

Raccoon Roundworm (*Baylisascaris*) Infection

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What is raccoon roundworm infection?

Raccoon roundworm infection is caused by the parasitic worm *Baylisascaris procyonis*. It is also called *Baylisascaris* (Bay-liss-ass-kuh-ris) infection or baylisascariasis (bay-liss-ass-kuh-reye-asis). The *Baylisascaris* worms live in the intestines of healthy-looking raccoons, and their eggs are shed in raccoon feces. When other animals ingest raccoon feces due to feeding on seeds found there, they can become seriously ill or die. Humans may also be exposed to *Baylisascaris* infection when they play or work in areas where raccoons deposit feces.

How do people become infected?

People become infected by swallowing *B. procyonis* eggs found in raccoon feces. This can happen after touching soil, sand, bark, or anything that has come into contact with raccoon feces and then touching your mouth or eating without washing your hands. It can also happen after directly swallowing raccoon feces or soil, sand, or other materials that have come into contact with raccoon feces. Once swallowed, the eggs hatch into worms in the intestine and move to different areas of the body. Children can encounter raccoon feces near fireplaces and hearths, sand boxes, playground equipment or piles of rocks or logs. Adults may contact raccoon feces in attics or crawlspaces under houses and in barns or outbuildings.

What are the symptoms of raccoon roundworm infection in humans?

B. procyonis worms can infect a number of organs and muscles in the body, including the liver, brain, spinal cord, and eyes. Symptoms are different depending on where the worms travel and can include nausea, tiredness, confusion, loss of coordination and muscle control, blindness, and coma. Some people may have mild symptoms or no symptoms at all if they only swallow a few eggs. Symptoms usually develop about a week after swallowing the eggs.

How is raccoon roundworm infection diagnosed?

Diagnosis in humans is difficult. If your doctor thinks you may have raccoon roundworm infection, he/she will rule out other infections and may use an MRI, brain biopsy, or blood test to confirm raccoon roundworm infection.

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How is raccoon roundworm infection in humans treated?

Treatment for raccoon roundworm infection varies depending on a person's symptoms. Treatment can be complicated and may not reverse damage already done by the worms. Treatment decisions should be made with your doctor.

How many human cases have there been?

There have been fewer than 30 human cases reported since the disease was found in the 1980s and none have been in the southeastern United States. Most people probably swallow only a few eggs, causing mild cases that are never diagnosed. Because there is no commercially available blood test, no large-scale studies have been done to determine the total number of people infected by raccoon roundworm.

Where is this infection found and could the raccoons around my house be infected?

The number of raccoons infected at any given point in time varies widely by state and region (Figure 1). The highest rates of infection are found in the upper Midwest and coastal western states. In these areas, the percent of infected raccoons can be as high as 90% in young raccoons and >35% in adult raccoons. *B. procyonis* was only found in the Southeast recently. The first report occurred in 2001 from DeKalb County, Georgia. In that study, 11 out of 50 (22%) raccoons were infected. During the same year, a wildlife rehabilitator in Clarke County, Georgia reported finding these worms in a raccoon; however the county of origin of this raccoon is not known. In 2006, worms were found in two raccoons from Athens, Georgia (Clarke County) that were submitted to the Southeastern Cooperative Wildlife Disease Study (SCWDS) at the University of Georgia. An ongoing study has found these worms in about 8% of raccoons from Clarke County, Georgia.

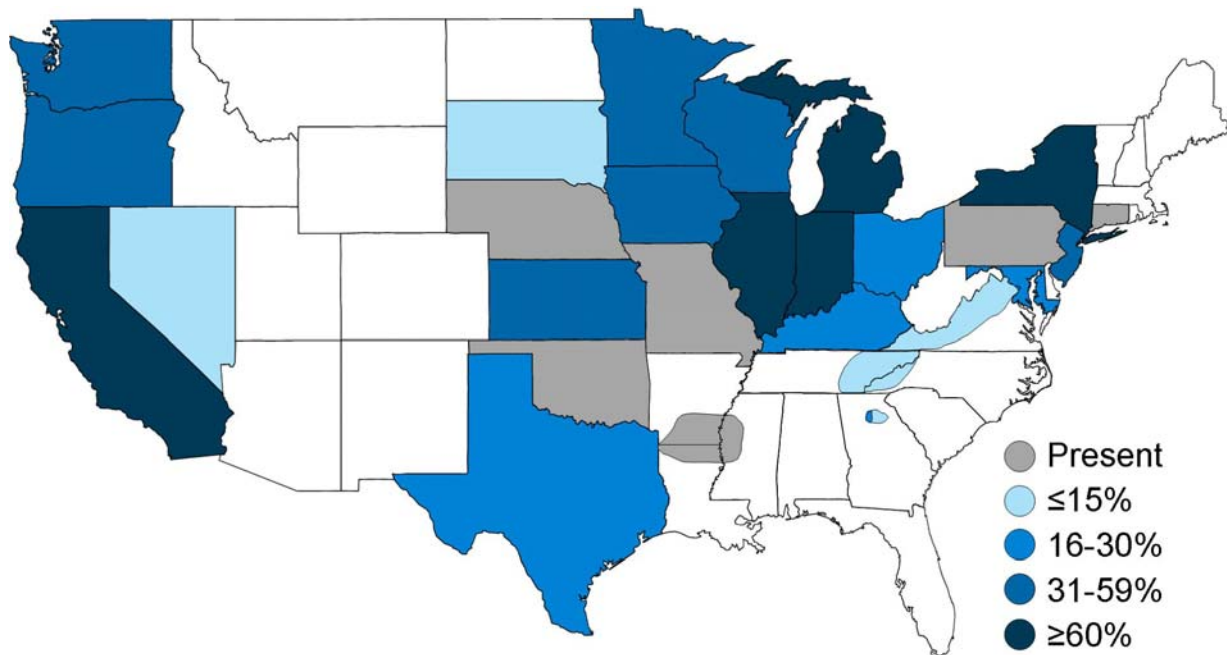


Figure 1: General distribution and percent of raccoons infected with *Baylisascaris procyonis* in the United States.

What do these worms look like?

B. procyonis is a large parasitic worm (9-20cm) that lives in the small intestine of raccoons. The worms can be white, beige, or tan in color (Figure 2). The worms grow and reproduce inside raccoon intestines without making them ill. Their microscopic eggs enter the environment through the feces of an infected raccoon. These eggs must develop in the environment for 10-14 days before they can infect a host.



Figure 2: Adult *Baylisascaris procyonis* worms from the small intestine of a raccoon

How long can eggs live in the environment? How can I get rid of them?

B. procyonis eggs can live in moist, mild environments for years. Millions of eggs can be present, and they have a sticky covering that allows them to stick to surfaces such as shoes and animal fur. Only a few methods are effective in killing the eggs. One method involves using concentrated corrosive chemicals such as a 50/50 mixture of xylene and absolute alcohol, boiling lye, or boiling Lysol (Kazacos 1983). However, using these chemicals in the environment is not ideal or practical. Boiling water can be used to kill the eggs in a laboratory setting but in the environment it is difficult to expose all the eggs to water that remains at a high enough temperature to ensure killing. Another method is to burn or scorch the areas where raccoon feces or eggs were found. This is useful in getting rid of eggs in some places, however most areas cannot be burned (e.g., roofs, decks, etc.). Always use caution when burning or using chemical cleaners and use them according to label directions.

How can I prevent raccoon roundworm infection?

Never feed raccoons or keep them as pets. To keep raccoons from living around or coming near your home, throw away unused pet food and water, cover sand boxes, remove bird feeders and fish ponds, keep trash cans tightly covered, and clear overgrown brush. Stay away from raccoon feces, which can be found on surfaces such as fallen logs, stumps, large rocks, woodpiles, decks, at the base of trees, or in raised forks of trees (Figure 3). Feces are usually dark, shaped like cylinders, have a strong smell, and often contain undigested seeds. Always wash your hands before eating and monitor the activities of children and developmentally disabled persons while outside.

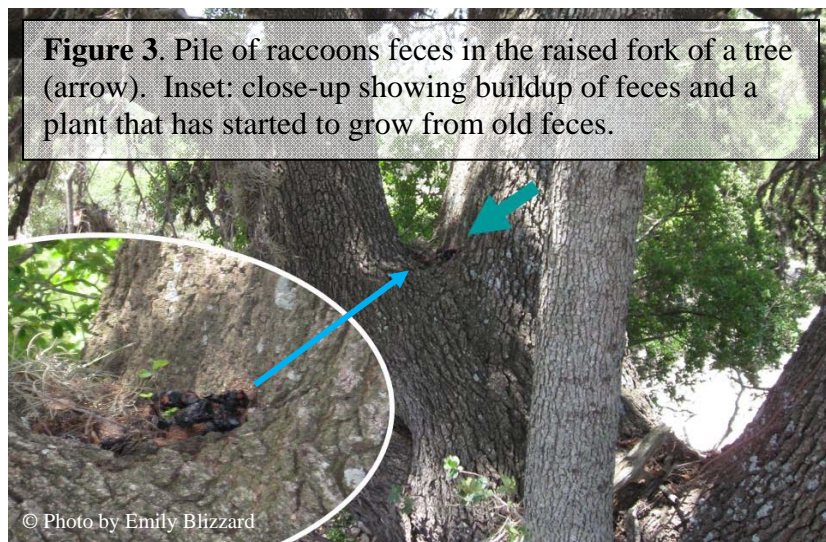


Figure 3. Pile of raccoons feces in the raised fork of a tree (arrow). Inset: close-up showing buildup of feces and a plant that has started to grow from old feces.

Can dogs and other animals become infected?

Dogs can and do become infected with *B. procyonis*, which increases their owners' risk of infection when they come into close contact with their dogs (Kazacos 2001). To prevent human infection, it is important to deworm your dog regularly, as dogs may not show any signs of infection. Always wash your hands after cleaning up after your dog and do not allow pets on furniture or bedding.

There are over 90 other types of birds and mammals that can be infected with *B. procyonis*. They are infected in the same way as humans, by swallowing eggs found in raccoon feces. Some animals, such as rodents, rabbits, monkeys, quail, and chickens, are more likely to develop severe disease. Some animals like cats, opossums, birds of prey, and domestic/wild hoofstock (e.g., sheep, goats, pigs) rarely develop disease even when exposed to eggs. In addition to disease in free-ranging animals, outbreaks have been reported in rehabilitation centers and zoological parks. *B. procyonis* can cause central nervous system damage, causing strange behaviors such as circling, rolling, falling over, inability to move, laying on their side or back, and paddling the air with their feet. These signs also occur in animals with rabies and other diseases. Never touch a wild animal. Call your County Animal Control Office to report sick animals or animals acting strangely.

Are there any other worms that can cause similar symptoms?

Yes, there are several other worms that can cause similar illness. A common worm related to *B. procyonis* found in puppies and young dogs is *Toxocara canis*. Cats and kittens can be infected with a worm called *Toxocara cati*. These worms can also cause illness in people, so it is important for pet owners to take their pets to a veterinarian regularly to be examined and treated.

Raccoons have become a problem around my home. What can I do?

If you think that an animal may have a disease, please contact your local Game Warden or County Animal Control Office to have it trapped, removed, and tested. It is illegal to trap or kill a raccoon or any other wild animal without a proper permit. In most states, you can apply for a nuisance permit or game permit since raccoons can be hunted as game animals. Please ask your local officials for approval to receive the proper training and necessary permit for getting rid of raccoons around your home.

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