to prohibit the public from relocating or translocating native wildlife.
Human echinococcosis is a parasitic disease that affects an estimated 2–3 million people and results in an annual monetary loss of over $750,000,000 worldwide. The only treatment for human cystic echinococcosis is surgery to remove the cysts from the affected organ(s) or PAIR (percutaneous aspiration, injection of chemicals and re-aspiration) as traditional anthelmintics are largely ineffective against the encysted parasite. Treatment is difficult, costly, and risky. Canids, such as wolves, dogs, and coyotes, are the only definitive hosts producing the infective stage of the parasite in their feces. In order to most effectively prevent human infection
is to remove the definitive hosts from the area. Humans are not the only species adversely impacted, however. Wild ruminants such as deer and elk serve as initial hosts for the parasite.
Once a wolf ingests infected tissue from the initial host, such as deer meat or entrails, the wolf begins to shed the infective stage of the tapeworm in feces and the environment is contaminated. Humans may be infected through ingestion of contaminated soil or even through consumption of fresh produce from contaminated areas.
In areas where livestock are raised, environmental contamination with echinococcus can produce economical losses for producers as infected sheep and cattle carcasses may be downgraded at slaughter upon inspection. Prevention of environmental spread and avoidance of introduction of the parasite to new areas is essential to prevention of human infection and livestock impact. Once introduced, the only real solution to eliminate the parasite is to remove the host that sheds the infective stage – wild canids. If wolves are introduced from an area containing the parasite, the wolves will
introduce echinococcus to their new environment. As one might imagine, clean-up can be costly and difficult and perhaps should be the responsibility of the entity that introduced the wolves.
Given the potential for infection of our most vulnerable, our children, through contamination of playgrounds and other outdoor recreation areas, decreasing environmental contamination must be accomplished.
While echinococcus is globally distributed, infection is rarely reported in the United States and it has not been considered endemic to Colorado, historically. Translocation of any wild animal population carries with it the risk of disease introduction to the new environment. Echinococcus is present in Canada and parts of Alaska, and wolves moved from these areas are quite likely to be circulating echinococcus and other parasites. In fact, echinococcus identified recently in Idaho wildlife was determined to be the northern species, Echinococcus canadensis, considered endemic to Canada. As the parasite was characterized following wolf translocation, it is difficult to conclusively determine if the translocation introduced the parasite. But, one can surmise that the wolf translocation is the likely culprit.
If one is interested in preventing this awful disease in Colorado families, the solution is fairly straight-forward: eliminate the introduced definitive hosts. Given the financial

burden generated by human infections and potential economic losses to livestock producers, prudence would dictate that any translocated wolves from an echinococcus-endemic region be avoided

1. Jacey Roche Cerda and Lora Rickard Ballweber (2018) Confirmation of Echinococcus canadensis G8 and G10 in Idaho Gray Wolves (Canis lupus) and Cervids. Journal of Wildlife Diseases: April 2018, Vol. 54, No. 2, pp. 403-405.
2. Cerda, J., Buttke, D., & Ballweber, L. (2018). Echinococcus spp. Tapeworms in North America. Emerging Infectious Diseases, 24(2), 230-235.
3. Echinococcosis from: https://www.cdc.gov/dpdx/echinococcosis/index.html. Accessed 2/12/2020.
4. William J. Foreyt, Mark L. Drew, Mark Atkinson, and Deborah McCauley (2009) Echinococcus granulosus in Gray Wolves and Ungulates in Idaho and Montana, USA. Journal of Wildlife Diseases: October 2009, Vol. 45, No. 4, pp. 1208-1212.
5. Narra, R., Maestri, M., Budke, C. M., Tamarozzi, F., Mariconti, M., Nicoletti, G. J., ... Brunetti, E. (2016). Costs Associated with Surgically Treated Cases of Abdominal Cystic Echinococcosis: A Single Center's Experience from 2008 to 2014, Pavia, Italy. The American journal of tropical medicine and hygiene, 95(2), 405–409.
6. Schurer, J. M., Rafferty, E., Farag, M., Zeng, W., & Jenkins, E. J. (2015). Echinococcosis:
An Economic Evaluation of a Veterinary Public Health Intervention in Rural Canada. PLoS
neglected tropical diseases, 9(7), e0003883.
7. Wildlife Translocation from:
https://www.aphis.usda.gov/wildlife_damage/reports/Wildlife%20Damage%20Management%20Technical%20Series/Wildlife-Translocation-WDM-Technical-Series.pdf
accessed 2/13/20.

To whom it may concern:

As a Colorado Veterinarian I am extremely concerned about the transmission of Echinococcus canadensis Genotypes G8 and G10 by wolves and its impact on our livestock industry and deer and elk herds. We already have wolves here in Colorado carrying Echinococcus. As wolves are introduced and more wolf-wildlife-livestock predation occurs, this disease will be spread across the state and carried to all new wolf introductions. As an USDA Accredited Veterinarian, I have agreed to a unique set of obligations and expectations. USDA Accredited veterinarian's carry out the programs and services of the USDA APHIS. These disease surveillance and eradication programs are designed first and foremost to protect public health from communicable diseases. Much effort is spent to prevent, control, and eradicate diseases in animals which can also be transmitted to people. We must keep trans-boundary and emerging diseases in mind every time we examine an animal. It is our responsibility to report and help control such diseases.

I am concerned about the danger of Echinococcus disease in humans, especially children here in Colorado. When our livestock and wildlife pick up this infection from wolf scat, their meat can become tainted with infectious particles. Our domestic dogs will also pick up this infectious disease and can serve as bridge-hosts to bring dangerous Echinococcus infections home to their human families.

Humans

According to the CDC "Alveolar and cystic echinococcosis are emerging and reemerging in Europe, Africa, and Asia. The expansion on Echinococcus spp. Tapeworms in wildlife host reservoirs appears to be driving this emergence in some areas. Recent studies suggest a similar phenomenon may be occurring in North America." Also, from the CDC "Echinococcus spp. are zoonotic tapeworms currently infecting 2-3 million persons worldwide and causing $200 to $800 million in annual economic losses related to human infection." The worldwide impact of Echinococcus on public health and the related expenses is reason enough to warrant a NEPA review of wolf reintroduction in Colorado.

Deer and Elk

Impacts will also occur to our deer and elk herds as incidental hosts. Our big game herds are already at risk from CWD. They do not need another disease to deal with. If one cyst is incised in field preparation of a deer or elk for meat, the entire carcass is contaminated. How many hunters will unknowingly open a cyst putting themselves at risk of hydatid disease?

Livestock
From a CSU paper by Cerda, J. etal. "Infection in livestock can cause substantial economic losses, including the condemnation of infected viscera; decreased meat, milk, and wool production; and delayed fecundity, growth, and performance. Estimated global economic loss due to infection in production animals is $1.5–$2 billion annually. The global disease burden on wildlife species is unknown, as is the effect that echinococcosis may have on the overall fitness of wildlife animals and populations."
Hydatid disease will be causing economic hardships for the livestock industry in addition to the losses from wolf predation and mitigation efforts.

Where will these introduced wolves come from? Between 2006 and 2008 a survey of wolves found a 62% positive rate for Echinococcus in Idaho and 63% positives in Montana. This was the first the authors had heard of Echinococcus in Idaho and Montana. They can be treated but they will still comingle with the wolves here that are positive with an exponential expansion of the disease in Colorado. Any transportation of wolves into Colorado must follow the laws that any other species would have come under. Extensive testing for diseases and treatments must be done with peer review and transparency to the public.

Echinococcus is classified by USDA APHIS as a regulated livestock pathogen. The infected wolves in Colorado belong to the Federal government not the state of Colorado. This disease should be dealt with just like any other disease by preventing, controlling, and eradicating the disease.

It is for these reasons I request the Colorado Parks and Wildlife to complete a NEPA evaluation of the risks of introducing and intensifying Echinococcus infections through wolf introduction into the State of Colorado to wildlife and livestock.

Bob Bessert DVM
Paul Bingham DVM
Shawn Bott DVM
Stephanie Farnese DVM
Kramer Gopffarth DVM
Peter Jouflas DVM
Ian Smith DVM
Lee Smith DVM
Dick Steele DVM
Tom Gore DVM

Declaration of Warning for the Court

To: The Honorable Bench

Western Predator Control Association, Rodney E Evans DVM, Tim Kemery

Subject: Protocol to Remove Infection of Echinococcus canadensis from Wolves; Lifecycle of E canadensis

Research by Western Predator Control Association (WPCA) revealed that Echinococcus granulosis (E. g) was brought to N.W. Canada by a shipment of domestic reindeer from Lapland in the year 1900. Association with the wild reindeer and/or the herd dogs that accompanied them led to infection of the wild reindeer, moose, and caribou—and eventually to the infection of the wolves. People were also infected. This explains the high infection rate of the wolves in this part of Canada and explains why the wolves injected into the U.S. are all infected. This is where the wolves were captured for shipment to Idaho—and where they now are spreading the infection to our wildlife and domestic ungulates. People were also infected at a high rate in N.W. Canada.

Thus, all the wolves brought into Idaho and Yellowstone were likely infected—and the team that brought them knew they were infected. They treated them once with Praziquantel—or at least claimed they did.

Somewhere in the mix, the hydatid cyst and the tapeworm that causes it became endemic in Idaho. This was NOT endemic in Idaho prior to this date. The name—Echinococcus granulosis—was changed to Echinococcus canadensis somewhere in this mix.

The life cycle of the Echinococcus canadensis involves wolves as the definitive host. They ingest the eggs in the stool of other infected canines or while eating hydatid cysts in the internal organs of the wild ungulates and domestic livestock. The life cycle takes approximately six weeks to complete and takes an Intermediate host which would be a wild ungulate or a domestic ungulate. They become infected by grazing and ingesting the eggs of the E. canadensis from the contaminated grass.

The tapeworm is then passed from the ungulates—wild or domestic—when they are killed and eaten.

Hydatid cysts contain live larvae and are eaten by dogs, wolves, and other canines. They enter the canine as larvae or subadult tapeworms and develop into adults. The adult tapeworm is approximately 0.25 inches long and includes five segments one of which is the egg sac. The egg sac releases the eggs which pass in the stool of the canine.

Parasitologists tell us that a single wolf carrying a relatively low 1,000 tapeworms can spread up to 1 million eggs every two weeks. It is not uncommon for a wolf to carry 30,000—40,000 adult tapeworms. A canine has contact with a continuing supply of all stages of tapeworms in heavily infected areas.

Praziquantel only kills the adult tapeworms and it is questionable how many adults can be killed with the allowable doses for canines. W. Evan Secori and Susan Mongomery wrote in a paper dated 2015 that "(Praziquantel) is only effective against adult parasites and a single treatment may not kill all the worms.". Since wolves are constantly eating hydatid cysts and sub-adult stages along with adult stages, they are—under normal conditions—carrying hundreds of thousands of adults along with millions of

sub-adult stages of tapeworms. Praziquantel kills some of the adults leaving some adults to hatch in addition to millions of sub-adults maturing all the time within the digestive tract.

So, we see that one dose of Praziquantel only has a minute effect on the numbers of tapeworms. A second dose of Praziquantel in 30 days would kill another group of worms that have matured to adults. A third dose in another 30 days would likewise kill some more maturing adults.

This would be enough to delay the numbers of eggs being spread around, but only if all the stool material passed by the wolves in their cages was kept cleaned up. If wolves are on their own like those recently injected into Grand County Colorado, they will continue reinfecting themselves by coprophagic means and a wolf free from an infection of E. canadensis becomes a dream which seems unattainable.

Truthfully, it seems almost impossible to treat a wolf enough to stop the passing of eggs completely.

Both Parasitologists Dr Laura Ballweber from Colorado State University and Dr Foreyt from Washington State University made clear references to the possibilities of incomplete cleaning of the Echinococcus tapeworm larvae from the translocated wolves brought to Idaho and Montana with a single dosing of Praziquantel. This protocol has been repeated in treating the recent Oregon wolves released in Grand County Colorado—with the same outcome expected.

With these issues in mind and to have control of this disease, it is imperative to have a comprehensive surveillance and control program in place.

To backtrack a little and remind the Court of the serious nature of this disease, the tremendous expense involved in treating it, and the ease of being exposed to it, we review some of the facts.

*In 2001 a resident of Custer County Idaho was infected by doing yard work in a yard that transplanted wolves frequented and defecated on. It took approximately two years to diagnose and $63,000 above insurance payments to remove the cyst and approximately half the liver. These were the costs in the early stages—around 2005.

*Wolves travel on back-country roads and leave piles of scat. The scat dries out and becomes aerosol when ATVs run over it while drivers inhale the dust carrying tapeworm eggs.

*Chokecherries, wild raspberries, and other berries growing beside the roads are covered with eggs and dust. Do you clean them off before eating?

*Dogs sniff and lick wolf scat and your pets then lick your face. Dogs roll in wolf scat and then come back in your house and yard. Your dogs eat on gut piles of butchered deer, elk, or domestic animals—all of which carry hydatid cysts—and then come home to contaminate your lawn and house.

*Birds—especially scavengers like magpies and ravens—give new meaning to the term airmail when you think of tapeworm eggs.

*Flies are clustered on wolf scat when you come by and they swarm you landing on your lips and near your mouth and eyes. Many flies eat manure so they carry wolf manure in your face. Flies have been documented flying over a mile in 24 hours. So, you could be having a picnic a mile away from the wolf scat when exposed to it.

*A hydatid cyst has been found in a man's leg at the site of a wasp sting—so wasps and bees can carry it.

*You drink out of a spring or stream while—unbeknown to you—a wolf had defecated in the stream around the corner upstream. Giardia would seem like a walk in the park compared to tapeworm.

*Tragically –our kids are more at risk than the rest of us. Kids will be kids—sticking things in their mouths, picking everything they see for close examination, not washing their hands, wading and swimming in creeks and canals, stomping in puddles to splash each other, and literally everything else!

The wolf reintroduction into Colorado has—as it did in Idaho—polarized the people. Those that want the wolves want them whatever it costs. They don't want to know about the tapeworm. The polarization is the reason we don't reveal the identity of the person infected by the tapeworm. The family fears for their safety. Polarization is why we got a bomb threat against a Town Meeting we had to get the word out about the tapeworm the wolves were carrying.

This is an economic issue for the hunters and outfitters and guides that depend on big game numbers. It is an economic issue for the livestock industry. The ramifications of contamination of our environment with tapeworm eggs are huge and tragic.

While this is an economic issue, it is—above all else—a public health and safety issue!!

s/ Rod Evans DVM

s/ Tim Kemery

EG Graphic from Pearson Education 2013 Accessed 12/28/2023

https://i.pinimg.com/originals/b9/6a/24/b96a2465e8445fc17d1280d078b3fbd3.jpg

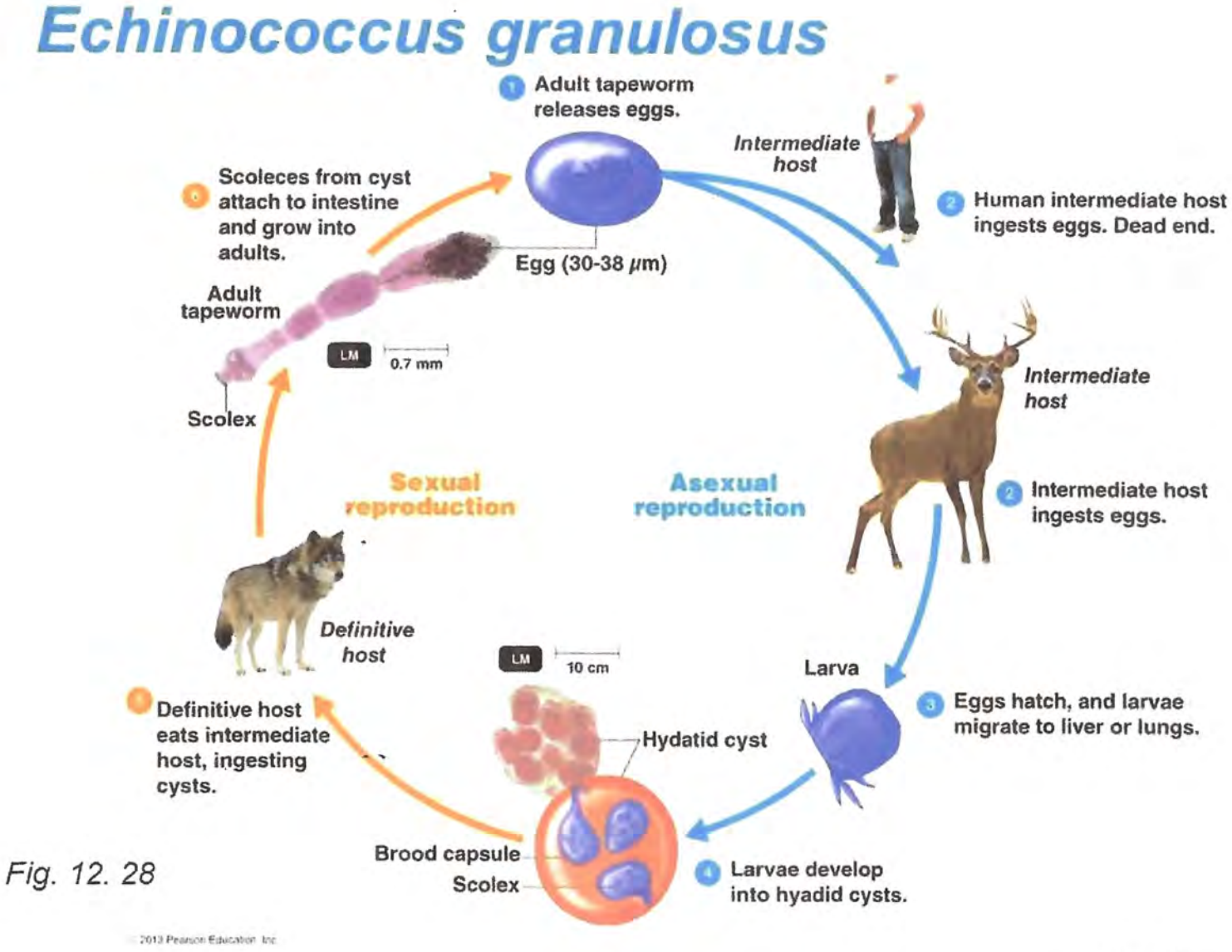

Fig. 12. 28

To: Montana Legislature's Environmental Quality Council

Attention: Hope Stockwell, Research Analyst, Environmental Policy Office, Montana Legislative Services Division; 406-444-1640; hstockwell@mt.gov

From: Valerius Geist, Profesor Emeritus of Environmental Science, The University of Calgary, Calgary, Alberta, Canada

April 27th 2010

Re: **Hydatid disease**

There is a fair amount of technical literature available on hydatid disease. However, this knowledge is useful only if interpreted professionally, rather than taken at face value. The latter can be misleading. Moreover, such interpretation does require some additional knowledge not covered by the technical literature.

Hydatid disease is most dangerous when it is spread by the family dog in the house, kennel and yard, in such a fashion, that infections of family members is ongoing, thereby leading to multiple infections. The danger arises from the family dog spreading with its feces the eggs of dog tape worms (*Echinococcus granulosus*) or Fox tape worm (*E. multilocularis*). The danger is heightened by moist lawns and yard conditions and lessened, but not eliminated, when the yard is dry and dusty. Moist conditions favor the survival of tape worm eggs, and dry sunny conditions reduce such. Since the dog cleans its anus and fur with its tongue, the tape worm eggs are also transferred to its fur, from which they are shed in the house, or when the dog is handled by the family. The continuous presence of infective eggs on the floor and furniture favors the infection of children who play on the floor and which may then transfer hydatid eggs from their dirty hands to their mouths.

The manner in which we handle our family dogs is based on a long standing tradition, one that does not include precautions pertaining to hydatid disease. This is in historical contrast to countries where hydatid disease is a serious concern, where dogs are kept out of homes, especially where dogs are considered unclean and thus rarely handled. In Russian Karelia not only were dogs kept out of homes, and warnings issued against petting or playing with dogs, but guests were also expected to wash their hands at the door.

Also, in northern Canada, where hydatid disease is prevalent, dogs are not usually kept as house pets, but as working sled dogs. The dogs are tied up away from houses, where there is limited interaction between the dogs or their owners. Secondly, they shed infected feces into wet herbaceous vegetation where tape worm eggs are less likely to be spread than on a ranch, rural or urban yard. A likely source of infection are fecal soiled sled harasses. Please note, that the manner in which we treat dogs as pets is highly conducive to passing on hydatid disease to family members.

How can family dogs become infected with dog or fox tape worm? In order for the dog to become infected it needs to ingest the hydatid cysts found primarily in lungs and livers of big game such as deer, elk and moose. Or, in the case of the pastoral form of the dog tape worm, in the lungs and liver of domestic sheep.

In order that rural farm and ranch dogs or urban hunting become infected with dog tape worm, the dogs must have access to piles of infected big game offal, or to winter killed big game. Consequently, the crucial contributing factors are infected big game herds close to family dogs, a condition that is prevalent where, primarily, deer and elk stay close to ranches and farms or in rural hamlets and recreation communities. This is a condition found not infrequently in winter, especially if such big game animals crowed in close to humans in order to escape wolf predation. Under such conditions deer and elk, the intermediate host, harboring hydatid cysts come in close proximity of dogs, the definitive host of the dog tape worm.

Dogs guarding homes and buildings, but free to roam are likely candidates to roam far at night and come across infected gut piles left by hunters, or come across the carcass of elk and deer that died of natural causes. Moreover, hunting dogs are at risk if roaming ahead of their owners they come across infected big game gut piles.

Deer and elk become infected by hydatid eggs shed in the feces of coyotes and wolves. Such eggs find their way onto vegetation where they are ingested by feeding deer or elk. Wolves and coyotes are thus the reservoirs of hydatid disease. The more infected wolves and coyotes, the more infective eggs are passed on big game ranges, and the higher the incident of infected deer and elk. If these infected deer or elk move to lower elevations onto ranches, they carry hydatid cysts close to rural dogs fro months on end.

While hydatid disease is not serious if one or two cysts form in liver or lungs, where they are encapsulated by the host tissue and where such cysts may calcify. The exception here is a cyst in the brain, as such is lethal. Cysts may appear in atypical locations such as the heart, lungs or long bones where they are medically problematic.

Hydatid disease becomes very dangerous where the individual human ingests hydatid eggs again and again. This leads to multiple cyst formation, and such can be lethal. Multiple cyst are much more likely than single infections to interfere with organ functions, overcome the immune system of the host, and grow to large size. This may take a decade or more. Large cysts may burst in the infected person during exercise such as football or hockey games. In a small percentage of cases this will lead to quick death through a severe allergic reaction. It will lead to hospitalization and extended attempts to clean the patient's peritoneal cavity as fragments of the interior lining of the cyst will grow new cysts full of tape worm heads. Extended medical care is then inevitable. A persons prognosis depends on whether rural doctors know and recognize symptoms of the disease.

While the most dangerous situation arises with infected family dogs, persons may also catch the disease handling the carcasses of infected wolves, coyotes and foxes, or ingesting contaminated berries and mushrooms (if such are eaten raw). The tiny tape worm eggs can be liberated as the feces dries, and is disturbed by a curious onlooker poking into the fecal matter to discover what the wolf or coyote ate. Infection rates from such causes are low and multiple infections even rarer. Sensible precautions and hygiene can greatly reduce infections from such sources.

Family dogs living for many months on end close to sizable infected deer and elk populations are most at risk catching and passing on hydatid disease repeatedly to their owners. There are claims that hydatid eggs ingested by humans rarely lead to infections as conditions inside humans do not match such of deer or elk. I have seen no data supporting or contradicting this claim. Whatever the potential rate of infection, with multiple or continual exposure to abundant dog tape worm eggs, multiple infections, especially in children are likely.

You are probably aware that claims are made that based on the technical literature, hydatid disease is rare. This assessment in technical reports emanating largely from hospitals is based on the gross rate of that disease compared to other ailments the regional hospitals are dealing with. No report has isolated the the population at risk, namely the number of people who come in regular contact with infected wolves, as well as the number of people that feed infected offal from caribou and moose to their dogs. Not at risk are hunters and trappers that handle uninfected wolves or that feed uninfected offal to their dogs, because the disease is not found everywhere. Nor are the urban populations serviced by said hospitals at risk as their dogs are not fed infected offal, while those that hunt do not bring into cities infected offal. In short, the population at risk for hydatid disease is tiny compared to the population at large serviced by regional hospitals. This implies that the risk of becoming infected where the circumstances favor such is actually fairly high. I am not aware that a refined analysis trying to capture the population at risk has ever been done. Not everything relevant is covered by the technical literature, as indicated by my experiences during my research work and retirement as recorded below.

Another reason for the low incident of hydatid disease historically is that wolves have been rare historically and have only in recent times increased sharply in number. For instance, I became aware in 1961 while on my study area for Stone's sheep that, years earlier, in northern British Columbia there had been extensive wolf control via aerial broadcast of poison bait onto frozen lakes in winter. I was informed of such by native trappers and guides who told me that the reason for said aerial poisoning was to control diseases. This happened to a wolf population which had apparently expanded after World War II. Hydatid disease was fairly widespread throughout British Columbia before the 1950's. Furthermore, trapping was common then and trappers widely used dog teams. However, one cannot travel extensively with dog teams where wolves are common. This has been formally reported by the Danish Greenland explorer Peter Freuchen. He was stranded in a meteorological station as supplies failed to get through to him as wolf packs attacked the sled dogs of the supply trains. In Greenland then there were regions with people (and dogs) and regions with wolves but without people (and dogs).

During my studies, when native trappers were my neighbors a days trip away by dog sled, there were few wolves, but a great abundance of caribou. After the native trappers left, resettling to a native community, wolf numbers increased till super packs were recorded by my students. Caribou became very scarce. Furthermore, besides aerial control of wolves, British Columbia had a corps of predator control officers who were efficient as I can vouch form my personal experiences on Vancouver Island. Where wolves became troublesome by preying on livestock they went into action, as they did on our neighbors farms, eliminating problem wolves. In earlier decades, conservation officers also went out after hunting season and trapped wolves. Moreover, wolves may be taken by hunters in season, and farmers with depredation problems can get permission to shoot or trap wolves and may not only call on provincial predator control officers for help, but also on professional trappers. All this happened in my neighborhood and two misbehaving packs of wolves were removed. In the Russian literature there are hints that hydatid disease is depended on densities of predators. Where such are low, the infection rate in wild ungulates is also low, and vice versa. Wolves built up since the 1980's in British Columbia. However, with its policies of wolf control in settled areas, wolf densities, and thus hydatid disease, and the availability of infected deer, elk and moose to rural dogs is likely to be low. There are also claims that *Echinococcus granulosus* has a low infectivity in humans, implying that one need not worry too much about it. First of, if this claim is based on the low prevalence rate as reported in the literature, than it ignores the lack of a detailed analysis of the population at risk. As I indicated above, the apparent low rate of prevalence is due to the inclusion of populations <u>not</u> at risk. Secondly, this is in flat contradiction to the historical perception of this parasite. In Finland, the state sent helicopter crews equipped with submachine guns to eliminate wolves, in order to control this disease. In Russian Karelia rural people reduced contact with dogs, would not allow dogs in dwellings, and made even visitors wash hands at the door before entry. I was subject as a child to some of these teachings initiated by my maternal grandfather as a member of our family had died of hydatid disease. Thirdly, the claim of a benign parasite is flatly contradicted by Delane C. Kritsky; Professor Emeritus, Idaho State University, who was Associate Dean and Professor (35 years) within Department of Health and Nutrition. I am sure his statement has been circulated to you. It happens to coincide with what I was taught in parasitiology classes at the University of British Columbia nearly fifty years ago by Professor Adams who had studied the disease hands on! We were instructed to be very cautious as an *Echinococcus* infection can be lethal, or lead to complicated surgery and extended recovery. We were then also shown colored slides of what such surgery taken in Vancouver hospitals looked like. It is not a disease I can take lightly. The most serious concern is thus the transmission of *Echinococcus granulosus* eggs from wolves (coyotes) to deer/elk, followed by a transmission to family dogs in rural settings where deer/elk crowed in about ranches, farms and settlements, followed by repeat transmissions of hydatid eggs from infected yards, lawns and homes to their inhabitants, especially children. Multiple infections are almost certainly assured. The disease may take a decade or more to develop, and is not readily diagnosed, though some individuals with a cyst in the brain or heart etc may die earlier. If the transmission chain above is broken, you need not worry about hydatid disease in above context. Direct transmission from the feces or fur of infected wolves, coyotes and foxes is a lesser danger which can be countered by appropriate avoidance and hygienic practices.

Sincerely,

Centers for Disease Control and Prevention. CDC twenty four seven. Saving Lives, Protecting People
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Volume 24, Number 2—February 2018
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L.R. Ballweber); National Park Service, Fort Collins (D.E. Buttke)

Cite This Article

Abstract

Alveolar and cystic echinococcosis are emerging and reemerging in Europe, Africa, and Asia. The expansion of Echinococcus spp. tapeworms in wildlife host reservoirs appears to be driving this emergence in some areas. Recent studies suggest a similar phenomenon may be occurring in North America. We describe the context of Echinococcus spp. research in North America, with a specific focus on the contiguous United States. Although studies were conducted in the United States throughout the 1900s on various sylvatic and domestic Echinococcus spp. tapeworm cycles, data are lacking for the past ≈30 years. We review previous research, provide analysis of more recent focal studies, and suggest that Echinococcus spp. tapeworms, in particular E. canadensis, may be underrecognized. As a result, we suggest that additional research and surveillance be conducted for these tapeworms in wildlife host reservoirs across the United States.

Echinococcus spp. (family Taeniidae, class Cestoda) are zoonotic tapeworms currently infecting 2–3 million persons worldwide and causing US $200–$800 million in annual economic losses related to human infection (1,2). Infection appears to be increasing, reemerging, and geographically expanding in multiple locations across Europe, Asia, Africa, and the Americas (primarily in Latin America), with >200,000 new cases/year (3). Echinococcus spp. tapeworms have complex domestic and sylvatic life cycles that affect the health of >40 companion animal, livestock, and wildlife host species (4,5).

The basic Echinococcus spp. life cycle involves 2 hosts, where carnivores (wild and domestic) are the definitive hosts and small mammals and ungulates (domestic and wild) are the intermediate hosts (6). From within the small intestine of the definitive host, the mature tapeworm releases immediately infective eggs that are shed with the feces into the environment. Intermediate hosts ingest the eggs as they feed on contaminated vegetation. Once ingested, the oncosphere hatches and penetrates the small intestine to migrate to various organs and tissues, where it develops into one or more hydatid cysts (6). Definitive hosts ingest the cysts when feeding on the viscera of infected intermediate hosts (6). Humans are aberrant dead-end hosts that are infected from accidental ingestion of eggs, typically from interaction with domestic dogs, which act as bridge hosts between wildlife and the human environment. Contamination of the human environment may occur either directly (from feces) or indirectly (eggs carried on paws and fur) (7). Humans may also become infected through foodborne transmission, most often through eating inadequately washed fruits and vegetables (8). Intermediate hosts and humans may develop alveolar, cystic, or polycystic echinococcosis, depending on the parasite species involved (6).

Infection in livestock can cause substantial economic losses, including the condemnation of infected viscera; decreased meat, milk, and wool production; and delayed fecundity, growth, and performance (4). Estimated global economic loss due to infection in production animals is US $1.5–$2 billion annually (2). The global disease burden on wildlife species is unknown, as is the effect that echinococcosis may have on the overall fitness of wildlife animals and populations.

Echinococcosis

17 May 2021

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Français
Русский
Español

Key facts

- Human echinococcosis is a parasitic disease caused by tapeworms of the genus Echinococcus.
- The two most important forms in humans are cystic echinococcosis (hydatidosis) and alveolar echinococcosis.
- Humans are infected through ingestion of parasite eggs in contaminated food, water or soil, or after direct contact with animal hosts.
- Echinococcosis is often expensive and complicated to treat and may require extensive surgery and/or prolonged drug therapy.
- Prevention programmes focus on deworming of dogs, which are the definitive hosts. In the case of cystic echinococcosis preventive measures also include, deworming dogs, slaughterhouse hygiene, and public education.
- More than 1 million people are affected with echinococcosis at any one time.

Human echinococcosis is a zoonotic disease (a disease that is transmitted to humans from animals) that is caused by parasites, namely tapeworms of the genus Echinococcus. Echinococcosis occurs in 4 forms:

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Echinococcus granulosus in Gray Wolves and Ungulates in Idaho and Montana, USA

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ABSTRACT: We evaluated the small intestines of 123 gray wolves (*Canis lupus*) that were collected from Idaho, USA ($n=63$), and Montana, USA ($n=60$), between 2006 and 2008 for the tapeworm *Echinococcus granulosus*. The tapeworm was detected in 39 of 63 wolves (62%) in Idaho, USA, and 38 of 60 wolves (63%) in Montana, USA. The detection of thousands of tapeworms per wolf was a common finding. In Idaho, USA, hydatid cysts, the intermediate form of *E. granulosus*, were detected in elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and a mountain goat (*Oreamnos americanus*). In Montana, USA, hydatid cysts were detected in elk. To our knowledge, this is the first report of adult *E. granulosus* in Idaho, USA, or Montana, USA. It is unknown whether the parasite was introduced into Idaho, USA, and southwestern Montana, USA, with the importation of wolves from Alberta, Canada, or British Columbia, Canada, into Yellowstone National Park, Wyoming, USA, and central Idaho, USA, in 1995 and 1996, or whether the parasite has always been present in other carnivore hosts, and wolves became a new definitive host. Based on our results, the parasite is now well established in wolves in these states and is documented in elk, mule deer, and a mountain goat as intermediate hosts.

Key words: *Canis lupus*, *Echinococcus granulosus*, survey, tapeworm, wolves.

Echinococcus granulosus is a minute tapeworm that is approximately 3 mm in length and requires two mammalian hosts to complete the life cycle. Genetic heterogeneity is common in *E. granulosus*, and at least 10 strains of the parasite have been identified (Jenkins et al., 2005). In North America, adult *E. granulosus* is found primarily in wolves (*Canis lupus*), coyotes (*Canis latrans*), and domestic dogs (*Canis lupus familiaris*). The intermediate form of the tapeworm is a hydatid cyst (metacestode), which is a fluid-filled cyst containing numerous immature forms of the tapeworm called protoscoleces. Hydatid cysts are found primarily in the lungs and liver of wild, even-toed, and domestic ungulates but will also develop in certain other animals, including humans. Hydatid disease in humans, caused by specific strains of *E. granulosus*, is an important zoonotic disease. Comprehensive reviews of *E. granulosus* and hydatid disease have been published (Thompson and Lymbery, 1995; Jones and Pybus, 2001; Jenkins et al., 2005).

In 1995 and 1996, 66 wolves were reintroduced from Alberta, Canada, and British Columbia, Canada, into central Idaho, USA ($n=35$), and into Yellowstone National Park, Wyoming, USA ($n=31$). At the end of 2007, there were an estimated 1,500 wolves in Idaho, Montana, and Wyoming, USA (Sime et al., 2008).

In North America, adult *E. granulosus* in wolves has been reported previously from Alaska, USA; Minnesota, USA; Alberta, Canada; British Columbia, Canada; Northwest Territories, Canada; Ontario, Canada; and Yukon Territory, Canada (Choquette et al., 1973, and reviewed by Leiby and Dyer, 1971; Jones and Pybus, 2001), but recent surveys within the past 20 yr are lacking. Hydatid cysts have been reported from moose (*Alces alces*), elk or wapiti (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), caribou (*Rangifer*

LETTERS

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Confirmation of *Echinococcus canadensis* G8 and G10 in Idaho Gray Wolves (*Canis lupus*) and Cervids

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ABSTRACT: We confirm the presence of *Echinococcus canadensis* genotypes G8 and G10 in gray wolves (*Canis lupus*) and cervids in Idaho. Our results demonstrated that cystic echinococcosis remains a potential public health issue, indicating the need for regular deworming of domestic dogs, who often act as potential bridge hosts.

Foreyt et al. (2009) reported *Echinococcus granulosus* in gray wolves (*Canis lupus*) in Montana and Idaho and in various wild ungulates in Idaho. At that time, it was suggested that the *E. granulosus* variant present was the northern biotype. With advances in molecular genetics, the northern biotype is now recognized as incorporated within the species *Echinococcus canadensis*, which encompasses two previously identified *E. granulosus* genotypes: G8 and G10 (Thompson 2017). These genotypes have a Holarctic distribution with sylvatic cycles involving wolves as definitive hosts and moose (*Alces alces*), elk (*Cervus canadensis*), and caribou (*Rangifer tarandus*) as intermediate hosts (Lymbery et al. 2015; Romig et al. 2015; Cucher et al. 2016). *Echinococcus canadensis* was also identified in domestic dogs (*Canis lupus familiaris*; Himsworth et al. 2010). *Echinococcus canadensis* genotypes cause human cystic echinococcosis (CE); however, the disease appears to be less severe than that associated with *E. granulosus* (G1–3) and *Echinococcus intermedius* (G6/7; Oksanen and Lavikainen 2015; Cucher et al. 2016).

Because the different species and genotypes of *Echinococcus* have distinct biological and epidemiologic significance, molecular characterization is critical to understanding transmission patterns, assessment of public health risks, and the design/implementation of control and prevention programs. Given that Foreyt et al. (2009) did not provide the genotypes present, our purpose was to determine which genotypes are present in wildlife in Idaho.

Intestinal tracts from seven wolves, 11 coyotes (*Canis latrans*), and three red foxes (*Vulpes vulpes*); lungs from five elk and one mule deer (*Odocoileus hemionus*); and lungs, spleen, and liver from one mule deer were submitted from hunter-killed animals from central and northern Idaho between 2011 and 2014. Samples were frozen before shipment and stored at –80 C for >2 wk before processing. Once thawed, fecal samples were obtained from the rectum. The tracts were processed for tapeworm recovery, as previously described (Foreyt et al. 2009). The lungs, liver, and spleen were examined grossly. Cysts were excised from the tissues, and contents and sections of cyst walls were frozen at –80 C.

Genomic DNA was isolated from *Echinococcus* tapeworms, cyst walls/contents, and fecal samples, as previously described (da Silva et al. 1999), except Lysing Matrix A (MP Biomedicals, Santa Ana, California, USA) was substituted for Lysing Matrix F (MP Biomedicals), and the run time was increased to 6.0 M/s for 40 s. We stored DNA at –20 C until it was used in a multiplex PCR for the simultaneous detection of *E. granulosus* (G1–10), *Echinococcus multilocularis*, and other tapeworm genera, including *Taenia* (Trachsel et al. 2007). Because sequencing of amplicons obtained from the multiplex procedure was unsuccessful, a second PCR targeting the *NADH1* gene was performed (Obwaller et al. 2004). Amplicons were gel-purified using the QIAquick Gel Extraction Kit (Qiagen, Valencia, California, USA), following manufacturer's instructions, and products submitted to Colorado State University's Proteomic and Metabolomic Laboratory (Fort Collins, Colorado, USA) for direct

sequencing. Sequences were edited and aligned using Lasergene 10 software (DNASTAR, Madison, Wisconsin, USA) and compared with GenBank database (National Center for Biotechnology Information, Bethesda, Maryland, USA).

All seven wolves were infected with *Taenia*; however, only four wolves were infected with *Echinococcus*. *Echinococcus canadensis* G10 was identified in three wolves, with G8 identified in the fourth. *Echinococcus* was not found in any of the coyote or fox samples, although three coyotes harbored *Taenia* sp. Neither *E. granulosus* (G1–3) nor *E. multilocularis* were identified in any animal.

Four sets of elk lungs harbored two hydatid cysts each, with the fifth harboring eight cysts. Sequencing results of four cysts from the latter elk showed both G8 and G10 were present (two cysts each). Sequencing results of single cysts from the other four elk showed G10 was present in three, with G8 in the fourth. One set of mule deer lungs had two cysts, both of which were identified as G8. The second mule deer had no cysts in the lungs but did have a single cyst in the spleen, which was identified as G10.

Echinococcus canadensis G8 and G10 was confirmed in wolves and cervids of Idaho. Previously, *E. granulosus*–infected sheep (*Ovis aries*) from Idaho were identified in the 1960s (Sawyer et al. 1969). Although that was before molecular genetics, given our current state of knowledge regarding the biology and systematics of the group, it is likely those were *E. granulosus* G1. There are no reports documenting infected wildlife in Idaho before that of Foreyt et al. (2009). Those authors proposed several potential sources for the current foci, including spillover from domestic sheep; however, any conclusions on the source of the present cycle are speculative.

Echinococcus granulosus (G1) and *E. intermedius* (G6/7) are the most important causative agents of CE worldwide (Hämäläinen et al. 2015; Cucher et al. 2016). In circumpolar regions, human CE infections identified before genetic typing are thought to be caused by the same genotypes currently identified in the local wildlife (G8/10); however, molecular confirmations of human infections in those regions are rarely performed. Thus far, G10 has been confirmed in four people (southern Mongolia, northwest Russia, northeast China, eastern Finland) and G8 in one person in Alaska (Hämäläinen et al. 2015; Yang et al. 2015).

In the northern latitudes of North America, CE remains a public health concern (Schurer et al. 2013). Because of the severity of human CE caused by *E. granulosus* (G1), control has focused on the domestic cycle of that species. For *E. canadensis*, sylvatic (wolf–cervid), semisynanthropic (hunting or sled dogs–cervid) and synanthropic (herding dogs–reindeer) cycles exist with human infections associated primarily with the latter two (Oksanen and Lavikainen 2015). Because dogs are key hosts bridging sylvatic cycles with human exposure, control efforts should target all at-risk animals in endemic regions. Thus, to prevent transmission to dogs, control of their diet is essential (Schurer et al. 2013; Hämäläinen et al. 2015; Oksanen and Lavikainen 2015). However, this is not always possible (e.g., free-roaming dogs). Therefore, deworming at-risk dogs is warranted. The frequency of treatments depends on the parasite species present. If the only concern is *E. canadensis*, deworming every 6 wk is appropriate. However, if *E. multilocularis* or other helminths are also present, monthly treatment may be necessary because of the shorter prepatent periods.

LITERATURE CITED

Cucher M, Macchiaroli N, Baldi G, Camicia F, Prada L, Maldonado L, Avila HG, Fox A, Gutiérrez A, Negro P, et al. 2016. Cystic echinococcosis in South America: Systematic review of species and genotypes of *Echinococcus granulosus* sensu lato in humans and natural domestic hosts. *Trop Med Int Health* 21:166–175.

da Silva AJ, Bornay-Llinares FJ, Moura IN, Slemenda SB, Tuttle JL, Pieniazek NJ. 1999. Fast and reliable extraction of protozoan parasite DNA from fecal specimens. *Mol Diagn* 4:57–64.

Foreyt WJ, Drew ML, Atkinson M, McCauley D. 2009. *Echinococcus granulosus* in gray wolves and ungulates in Idaho and Montana, USA. *J Wildl Dis* 45: 1208–1212.

STATE OF COLORADO

Dreher - DNR, Brian <brian.dreher@state.co.us>

Fwd: Results

1 message

DeWalt - DNR, Reid <reid.dewalt@state.co.us> Mon, Apr 13, 2020 at 9:58 AM
To: Brian Dreher - DNR <brian.dreher@state.co.us>, David Klute - DNR <david.klute@state.co.us>, Eric Odell - DNR <eric.odell@state.co.us>

FYI

Reid DeWalt
Assistant Director
Aquatic, Terrestrial, and Natural Resources

LIVE LIFE OUTSIDE

P 303.866.3203 ext. 4665 | C 303.921.6349
6060 Broadway, Denver CO 80216
reid.dewalt@state.co.us | cpw.state.co.us

---------- Forwarded message ---------
From: **Ver_Steeg - DNR, Jeff** <jeff.ver_steeg@state.co.us>
Date: Mon, Apr 13, 2020 at 8:37 AM
Subject: Fwd: Results
To: DNR_CPW_CPWLT@state.co.us <DNR_CPW_CPWLT@state.co.us>

All,

Final results of testing for *Echinococcus* in the wolf scat sample. Our lab determined that *E. canadensis* was detected in 3 of the 6 samples tested. We know that the *Echinococcus* tapeworm has been found in a coyote in Colorado already. How widely distributed it is in Colorado coyotes, or other canids, or how prevalent it is, remains unknown. The detection in scat from NW Colorado wolves is not surprising if you consider the probability that these wolves originated in Wyoming.

Jeff

---------- Forwarded message ---------
From: **Wood - DNR, Mary** <mary.wood@state.co.us>
Date: Mon, Apr 13, 2020 at 7:58 AM
Subject: Results
To: Jeff Ver_Steeg - DNR <jeff.ver_steeg@state.co.us>
Cc: Karen Fox - DNR <karen.fox@state.co.us>

Hi Jeff,

Attached is the final report on the wolf fecal samples submitted to the wildlife health laboratory. Echinococcus was detected via PCR and confirmed via sequencing in three out of the six samples submitted. Also attached is our fact sheet on hydatid disease.

Thanks!

Mary

--

Colorado Parks and Wildlife
Wildlife Health Lab
317 W Prospect Rd
Fort Collins, CO 80526

WHL # [redacted]
Animal ID: n/a

Submitted By: Jeff Goncalves
Submission Date: 3/3/2020

Species: Gray wolf (*Canis lupus*)
Age: unk **Sex**: multiple

History: Moffat County. Six fecal samples collected from suspected wolf kill site. [redacted] All collected at [redacted] on 1/2/2020-1/3/2020. Genetic tests confirm as gray wolf, including 3 females, 1 male [redacted] "wolf scat #1", collected 1/19/2020 [redacted] One sample confirmed as wolf.

DIAGNOSIS: *Echinococcus canadensis*, genotype G8, detected in three of six fecal samples.

REMARKS: *Echinococcus canadensis* is the cause of hydatid disease. The genotype detected in these wolf fecal samples are consistent with other reports from wolves in North America.

GROSS PATHOLOGY: Fecal samples are grossly within normal limits, with no obvious parasites/eggs observed. The feces are composed mainly of hair and are well-formed with normal consistency.

LABORATORY RESULTS:

[redacted] (F1):
Fecal Exam (feces): 1 EPG *Toxascaris leonina*, 4 EPG Taeniid-like eggs, and non-canine coccidia detected. Coccidia appearing to be non-canine in origin was identified in this sample. The presence of these non-canine coccidia are suggestive of environmental contamination or ingestion of feces from other species (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Not detected.

[redacted] (F2):
Fecal exam (feces): 300 EPG Taeniid-like eggs detected (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Detected, sequencing consistent with genotype G8.

[redacted] (F3):
Fecal exam (feces): 117 EPG *Toxascaris leonina*, 7 EPG Taeniid-like eggs (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Not detected.

[redacted] (F4):
104 EPG Taeniid-like eggs detected (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Detected, sequencing consistent with genotype G8.

[redacted] (F5):
Fecal exam (feces): 10 EPG Taeniid-like eggs and non-canine coccidia. Coccidia appearing to be non-canine in origin was identified in this sample. The presence of these non-canine coccidia are suggestive of environmental contamination or ingestion of feces from other species (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Not detected.

[redacted] (F6):
Fecal exam (feces): 1 EPG *Toxascaris leonina* and 154 EPG Taeniid-like eggs detected (CSU F20-0018846)
Echinococcus canadensis, in-house PCR (isolated Taeniid-like eggs): Detected, sequencing consistent with genotype G8.

Colorado Parks and Wildlife
Wildlife Health Lab
317 W Prospect Rd
Fort Collins, CO 80526

WHL # 17 195
Animal ID: CWD# 16005312
Head tag# 6111615

Submitted By: Josh Dilley
Necropsy Date: 2/16/2017

Species: Moose (*Alces alces*)
Age: Adult **Sex**: F

History: Moose reported to be in a resident's yard on and off for a month. CPW personnel responded and found moose in poor body condition, drooling, with one slightly cloudy eye. Tranquilized with 2cc BAM and euthanized with two gunshots to the chest.

DIAGNOSIS: 1/Brain: Granulomatous encephalitis, with intralesional cestode larval cyst (hydatid cyst disease).
2/Eye: Mild focal chronic active keratitis with mild corneal edema.

REMARKS: Gross and histologic findings are highly suggestive, if not diagnostic, for hydatid cyst disease, caused by *Echinococcus granulosus*. This is not considered an endemic parasite of Colorado and the disease is zoonotic. The cloudiness in the eye is likely due to trauma sustained due to neurologic disease. The animal may have had visual impairment due to the location of the parasite cyst in the brain.

GROSS PATHOLOGY: Presented for necropsy is the head of an adult female moose in poor body condition with mild autolysis. An approximately 4 cm diameter subcutaneous abscess is present associated with the base of the bell on the right side. There is no evidence of communication with tissues beyond the subcutaneous space. The abscess appears to be ruptured, with drainage through the skin. The lymph nodes of the head are diffusely enlarged. Bilaterally the corneas of the eyes have central cloudiness with no evidence of ulceration. Within the brain, on the left side, within the cerebral cortex, is an approximately 5 cm cyst. Because the skull was cut through the cyst with a band saw, the contents of the cyst appear to have been destroyed and cannot be evaluated grossly.

HISTOPATHOLOGY: 1/Brain cyst: Focally, the white matter of the cerebral cortex is displaced by an expansive parasitic cyst. The cyst is lined by a germinal epithelium containing frequent nuclei and infrequent calcareous corpuscles. The germinal membrane is surrounded by a laminated layer composed of dense sheets of acellular eosinophilic homogenous material. The cyst has been ruptured but does contain a single protoscolex approximately 100 microns in diameter. The protoscolex appears as a dense ball of nuclei with an off-center clearing that does not contain refractile hooks, likely because hooks are out of section. The parasite cyst is surrounded by a robust granulomatous response including numerous multinucleated giant cells and peripherally lymphocytes and plasma cells within the brain.

2/Brain cyst: Histologic findings are similar to those described above in slide 1. Again only a single protoscolex is present within the section, this time bearing nonrefractile (immature) rostellar hooks.

3/Brain cyst: Histologic findings are similar to those described above in slide 1. Multiple protoscolices are observed including several protoscolices with refractile rostellar hooks. In this section, inflammation surrounding the cyst is composed of both a granulomatous response as describe above, as well as regionally extensive necrosis and suppuration.

4/Brain, cerebral cortex distant to parasite cyst: Within normal limits.

5/Eye: Focally, within the central region of the cornea, the corneal stroma is mildly thickened by fibroplasia and neovascularization, with mild edema and minimal infiltrates of lymphocytes, plasma cells, and neutrophils. The corneal epithelium is intact.

LABORATORY RESULTS:
PCR for *Echinococcus granulosus* is being pursued.
Chronic wasting disease, ELISA (lymph node): Not detected (CSU F1715187)
Chronic wasting disease, IHC (obex): Not detected (CSU F1715187)

INTERNAL LAB NO.	SERIAL NO.	USDA-FSIS-OPHS EASTERN LABORATORY	EST. NO.	RETAIN TAG NO.
B48577	102215698	PATHOLOGY REPORT	[redacted]	MPD62290148

PATHOLOGIST REPORT

Beef Cow

Within sections of lung, there are a few cysts compressing the adjacent pulmonary tissue. These cysts are lined by a thick, eosinophilic, hyalinized laminated membrane and contain small amounts of inspissated protein fluid residue and mineral. Surrounding the cysts are epithelioid macrophages and multinucleated giant cells forming granulomas. There is a thick band of fibrosis admixed with eosinophils, lymphocytes and plasma cells along the perimeter of the granulomas.

COMMENT:

The histologic findings are consistent with degenerate hydatid cysts in the lung. In this case, based on the distribution of the lesions and unilocular cyst formation, Echinococcus granulosus is suspected. Please follow the regulation 9CFR311.25(d) for proper disposition. Liver was not identified histologically or within the submission jar at prosection. Reported to: Dr. Van Batavia via Outlook

DIAGNOSIS:

Hydatid cyst with granuloma, multifocal, lung **7807-07**

PATHOLOGIST'S SIGNATURE	CODE	DATE STARTED	DATE COMPLETED	DATE MAILED
Carrie E. Schmidt VMD PhD	179	5/31/2019	6/3/2019	
CONDITION ON RECEIPT	**SRC**	**NO. TISSUES**	**NO. SLIDES**	**LAB CODE**
SATISFACTORY	71			1303

INTERNAL LAB NO.	SERIAL NO.	USDA-FSIS-OPHS EASTERN LABORATORY	EST. NO.	RETAIN TAG NO.
B48578	102215687	PATHOLOGY REPORT	[redacted]	MPD62290149

PATHOLOGIST REPORT

Beef Cow

Within sections of lung, there are a few cysts compressing the adjacent pulmonary tissue. These cysts are lined by a thick, eosinophilic, hyalinized laminated membrane and contain small amounts of inspissated protein fluid residue and mineral. Surrounding the cysts are epithelioid macrophages and multinucleated giant cells forming granulomas. There is a thick band of fibrosis admixed with eosinophils, lymphocytes and plasma cells along the perimeter of the granulomas. Similar cysts disrupt the hepatic microarchitecture.

COMMENT:

The histologic findings are consistent with degenerate hydatid cysts in the lung and liver. In this case, based on the distribution of the lesions and unilocular cyst formation, Echinococcus granulosus is suspected. Please follow the regulation 9CFR311.25(d) for proper disposition. Reported to: Dr. Van Batavia via Outlook

DIAGNOSIS:

Hydatid cyst with granuloma, multifocal, lung and liver **7807-C7**

PATHOLOGIST'S SIGNATURE	CODE	DATE STARTED	DATE COMPLETED	DATE MAILED
Carrie E. Schmidt VMD PhD	179	5/31/2019	6/3/2019	
CONDITION ON RECEIPT	**SRC**	**NO. TISSUES**	**NO. SLIDES**	**LAB CODE**
SATISFACTORY	71			1303

FSIS 10,300-3 10/93