Raccoon-borne pathogens: Viruses and Bacteria

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Northern raccoons (*Procyon lotor*, Fig. 1) can carry many diseases that present significant health hazards to both people and pets. Some of these diseases may not affect raccoons directly, but can be deadly to other animals. Many of these diseases are spread by multiple species, others are primarily spread by raccoons. As it is not possible to be certain if a wild animal is sick, it is safer to consider it as a hazard and avoid it. Contact animal control or a wildlife rehabilitator if you suspect an animal is sick or behaving abnormally (contact details for Florida wildlife rehabilitators can be found on the [myFWC website](http://myfwc.com/media/2779805/licensedwildliferehabilitatorsbyregion.pdf)). Sick wild animals can act tame and confused, but should never be approached as if they are domesticated. They are still wild animals that can see you as a threat. More information on raccoons can be found in this [EDIS document](https://edis.ifas.ufl.edu/uw033). Due to their successful adaptation to urban environments, it is common for raccoons to come into contact with humans. This document is part of a series addressing health hazards associated with raccoons, and describes the most important raccoon-borne viruses and bacteria. Information on raccoon-borne parasites, and specifically the raccoon roundworm *Baylisascaris procyonis,* is covered in other documents in this series [*also to be published on EDIS*]. The following viruses and bacteria are known to occur in raccoons, and are a concern for people and/or pets: rabies, canine distemper, feline distemper/panleukopenia, canine parvovirus, *Salmonella*, tularemia, *Edwardsiella septicemia*, and leptospirosis (see a summary of raccoon-borne viruses and bacteria in Table 1).

<insert figure\_1\_female\_raccoon.jpg>

Figure 1. A young female raccoon in Broward County, South Florida.

Credit: Mathieu Basille, UF/IFAS.

[Click thumbnail to enlarge.]

# Viruses

## Rabies

**Rabies** is an extremely serious ribonucleic acid (RNA) virus in the Rhabdoviridae family, and one of the deadliest known diseases: If not treated early, rabies is nearly 100  percent fatal. About a dozen people in recorded history survived without prompt treatment of rabies and pre- or post-exposure vaccination. In contrast, over 59,000 die from rabies every year worldwide. Only 1 to 2 fatalities occur in the US each year; most deaths are in Africa and Asia, where vaccination and treatment are much harder to come by. Multiple organizations including the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) aim to [end all human rabies deaths](https://www.cdc.gov/features/rabies/index.html) by 2030 through vaccination and education.

Rabies is transmitted by saliva of infected mammals, including bats, raccoons, skunks, foxes, dogs, other canids, cats, and livestock. Theoretically any mammal can be infected with rabies, although the above are the most reported. Worldwide, 99 percent of human cases are caused by unvaccinated dogs. In the US however, most cases of human rabies come from bats. There have been [reported fatalities](https://www.npr.org/sections/health-shots/2016/06/02/480414566/bats-in-the-bedroom-can-spread-rabies-without-an-obvious-bite) from a rabid bats in which the victim did not realize they were bitten. Current CDC data on the most prevalent strain of rabies in the US can be found on their [website](https://www.cdc.gov/rabies/location/usa/surveillance/). Be aware that the [map](https://www.cdc.gov/rabies/location/usa/surveillance/wild_animals.html) from the CDC only shows the most common strains of rabies in each area (Fig. 2), except for bat rabies, which is a major strain throughout the US. Vaccination of pets and education have greatly reduced the number of rabies cases in humans and domestic animals in many areas of the world.

<insert figure\_2\_rabies\_strains\_cdc.jpg>

Figure 2. Most common strains of rabies in the United States (after bats, which is a main strain throughout the country). Note that these are the common strains, rabies is not limited to only these species and areas.

Credit: Centers for Disease Control and Prevention. <https://www.cdc.gov/rabies/location/usa/surveillance/wild_animals.html>

[Click thumbnail to enlarge.]

Rabies can cause aggressive behavior and excessive salivation; however, these are by no means the only symptoms. A rabid animal may also act tame, become active at unusual hours, or exhibit neurological abnormalities. Raccoons will occasionally forage for food during the day if it is quiet, a daytime sighting of a raccoon is not cause for alarm on its own. If the raccoon shows no fear of humans or exhibits neurological abnormalities, however, it could be rabid and should be considered with care.

Rabies has been observed in every county in the state of Florida (Fig. 3, Table 2). The Florida Department of Health publishes yearly records of reported cases that can be found on the [Florida Department of Health website](http://www.floridahealth.gov/diseases-and-conditions/rabies/rabies-surveillance.html). In 2017, 78 cases of rabies were reported, 36 of which were from raccoons.

<insert figure\_3\_rabies\_map.jpg>

Figure 3. Raccoon-borne rabies in Florida by county Jan 1997- Oct 2018. Taylor County is the only county in Florida to have zero cases of raccoon-borne rabies since 1997. Marion County has the most cases at 171.

[Click thumbnail to enlarge.]

**Pre-Exposure Vaccination**

Rabies pre-exposure vaccination is available for humans. Due to the high cost (which can exceed $1,000 in the US), it is only recommended for people who are more likely to come into contact with rabid animals, such as veterinarians, researchers, zookeepers, wildlife rehabilitation experts, animal control officers, or those traveling to regions where rabies is common. Vaccination can be obtained through doctors offices, travel clinics, and hospitals. Pre-exposure vaccination consists of three shots on days 1, 7, and 21 or 28. Vaccination for cats and dogs is much cheaper, at the cost of about $20 to $30 per yearly shot. Vaccination has been highly successful in reducing the number of human rabies deaths in the United States from more than 100 per year to just 1 to 2 annually. Distribution of the oral rabies vaccine has been successful in reducing the number of raccoon rabies cases as well. Frequency of Florida raccoon-borne rabies over time can be found in Figure 4.

<insert figure\_4\_rabies\_by\_year.jpg>

Figure 4. Frequency of raccoon-borne rabies in Florida by year (January 1997-Oct 2018).

[Click thumbnail to enlarge.]

**Post-Exposure Treatment**

If bitten by a mammal and you are not sure it has been vaccinated, treat it as a possible rabies case. If it is possible to do so *safely*, collect the animal. Otherwise, inform animal control. A cat or dog may be observed for ten days to identify clinical signs. There is not enough supporting evidence regarding the timeline of viral shedding to prove that observation alone is sufficient for other animals. Unfortunately, the only quick and reliable test involves dissection of the brain, hence euthanasia of the the animal is required.

Immediately after a person is bitten or scratched by a potentially rabid animal, flush the area with warm soapy water for several minutes to wash away as much virus as possible. Post-exposure vaccination should begin **immediately**. Even licking broken skin can cause infection if saliva enters the bloodstream. Guidelines for post-exposure treatment from the World Health Organization can be found [on their website](http://www.who.int/ith/vaccines/rabies/en/). Vaccination is available at emergency rooms and county public health offices.

Once more intensive, post-exposure treatment today consists of four to five shots given at the infection site or in the arm. The shots are on days 0, 3, 7, 14, and sometimes 28 for patients with weakened immune systems. The first shot is given with human rabies immune globulin. Anyone who was vaccinated before the exposure receives booster shots on days 0 and 3, but no immune globulin. Remember, no matter the cost or ordeal of treatment, the alternative is to potentially contract an incurable fatal disease.

More information on rabies can be found in this [EDIS document](http://edis.ifas.ufl.edu/uw282).

## Canine Distemper

**Canine Distemper**, also known as *Canine* *morbillivirus*, is a highly contagious RNA virus in the family Paramyxoviridae that can devastate a population of raccoons. It is the leading natural cause of death for raccoons, immediately following human-induced fatalities. Canine distemper cannot infect humans, but it can infect and kill many carnivores, including canids, bears, mustelids (weasels, ferrets, skunks, etc.), large felines (not including domestic house cats), procyonids (raccoons, kinkajous, ringtails, etc.), and seals. While each group of mammals mentioned is at risk, infection in canids appears to be most common, and is a serious issue for domestic dogs. Vaccination is inexpensive for dogs, and is readily available at veterinarians’ offices or mobile clinics. Canine distemper is *not related* to feline distemper (see next section), and the clinical signs differ. Both, however can infect raccoons and are very serious diseases.

Symptoms can range from the appearance of an upper respiratory infection (URI) to rabies-like neurological signs. It begins with nasal discharge, fever, conjunctivitis (inflammation and redness of the eye), lethargy, diarrhea, and lack of appetite. As the disease advances, neurological problems may become evident. Dogs have succumbed to infection with signs of a URI, or no signs at all. Head tilt, muscle twitching, disorientation, seizures, and deterioration of motor skills can all be seen at later stages. At this point infection with distemper virus is difficult to differentiate from rabies.

The virus is spread through direct or indirect contact with infected blood, saliva, or urine. While there is no specific cure, symptoms can be be alleviated and the animal can be supported in hope of recovery by using their own immune system. Animals that survive can exhibit lifelong symptoms, ranging from hardened footpads, to ocular or neurologic signs.

## Feline Distemper/ Panleukopenia

**Feline Distemper**, also known as feline panleukopenia virus (FPV), is a highly contagious disease caused by feline parvovirus. It is not related to canine distemper, but it is also deadly to raccoons. Feline distemper cannot infect humans, but it can infect and kill cats. Bleach can be used as a disinfectant, the virus is resistant to many other chemicals. Vaccination is cheap and readily available at veterinarians’ offices and mobile clinics. It is most deadly to kittens and cats with weakened immune systems. Adult cats have a reasonable chance of survival.

Symptoms include fever, depression, anorexia, dehydration, vomiting, diarrhea, abdominal pain, or sometimes no signs at all. Treatment is supportive and consists of administering fluids, blood or plasma transfusions, and antibiotics for secondary infections.

Feline distemper is spread through nasal secretions, blood, feces, urine, or fleas that have been feeding from an infected animal. It can also be spread through poor sanitation by hands, feeding dishes, and other materials. Feline distemper attacks rapidly dividing blood cells in the bone marrow, intestinal epithelium, and lymph nodes. If a cat survives, there are generally no long term effects.

## Canine Parvovirus

**Canine Parvovirus**, often called parvo for short, is a highly contagious disease in dogs in the family parvoviridae. Raccoons can carry this disease with no symptoms, but it can kill unvaccinated dogs. Parvovirus vaccines are inexpensive and are available from veterinarians and mobile clinics.

This virus attacks a dog’s gastrointestinal tract. Parvoviruses are highly resistant to heat, cold, drying, and can survive in the environment for long periods of time. Bleach can be used as a disinfectant, the virus is resistant to many other chemicals. It is spread by direct contact with an infected animal, contaminated surfaces, or feces. Signs in dogs include loss of appetite, abdominal pain and bloating, fever, low body temperature, diarrhea, vomiting, and lethargy. Most deaths occur 48 to 72 hours after symptoms are seen.

Treatment is supportive and includes nutritional support, combating dehydration, vomiting, diarrhea, and treating secondary infections. Even with supportive treatment the dog may succumb to the infection. This is especially true for puppies.

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# Bacteria

## *Salmonella*

***Salmonella*** is a common cause of food poisoning. Symptoms include vomiting, fever, and diarrhea. These symptoms normally resolve in 3 to 8 days without treatment. However, sometimes severe cases will require antibiotics or hospitalization. Detailed information on *Salmonella* is available [in a series of EDIS documents](http://edis.ifas.ufl.edu/topic_salmonella). *Salmonella* infection is most often acquired through contaminated food, but can also come from infected mammals, birds, and reptiles through poor sanitation, typically due to fecal-oral transmission. The CDC estimates that *Salmonella* infects over a million people in the US each year, causing around 20,000 hospitalizations and 400 deaths. *Salmonella* can also infect pet mammals and birds, and be carried without symptoms by reptiles and amphibians.

## *Francisella tularensis*

***Francisella tularensis*** causes tularemia, also known as rabbit fever, and can be spread by ticks and contact with infected mammalian tissue. Tularemia can be difficult to diagnose in humans, and mistaken for other diseases. Most people recover, but this can take several weeks of antibiotic treatment. Tularemia is not commonly seen in cats and dogs, but can cause organ system failure if not treated early and aggressively. In order to diagnose, usually several other diseases must first be ruled out. A vaccine is currently [under review](https://www.cdc.gov/tularemia/prevention/index.html). Raccoons have been shown to carry tularemia themselves, and by transport of ticks, but it is not clear how tularemia affects raccoons. Exposure can occur through contaminated water, insect vectors, animal carcasses, eating undercooked game, and inhalation of dried infective animal tissue. Raccoons may be useful as an indicator of tularemia presence in the environment.

## *Edwardsiella tarda*

***Edwardsiella tarda*** causes Edwardsiella septicemia, a rare but potentially deadly infection in humans and wildlife. However, *E. Tarda* has been found in animals that appear healthy, including raccoons. *E. Tarda* has been found in the intestines of many fish, reptiles, mammals, and birds, and is spread through infected animal feces. Exposure to contaminated water and fish are important factors in disease transmission. In fact, most reported animal cases have been from species closely associated with water. Edwardsiella septicemia often causes gastroenteritis. Antimicrobial treatment is available, however, a recent [literature review](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4692300/) found a 44 percent mortality rate in humans even with treatment. Edwardsiella septicemia remains rare and risk factors are not well understood.

## *Leptospira*

***Leptospira*** causes leptospirosis, which may lead to kidney damage, liver failure, meningitis, respiratory distress, and death if left untreated. Virtually all mammals can carry leptospirosis, and may or may not show clinical signs. Rodents are thought to be the primary vector. It is spread through contaminated urine and water. Infection is most common in warm and wet areas, but can occur elsewhere. Leptospirosis is seen in dogs, but uncommon in humans in developed countries. Once thought of as a disease of rural areas, leptospirosis infection is on the rise in urban areas, due to increased prevalence or increased detection.

# Conclusions and Prevention

With increased development and habitat fragmentation, the risk of humans coming into contact with raccoons and other adaptable species increases. Raccoons readily adapt to urban environments (Fig. 4), thus increasing the chance for spreading diseases to humans and pets. There are a few simple solutions to prevent the spread of raccoon-borne diseases. First, never feed wild animals. In addition to being illegal, feeding wildlife causes animals to associate humans with food, sometimes resulting in dependence on humans, loss of their natural fear, and aggression. Feeding wildlife also increases population density and territorial overlap, and the chances of disease transmission between individuals. In addition to not feeding wildlife, feed pets inside, or at least bring food in at night. Purchase raccoon proof garbage cans if they are getting into your garbage. If you have an unwanted raccoon on your property, call a wildlife removal specialist. Removing a raccoon yourself is difficult and risky, and there is a very high chance the raccoon will come back, or that you remove only part of a family and leave orphans.

<insert figure\_5\_dumpster\_raccoons.jpg>

Figure 5. A group (gaze) of five raccoons in a dumpster, a common gathering spot.

Credit: Caitlin Jarvis.

[Click thumbnail to enlarge.]

Vaccinating your pets and not letting them roam free without supervision is also important. The most common and serious viruses in raccoons are easily and inexpensive to prevent with vaccines against rabies, canine and feline distemper, and parvovirus. For instance, rabies vaccination is available for dogs, cats, and ferrets for around $20 to $30 per year. In many states, Florida included, it is a legal requirement to have dogs, cats, and ferrets vaccinated against rabies. Adverse reactions are very rare and normally not serious. Full details on legally required preventative treatments can be found in the [2018 Florida Statutes](http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&URL=0800-0899/0828/Sections/0828.29.html).

Raccoon-borne diseases pose a significant threat to humans, wildlife, zoo animals, and pets. With knowledge and simple measures we can avoid these hazards and be proactive in treatment. Most problems arise when people, or their neighbors, attract raccoons intentionally or unintentionally. When treated with respect and caution raccoons can live near humans as an interesting part of the urban ecosystem.

# Tables

Table 1. Summary of raccoon-borne viruses and bacteria

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Virus** | **Spread** | **Infect humans or pets?** | **Prevention** | **Outcome** |
| **Rabies** | Saliva in bites and scratches | Humans and mammalian pets | Vaccination | Fatal if untreated |
| **Canine distemper** | Direct or indirect contact with blood, saliva, or urine | Ferrets and dogs | Vaccination | Often fatal; neurological damage sometimes in survivors |
| **Feline distemper** | Blood, feces, urine, fleas | Cats | Vaccination | Fatal in kittens, sometimes fatal in adults |
| **Canine parvovirus** | Direct contact, contaminated surfaces | Dogs | Vaccination | Treatment may prevent fatalities |
| **Bacteria** | **Spread** | **Infect Humans or pets?** | **Prevention** | **Outcome** |
| ***Salmonella*** | Fecal oral transmission from contaminated food or animals | Humans, mammalian and avian pets | Sanitation | Usually resolves without treatment but may require antibiotics, severe cases may be fatal |
| **Tularemia** | Ticks, infected animal tissue | Humans and mammalian pets | Tick repellent and removal, avoid animal tissue | Antibiotics; successful in humans, less successful in pets |
| ***Edwardsiella tarda*** | Contaminated water and fish | Rare in humans, could infect pet mammals, amphibians, and reptiles | Avoid contaminated water and fish | Treatable, but can be fatal |
| **Leptospirosis** | Contaminated urine and water | More common in dogs, seen in humans and cats | Sanitation and avoid contaminated water | Can be fatal, can show no signs |

Table 2. Reported rabies in raccoons in Florida from Jan 1997- Oct 2018 by county.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **County** | **Total** | **County** | **Total** | **County** | **Total** | **County** | **Total** |
| Alachua | 140 | Flagler | 11 | Lake | 63 | Pinellas | 29 |
| Baker | 1 | Franklin | 3 | Lee | 32 | Polk | 126 |
| Bay | 68 | Gadsden | 1 | Leon | 69 | Putnam | 21 |
| Bradford | 2 | Gilchrist | 9 | Levy | 13 | St Johns | 20 |
| Brevard | 49 | Glades | 1 | Liberty | 2 | St Lucie | 24 |
| Broward | 31 | Gulf | 6 | Madison | 3 | Santa Rosa | 13 |
| Calhoun | 8 | Hamilton | 19 | Manatee | 18 | Sarasota | 46 |
| Charlotte | 13 | Hardee | 10 | Marion | 171 | Seminole | 90 |
| Citrus | 39 | Hendry | 7 | Martin | 31 | Sumter | 8 |
| Clay | 20 | Hernando | 35 | Monroe | 5 | Suwannee | 29 |
| Collier | 12 | Highlands | 12 | Nassau | 15 | Taylor | 0 |
| Columbia | 20 | Hillsborough | 78 | Okaloosa | 12 | Union | 7 |
| Dade | 11 | Holmes | 15 | Okeechobee | 3 | Volusia | 84 |
| Desoto | 1 | Indian River | 19 | Orange | 106 | Wakulla | 1 |
| Dixie | 10 | Jackson | 50 | Osceola | 24 | Walton | 12 |
| Duval | 37 | Jefferson | 2 | Palm Beach | 147 | Washington | 6 |
| Escambia | 13 | Lafayette | 3 | Pasco | 62 | **Total Florida** | **2012** |
| Data from the Florida Department of Health <http://www.floridahealth.gov/diseases-and-conditions/rabies/rabies-surveillance.html> | | | | | | | |

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