

Master of Public Health Field Experience Report

Educational Brochures on Zoonotic and Infectious Diseases from Wildlife

by

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## **Abstract**

The general public comes into contact with zoonotic threats every day, but do those people know of the possible diseases they could become infected with? People do not understand the severity of these diseases or the prevalence in any given backyard in the United States. Rabies, leptospirosis, tularemia, and the raccoon roundworm are a few of the zoonotic diseases that are commonly found in the wild. Education of the public is key to a healthy community that knows the correct response when coming into contact with wildlife.

Prairie Park Nature Center in Lawrence, Kansas is the wildlife drop off for northeast Kansas. Every day they assess cases of wildlife that have been in the hands of the general public. The nature center also educates the community by teaching them about wildlife in their environment. The nature center consists of 100-acre nature preserve that incorporates wetlands, woodlands, and prairie habitats with a five acre lake. During the school year classes go to the nature center to get an up close view on eagles, owls, ferrets, and cockroaches, to name a few. If a wildlife animal is seen hurt by the general public, the nature center is contacted by the police department to determine how to handle the situation. A concern of the nature center was the lack of knowledge the police department has when it comes to rabies. This was addressed by organizing a presentation with a power point on rabies with the Lawrence Police Department. When the public drops off a wildlife animal, there needs to be a better way to communicate the potential dangers of zoonotic or infectious diseases the public has come into contact with by handling the animal. This was done by creating informational brochures that are easy for the public to comprehend that provide information of what to be aware of when coming into contact with certain wildlife. Since rabies is by far the most fatal disease, there was a brochure made for rabies separately. Other informational brochures that were made came from the most seen

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animals at the nature center which included infectious and zoonotic diseases from raccoons, opossums, squirrels, skunks, and bats.

**Subject Keywords:** Infectious; Zoonotic; Wildlife; Public Health; Rabies; Nature Center

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To Dr. Paige Adams and Dr. Ellyn Mulcahy, thank you for being a supportive graduate committee and helping me find answers to my seemingly endless questions. I would also like to thank Barta Stevenson for taking time out of her busy day to always be available to answer my questions on enrollment.. All of your support has helped me to get to where I am today.

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## **Chapter 1-Field Experience Scope of Work**

The Prairie Park Nature Center sees approximately 400 people come through the doors every week. Most people come for education on wildlife species in the Lawrence, Kansas area. There are 100 acres to explore that have wildlife ranging from bobcats to bluebirds, beavers to deer, and everything in between. There is also a five acre lake that can be used for fishing or exploring, called Mary's Lake. The mission of the Prairie Park Nature Center is to promote an appreciation of the importance of conserving the natural world through hands-on environmental and conservation education. There are up to 615 classes each year that participants can sign up for with age ranges from 1 year of age to adults. Some classes that are available include Adventures after Dark (ages 7-12), Ecoenergy Camp (ages 6-12), Nature Story Time For Preschoolers (ages 1-4), and Introduction Archery for Adults (ages 50 and up).

Inside the nature center education building, a parrot greets all who walk in. There are staged natural habitats that are seen in the building. A pond is recreated so the public can see a beaver, turtle, and fish co-habitat. On the other side of the building is an area made for what is seen in the prairie grass, an ecosystem habitat that is common in Kansas. A timber rattler meets you with real ground hogs going in and out of the display. The public gets to interact with black footed ferrets and go see a bug center that has cockroaches up to 4 inches in size! Taxidermied deer are on site, with turkeys, eagles, and owls. The nature center also helps to rehabilitate animals. Live owls, hawks, and bald eagles are outside of the center in caged displays. These animals are used for educational displays so people can be up close and personal with these magnificent creatures. The nature center is operated by the Lawrence Parks and Recreation Department and is funded by the City of Lawrence through sales tax revenue. Admittance to the nature center is free to all visitors.

If an injured wildlife animal is found in Lawrence, the Prairie Park Nature Center is who the public relies on for assistance in the betterment of the animal. However, a large part of the public does not know what to do when coming into contact with wildlife or what diseases can be transmitted. The purpose of this project was to create informational handouts so that the public could take home information on infectious and zoonotic diseases that wildlife can transmit. This was accomplished by making brochures to keep on hand at the Prairie Park Nature Center. Specific brochures were created for five animals: bats, opossums, raccoons, skunks, and squirrels. A sixth brochure was made specifically for the most fatal zoonotic disease being transmitted today: rabies. Once the brochures were put together, the information was set out at the nature center and made available to Lawrence residents and all who visited the Nature Center.

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## **Learning Objectives**

Being a veterinarian, I come into contact with infectious and zoonotic diseases regularly. However, you forget just how prevalent and common these diseases are. I was able to review infectious and zoonotic diseases of wildlife by doing this educational project. I also learned of new diseases that I did not know certain animals were able to transmit. I was able to provide information that the general public could easily understand, while also explaining the medical terminology associated with each disease.

## **Activities Performed**

Over a period of four months, I was able to create five brochures for the most common animals brought into the nature center. I wrote educational material on what diseases these animals can carry and transmit to humans. Due to the significance of rabies in wildlife and its nearly 100% fatality rate, I also wrote a brochure on the rabies virus, specifically. I was included in a talk with the Lawrence Police Department, and a meeting will be scheduled to discuss rabies so that officers know what to do when confronted with a sick wildlife animal. At this time, the Lawrence Police Department has not scheduled the presentation due to scheduling conflicts. To gather my information I spent time at the Nature Center doing interviews with employees and with Marty on animals they see frequently and the most asked questions. Based on the responses I received, I tailored each brochure to what the public wanted to know. The educational material was found in veterinary notes, online, from wildlife books, and from the employees at the nature center.

## **Products Developed**

1. Five species specific brochures that included infectious and zoonotic diseases transmittable by animals. With each disease discussed, I explained ways to prevent the diseases from being transmitted. In each brochure, information was provided on whom to call in an emergency and how to determine if an animal is sick or injured. I also explained when to approach a wildlife animal and how to approach the animal without being bitten. I discussed the correct way to catch a wildlife animal if needed and what to do if the nature center is not open.
2. One disease specific brochure was made for rabies due to its nearly 100% fatality rate in humans. This brochure went over the prevalence of rabies in Douglas County, how rabies is transmitted,



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what to watch for in animals for signs of rabies, and what to do when you suspect that an animal could be sick from rabies.

3. The Lawrence Police Department is going to have a meeting where I will be speaking on rabies and the ways they can keep the general public safe from this disease. I made a PowerPoint presentation to discuss how rabies is transmitted and what they need to look for in clinical signs for animals with the disease. I also discussed humane ways of euthanizing wildlife animals that may be contagious.

The target audience for this project is the community of Lawrence, Kansas. More specifically, the target audience is those who come into contact with wildlife and are not aware of the chances of contracting an infectious or zoonotic disease.

## Chapter 2-Rabies

In a paper by Aristotle in 300 BC, rabies was mentioned in several literatures that noted the disease affects dogs and any animal that the dog bites (Smith, 2015). Since that time, much has been done to decrease the fatality of this deadly disease, but it is still a disease that is ever present in the world. The World Health Organization estimates 55,000 human deaths occur annually from rabies, mostly in rural areas of Asia and Africa. In the United States, 34 cases of human rabies were recorded from January 2003 to June 2013. Even today there are still cases of rabies in the United States. On January 16<sup>th</sup> of 2018, a 6 year old boy in Florida died of rabies after coming into contact with a sick bat in his family's home (CBS News, 2018). In Kansas, the last reported human case of rabies was in 1968 (KDHE, 2017). According to the Kansas State Veterinary Diagnostic Laboratory, in 2017 Kansas had 39 positive cases of rabies from animals. Positives included: 26 skunks, 3 horses, 2 bovines, 1 dog, 3 cats, 3 big brown bats, and 1 hoary bat.

Rabies is a negative-stranded RNA virus that is shaped like a bullet, in the genus *Lyssavirus* and is from the *Rhabdoviridae* family, order *Mononegavirales*. The disease can affect all mammals. Once in the body, the virus absorbs to the surface of the cell through the glycoprotein which then binds to the host cell surface receptors. Next, endocytosis occurs. The highest concentrations of the virus end up in the brain and saliva or salivary glands. Since the virus is neurotropic, its target organ is the brain. Once in the brain, the virus drives behavior (Hanlon, KSU, 2013). Clinical signs that can be seen once in the body of the animal include: fearfulness, aggression, excessive drooling, difficulty swallowing, staggering, seizures, unusual behavior, depression, self-mutilation, or increased sensitivity to light (AVMA, 2018).

Most commonly, the disease is transmitted by a bite from a rabid animal. However, transmission can also occur from being in contact with a rabid animal and an open wound on the body. Bats commonly clean themselves and have saliva covering their body. If a person with a cut on their hand were to pick up a bat that had the rabies virus on its body, the human could contract the rabies virus. The rabies virus has also been transmitted through organ donations, contamination of mucous membranes, and aerosolized transmission (AVMA, 2018). Once the virus replicates, it travels to the spinal cord and brain. However, it can take 10 days to 6 months for the virus to show signs of the disease (Hanlon, KSU, 2013). There are several protocols for rabid animal bites in Kansas. Someone who has been bitten by a potentially rabid animal needs to contact a physician, immediately.

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If a human is bitten, the-Douglas County Health Department has put together this algorithm to follow for the animal that bit:

Animal Vaccination Status	Animal Type	Recommendation		Updated Recommendation?	
Currently Vaccinated	Dog, Cat, Ferret, Horse, Cattle, Sheep	<ul style="list-style-type: none"> <li>Booster (w/in 96 hours of exposure*)</li> <li>Observe <b>45</b> days</li> </ul>		No	
Overdue for Vaccination	Dog, Cat	With appropriate documentation	<ul style="list-style-type: none"> <li>Booster (w/in 96 hours of exposure*)</li> <li>Observe <b>45</b> days</li> </ul>	Yes	
		Without appropriate documentation	<ul style="list-style-type: none"> <li>Consult with KDHE (required) prior to booster w/in 96 hours of exposure*                             <ul style="list-style-type: none"> <li>Prospective Serological Monitoring</li> <li>Animal in quarantine until results available</li> </ul> </li> </ul> <b>OR</b>	<i>Proper anamnestic response:</i> Observe <b>45</b> days	Yes
			<ul style="list-style-type: none"> <li>Treat as never vaccinated</li> </ul>	<i>Inadequate anamnestic response:</i> <b>4-month</b> quarantine	Yes
		Ferret, Horse, Cattle, Sheep	With appropriate documentation	<ul style="list-style-type: none"> <li>Case by case basis</li> <li>Consult with KDHE</li> </ul>	Yes
	Ferret, Horse, Cattle, Sheep	Without appropriate documentation	<ul style="list-style-type: none"> <li>Euthanize</li> <li><b>6-month</b> quarantine</li> </ul>	No	
	Never Vaccinated	Dog, Cat	<ul style="list-style-type: none"> <li>Euthanize</li> <li><b>OR</b></li> <li>Booster (w/in 96 hours of exposure*)</li> <li><b>4-month</b> quarantine</li> </ul>		Yes
Ferret, Horse, Cattle, Sheep		<ul style="list-style-type: none"> <li>Euthanize</li> <li><b>OR</b></li> <li><b>6-month</b> quarantine</li> </ul>		No	

\*If rabies booster vaccination is given >96 hours after exposure the observation OR quarantine period may be extended.

**Table 1-Management of Animals Exposed to Rabies, Douglas County Health Department**

A veterinarian should be called immediately if a domestic animal has bitten someone. Vaccine records of the animal that bit should be examined by a veterinarian to identify the next step.

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There are ways to prevent the infection of rabies. If there are animals in the household, make sure vaccinations are current for the virus. If there is wildlife acting in a strange manner close to a home, call for help. Each city will have people designated to answer these calls and will have wildlife professionals that are able to help to keep the public safe and to not harm the wildlife. Sick wildlife should never be handled by a member of the public who have had no wildlife training. Children should be taught to stay away from wildlife, even if it looks completely healthy. A bat being in a house is enough information to treat for rabies since most bat bites go unnoticed by humans. Once there are neurologic clinical signs, rabies is 100% fatal. Therefore, being proactive could save a life. It is standard protocol to test the bat if it is caught, but if it is not caught the whole family is supposed to be injected with rabies post exposure prophylaxis immunotherapy series. A medical professional should be called if questions need answered on what to do next if rabies is a potential threat.

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## **Chapter 3-Raccoons**

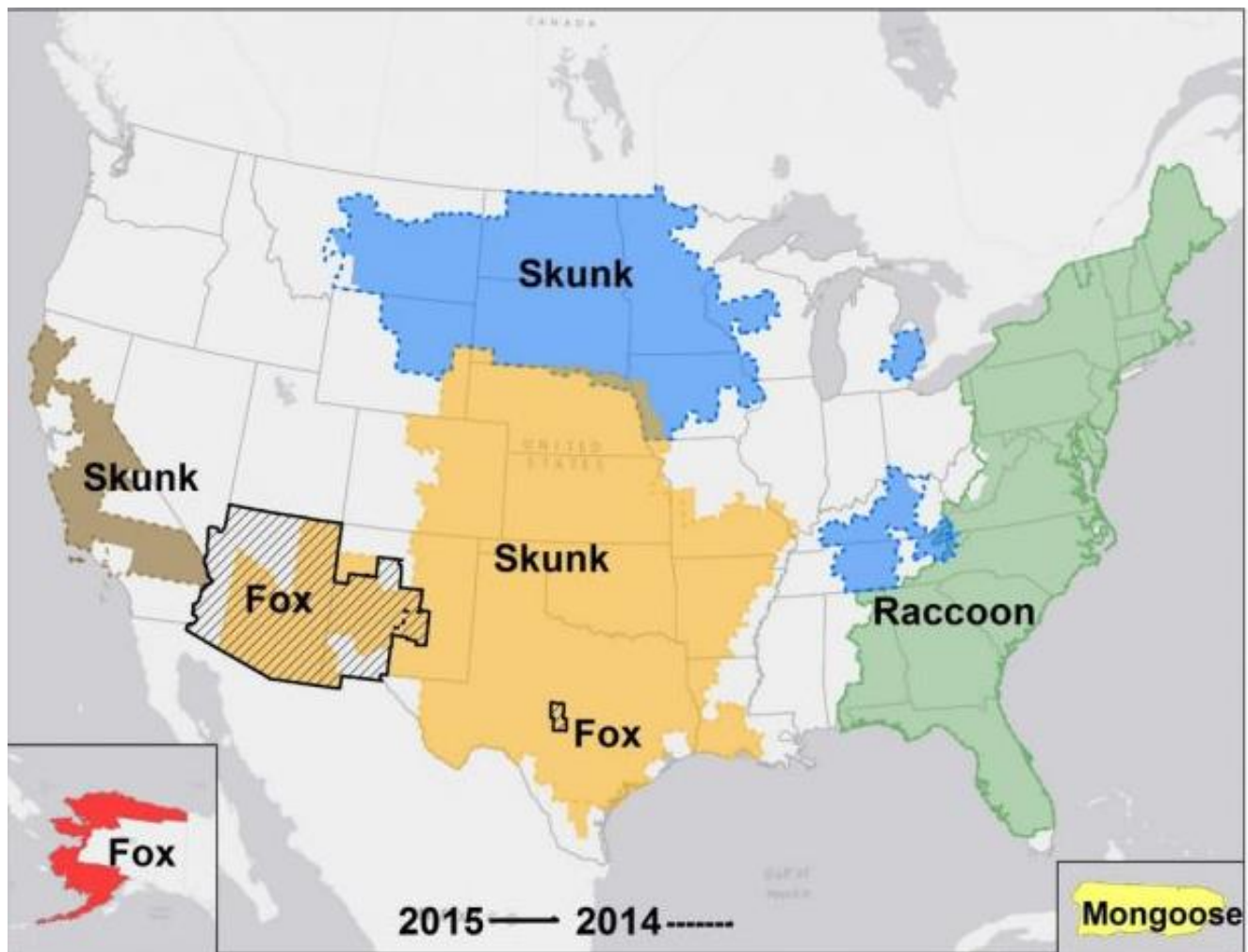
The American raccoon averages 24-38 inches and can weight anywhere between 14 to 23 pounds, depending on genetics and habitat. The toes on the raccoon are dexterous, and can grasp and manipulate food while also opening up doors and can grab jars. The raccoon's best sense is touch. The raccoon is native to North America and can be found in parts of Mexico, Canada, and regions of northern South America. In the wild, raccoons can live approximately two to three years. Raccoons overall have few predators, but they are known for being able to transmit diseases (PBS, 2012).

### **Infectious and Zoonotic Diseases**

#### **Rabies**

Rabies is present on all continents with the exception of Antarctica. Below is a picture from the Kansas State University rabies lab that shows which wild animal carries the most confirmed rabies cases in the respectful geographic location:

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**Figure 1-Wild Animals most likely to be Positive for Rabies in the United States, Kansas State University Rabies Lab**

However, in the past couple of years, the virus has been seen more in raccoons, locally. That is why rehabilitators will not accept baby raccoons in this area due to the possibility of rabies infection. It is possible for rabies to infect babies in their mother’s womb, which is why all baby raccoons must be treated as potential rabies suspects. Dogs used to be the most commonly seen domesticated animals with rabies, but now cats are more likely to be infected. As seen from the map above, most cases of rabies are in wild animals in the United States, but it is possible for any mammal to become infected with the virus. To combat the wildlife rabies reports, in the mid-1980s the United States came up with a rabies vaccine glycoprotein that was efficacious and stable in an oral form. Oral baits were made and dropped from planes into wildlife areas. This drastically decreased the number of rabies cases in the United States, along with rabies vaccines for domesticated pets. The most common domestic animals that are infected with rabies are cats and dogs (KSUVDL, 2016). Below is a graph from Dr. Hanlon, the

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former KSU Rabies Laboratory Director, of the wild animals with confirmed cases of rabies throughout the years:

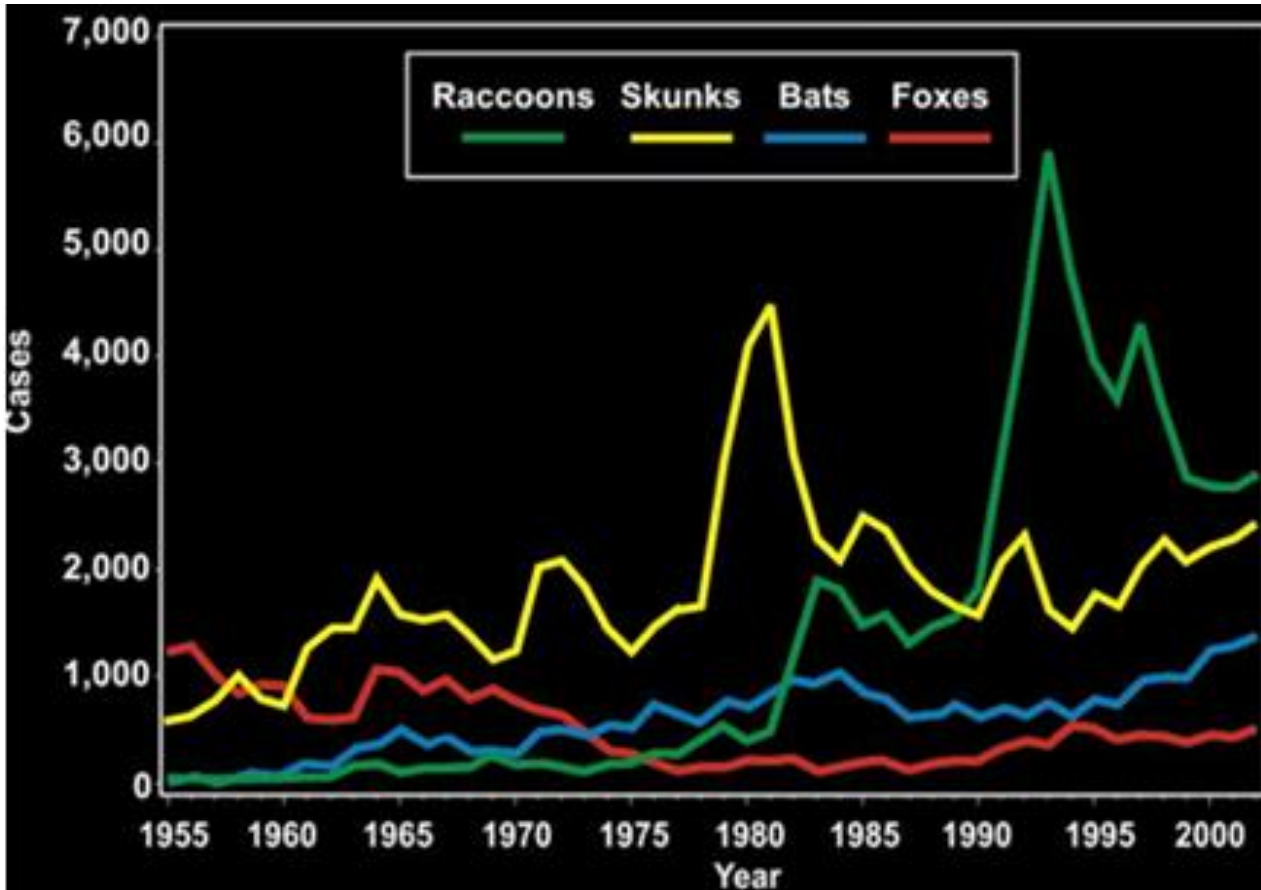


Figure 2-Rabies in Wild Animals, 1955-2002, Kansas State University Rabies Lab

Raccoons are by far the most common carrier of rabies today, with skunks in a close second. Foxes have had the largest decline in number of positive rabies cases throughout this period.

### Distemper

Canine distemper virus is a highly contagious, systemic, viral disease of dogs seen worldwide. When a sick raccoon is seen, the top differentials are distemper or rabies. Distemper is common in Kansas raccoons. Clinical signs that can be seen start as an upper respiratory infection such as eye drainage and nose drainage. Raccoons can also have diarrhea, act strangely, or have pneumonia with this disease. Paralysis has been seen as well. There is also a distemper virus that canines can acquire from raccoons. It has the same clinical signs as listed above and is very deadly. The clinical signs seen in distemper are similar to clinical signs seen in rabies cases. However, since more research is done on

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dogs, veterinarians have several other clinical signs that can be seen. For distemper cases, rhinitis/conjunctivitis, cough, diarrhea, hypoplastic enamel on the teeth, pustules and vesicles on the skin, cutaneous hyperkeratosis- especially on the foot pads, retinitis, epididymitis or neurologic signs could all be seen (Veterinary Virology, 2011). That is why it is never safe to approach a sick raccoon (RaccoonWorld, 2009).

### **Raccoon Roundworm**

*Baylisascaris procyonis* is a parasitic roundworm found in raccoon feces. This is a zoonotic disease that is transmitted to humans via the fecal oral route. This type of transmission is more worrisome in young children as raccoons like to defecate in one area. This is called a raccoon latrine. There are several instances where a raccoon latrine is on or near children's toys or play areas. Since children do not have the best hygiene, it is possible for the child to play with toys that have not been properly cleaned. The parasite is eaten in an infective stage, which occurs after being in the environment for three to four weeks. Once eaten by a human, the larva can become a cerebrospinal nematodiasis or neural larva migrans. Larval migration occurs rapidly, with larvae in the lungs within 18 hours and larvae in the eyes, brain, and somatic tissues in 3-7 days. The migration of the larvae will stop when the immune system attacks and encapsulates the larvae with eosinophilic granulomas. However, by this point, extensive neural damage may exist. Clinical signs seen in human cases can vary from asymptomatic to mild infections. Lethargy, irritability, loss of motor coordination, weakness, and ataxia can be seen, leading to coma or death. For the treatment of a human case with *B. procyonis*, unfortunately none have been found. The neurologic damage is permanent and could be deadly. Dryden and Broce did a study in Manhattan, Kansas to study the prevalence of *B. procyonis* infections. They found 50% of 111 urban raccoons examined had the deadly disease (Dryden, 2012).

### **Parvo**

Parvovirus is most commonly heard when discussing cats or dogs, but raccoons can also harbor this deadly disease. This virus was first diagnosed in 1978 when hundreds of thousands of dogs started dying. Since then, the virus is seen occasionally in domestic animals as well as several wildlife species, like raccoons. In a study from Colin Parrish and Andrew Allison, it was found that many wild carnivores carry the parvovirus and that it is easy for the virus to go from wild carnivore to domesticated dog. Allison and Parrish, both from the College of Veterinary Medicine at the Baker Institute for

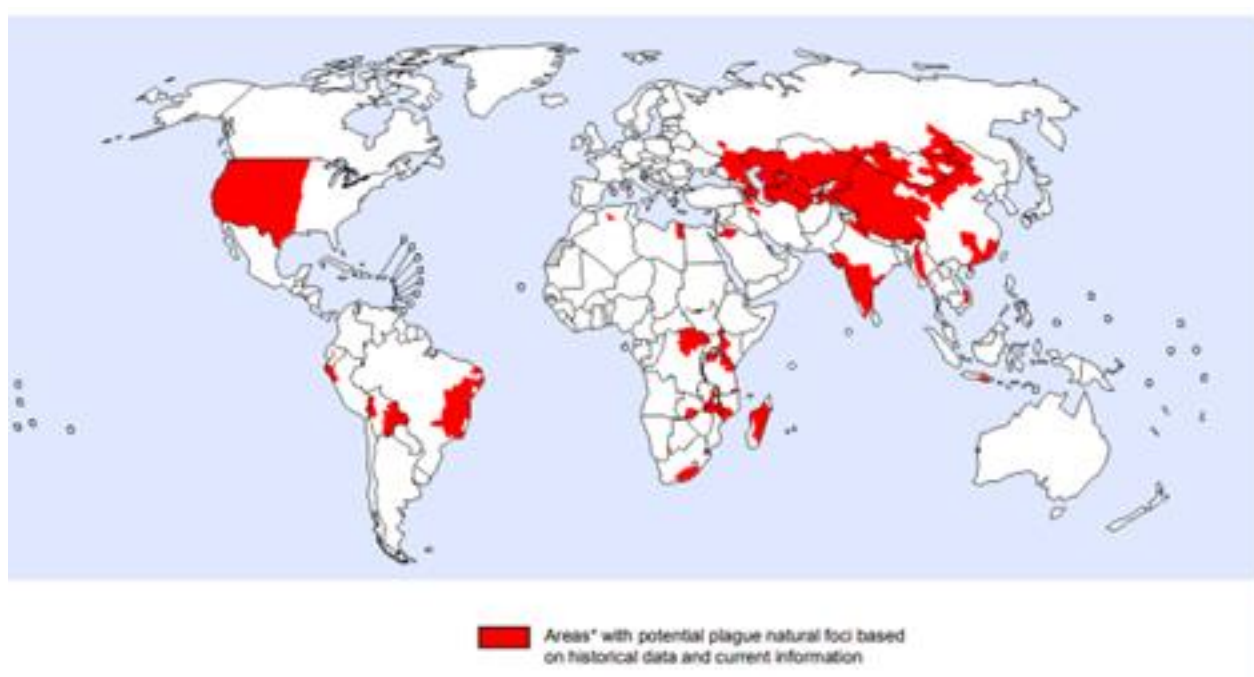


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Animal Health worked with the USDA to see how popular parvovirus was in the environment. Thanks to the USDA's National Wildlife Disease Program, 852 wild carnivores were tested for the virus using genetic sequencing to identify the virus. 19% of raccoons and 24% of coyotes tested positive for parvovirus. What was interesting is that the viruses in different host animals were all closely related in genetic sequence. The researchers found that parvovirus is able to adapt to a new carnivore host quickly and that it happens frequently (Buckley, 2014).

## The Plague

The plague is caused by the bacteria *Yersinia pestis*, a bacterium that is most commonly transmitted by fleas. Since raccoons can harbor fleas, it is possible for the animals to transmit the plague if brought into a home. The plague is a zoonotic disease, with a possible outcome of death. Even though the plague is most likely thought of for spreading in unsanitary conditions, it is still being spread today. From 2010 to 2015 there were 3,248 cases reported worldwide and 584 deaths (WHO, 2018). In the United States, the plague is most commonly diagnosed in Colorado. Between 2005 and 2015 the Colorado Department of Public Health and Environment reported that 20 human plague cases were reported. 60 percent of those cases came between 2014 and 2015 (CDPHE, 2017). Below is a graphic from the World Health Organization showing where the plague is distributed worldwide:



**Figure 3-Global Distribution of Natural Plague Foci as of March 2016, World Health Organization**

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## **Leptospirosis**

Leptospirosis is a zoonotic bacterial disease that is common in temperate or tropical regions and can be seen in Kansas. 100 to 150 cases of this disease are reported annually in the United States. The incidence of leptospirosis is relatively low in the United States; however leptospirosis is still considered the most widespread zoonotic disease in the world (CDC, 2018). The bacterium is from the genus *Leptospira*. Several animals can become infected with the disease-cattle, sheep, goats, swine, dogs, horses, humans, and several wild animals including raccoons. There are over 200 serotypes of leptospirosis, with some being more common than others. Some of the serotypes are more prevalent in certain animals. For example, *L. pomona* and *L. hardjo* are more common in cattle than *L. canicola*, which is regularly seen in dogs. Leptospirosis is transmitted through urine that is splashed onto mucous membranes, in skin cuts or wounds, urogenital tracts, or obtained from drinking contaminated waters. Clinical signs in raccoons range from vomiting, muscular stiffness, weakness, to jaundice and potential death. In humans, according to the CDC, symptoms can include fever, headache, red eyes, vomiting, abdominal pain, diarrhea, and in some cases, rash. Treatment, if caught early enough, can be done with antibiotics and supportive care. Due to the nature of the bacteria, there are some people who are more likely to catch the disease such as farmers, military personnel, sewer workers, veterinarians and animal caretakers, and mine workers.

## **Tick-borne Diseases**

Tick-borne diseases are becoming more frequent in the United States by the day. Most ticks in the United States are three-host ticks, meaning each life stage feeds on a separate host. Stage one is when a larvae hatches from an egg, and will find and feed on a host for a few days before it falls off and molts. Stage two is when the nymph finds a host and feeds, falls off and molts. And the final stage is where the adult finds a host and feeds, then falls off to lay eggs (females) and then will die. Each of these life stages feeds once for every 3-10 days and they must eat to be able to molt to the next stage. Once female ticks are engorged, they drop off the host and lay an egg mass of around 2,000 to 8,000 eggs. Below is a table that has the name of the tick, a picture and the diseases they can spread: (all information taken from Veterinary parasitology class from Kansas State University College of Veterinary Medicine, 2010)

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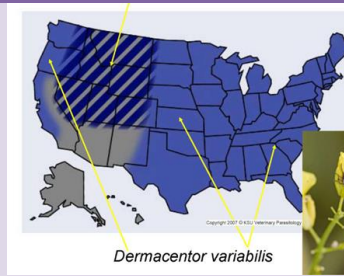



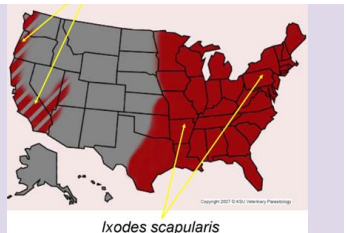


Tick Name	Picture Description	Known Diseases they Transmit	Geographical Location in United States
<p><i>Dermacentor variabilis</i></p> <p>American Dog Tick</p>	<p>Ticks</p> <p>Female <i>Dermacentor</i> Male</p> 	<p>--Cytauxzoonosis (<i>Cytauxzoon felis</i>)</p> <p>--Rocky Mountain Spotted Fever (<i>Rickettsia rickettsi</i>)</p> <p>--Tularemia (<i>Francisella tularensis</i>)</p> <p>--Tick paralysis in North America</p>	 <p><i>Dermacentor variabilis</i></p>
<p><i>Amblyomma americanum</i></p> <p>Long Star Tick</p>	<p>female male</p> 	<p>--Human Monocytic Ehrlichiosis (<i>Ehrlichia chaffensis</i>)</p> <p>--<i>Ehrlichia ewingii</i></p> <p>--Tularemia (<i>Francisella tularensis</i>)</p> <p>Southern Tick-Associated Rash Illness (<i>Borrelia lonestari</i>) a Lyme disease-like infection?</p> <p>--Cytauxzoonosis (<i>Cytauxzoon felis</i>)</p> <p>--Meat allergy disease</p>	
<p><i>Ixodes scapularis</i></p> <p>The Black-Legged Tick Or Deer Tick</p>	<p>female male</p> 	<p>--<i>Borrelia burgdorferi</i> (Lyme disease)</p> <p>--<i>Anaplasma phagocytophilum</i> (HE agent, <i>E. equi</i>)</p> <p>--<i>Babesia microti</i> (Humans)</p>	 <p><i>Ixodes scapularis</i></p>
<p><i>Rhipicephalus sanguineus</i></p> <p>Brown Dog Tick</p>	<p>female male</p> 	<p>--<i>Ehrlichia canis</i> (Canine Monocytic Ehrlichiosis)</p> <p>--<i>Babesia canis</i> (Canine Babesiosis)</p>	

Table 2-Ticks and the Micro-organisms they can Carry, Kansas State University

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All of the ticks mentioned in the table can be found in Kansas. The White-tailed deer are the best hosts for ticks, and as the deer have traveled so have the diseases. There is also a new disease from the Lone Star Tick that is causing concern for people in the United States. The disease is relatively new in the medical community, but in Kansas alone there have been positive cases. The bite from a Lone Star Tick can cause severe symptoms to develop after eating mammalian meat such as pork, beef, and lamb. The clinical signs seen after eating these meats include shortness of breath, hives, or even an anaphylactic reaction. In an article in the Chicago Tribune, Kansas State found the species spreading from the eastern part of Kansas, where it was once to be contained, to central and western Kansas from findings in 2016. The red meat allergy is known as the alpha-gal allergy, and is caused by a sugar molecule found in meat-galactose-alpha-1, 3-galactose (Gibbens, 2017).

Raccoons are able to have ticks that are feeding on the body and if petting a raccoon or getting close to a sick one, the ticks can easily go to human flesh. Therefore, raccoons are able to transmit these lethal diseases.

## **Toxoplasmosis**

Toxoplasmosis is a disease caused by the protozoan *Toxoplasma gondii*. Toxoplasmosis is discussed in depth to pregnant women due to the fact that it can cause abortions. Cats are the only known definitive hosts, however all warm blooded animals may serve as paratenic hosts. Toxoplasmosis is the most important multi-systemic protozoan disease in North America and raccoons are able to help spread the disease. Oocysts sporulate in the environment in 1 to 5 days in feces and can persist in the soil for 18 months. The oocysts cannot survive freezing and once sporulated; the oocysts are infective upon ingestion to all warm blooded animals. Once in the paratenic host, the sporulated oocyst releases the sporozoites which go to layers of the deep epithelium and tachyzoites, which are asexual, and go to portal circulation to the liver and lungs which then disseminates the disease all over the body. Once the disease is spread systemically the organism can encyst and the animal becomes a chronic carrier. In the United States 22 to 24% of the population are chronic carriers of this disease, however in Europe 70% test positive for this toxoplasmosis (Veterinary Parasitology, 2010). This disease can be spread to humans in several ways, with the most common way for transmission is eating undercooked infected meat containing *Toxoplasma* bradyzoites, usually found in pork, mutton, or venison. Other ways for transmission in humans include ingestion of the sporulated oocyst from fecal contamination from soil, sand boxes, litter boxes, unwashed garden vegetables, organ transplantation or

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blood transfusion, transplacental transmission, or ingestion of unpasteurized goat milk (Veterinary Parasitology KSUCVM, 2010).

To prevent this disease in humans, there are several precautions that people can take including: not drinking untreated water, cooking food to correct temperatures to kill all unwanted bacteria and parasites, wearing gloves when gardening or during any contact with sand or soil, keeping outdoor sand boxes covered at all times, and washing hands after working in soil. Indoor cats are less likely to spread the disease if raw meat is not fed. By cleaning the litter boxes daily, toxoplasmosis is not able to proliferate and the feces are not infective (CDC, 2018). If these precautions are taken, the risk of getting toxoplasmosis is slim.

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## Chapter 4-Skunks

Skunks are found primarily in the western hemisphere and are well known for the release of a scent gland that can be smelled for miles. These animals are omnivores that can live in a wide variety of habitats. They are primarily nocturnal and are about the size of a housecat. Skunks are able to help the environment by preying on insects, especially those that can be harmful to agriculture. The oldest fossil that was identified as skunk was discovered in Germany. The fossil was 11-12 million years old, meaning skunks have been on this earth for a long time (Britannica, 2018). However, they are able to contract several diseases to humans.

### Infectious and Zoonotic Diseases

#### Rabies

Skunks are the most common animal to test positive for rabies in Kansas. According to the K-State Veterinary Diagnostic Laboratory, 26 skunks tested positive for rabies in 2017 in the state of Kansas. It is a significant margin when compared to the other positives in Kansas which were: 3 big brown bats, 1 hoary bat, 2 bovines, 3 cats, 1 dog, and 3 horses.

Due to the likelihood of rabies in skunks in Kansas, rehabilitators will not accept skunks in this area. Below is a graph from Dr. Hanlon, the former KSU Rabies Laboratory Director, of the trend rabies on for wildlife vs. domesticated animals through the years, showing the positives of rabies vaccinations:

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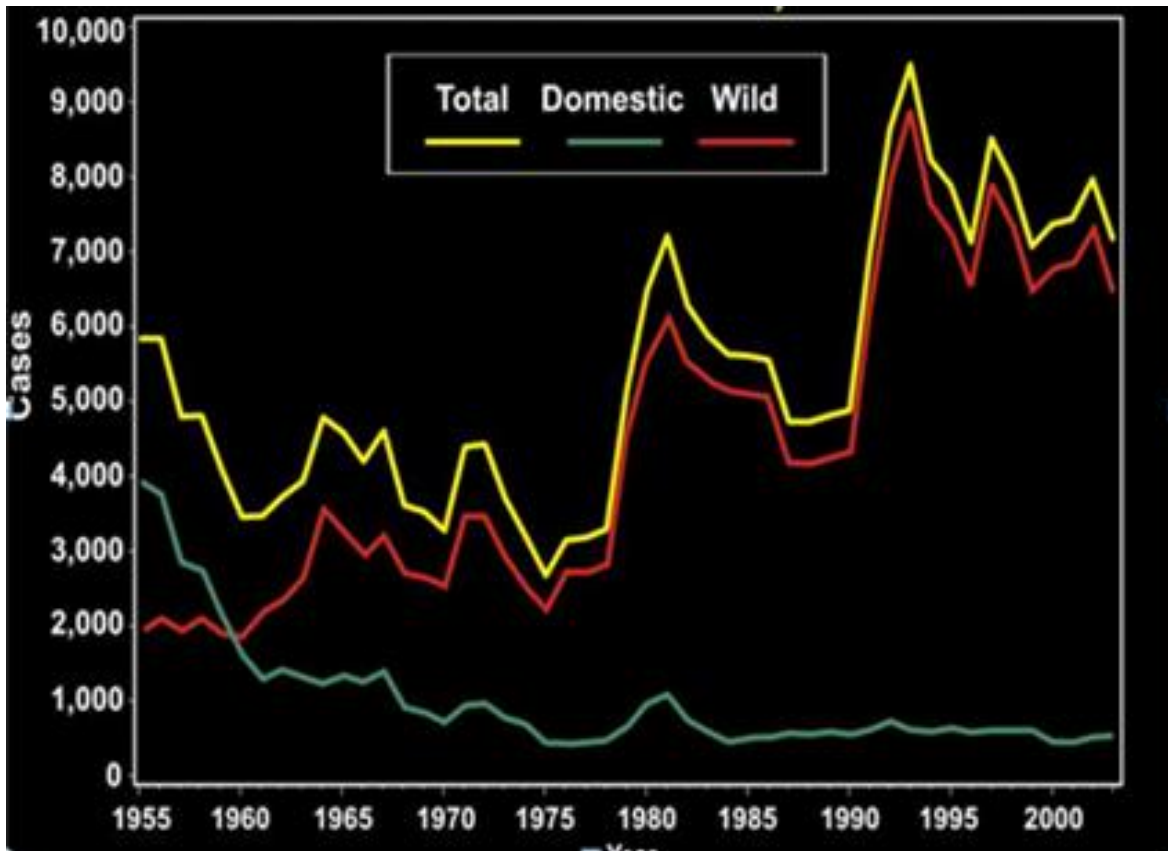


Figure 4-Cases of Animal Rabies, 1955-2003, Kansas State University Rabies Laboratory

Rabies vaccines in animals caused a drastic dip in the number of positive cases in domesticated animals as seen in the table above (green line). To prevent this disease in domestic animals make sure all pets are properly vaccinated.

### The Plague

Skunks can harbor fleas; therefore it is possible for the animals to transmit the plague if brought into a home or if a skunk with fleas comes into close contact with a house. There are two types of plague-bubonic and pneumonic, bubonic being the most commonly seen. Clinical signs of bubonic plague include enlarged lymph nodes or lymph nodes that burst with pus secretions. Fatality rate of bubonic plague is between 30 to 60%. The pneumonic plague is much more serious with a fatality rate of 100%. Pneumonic plague has clinical signs stemming from the lungs, causing pneumonia. Treatment for the plague is antibiotics and supportive therapy. For treatment to be effective, patients must be diagnosed in 18 to 24 hours for best results (WHO, 2018).

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## **Leptospirosis**

The bacteria of leptospirosis infect the kidneys of the host mammal. Wildlife, such as skunks, are natural reservoirs of the leptospirosis bacteria and some show no signs when they are infected with the disease. These animals urinate in bodies in of water and the bacterium is able to survive months in the water waiting to infect another mammal. Trappers, hunters, farmers, people who go near creeks, and wildlife biologist and rehabilitators are at an increased risk of contracting this potentially deadly disease. There is not a vaccine for humans, but there is an annual vaccine for dogs that helps prevent the spread of leptospirosis. Other ways to prevent this disease include avoiding stagnant bodies of water, draining stale or wet areas, and not drinking water from creeks and outdoor areas without properly boiling the water (CPHAZ, 2017).

## **Tick-borne Diseases**

In 2007, a doctor at the University of Virginia allergy clinic began noticing a rise in reported meat allergies. Dr. Commins started researching where the allergy was coming from in adults, who all had previously eaten meat on a very regular basis. The doctor discovered a correlation between the meat allergy and outdoors-type of people who went hiking frequently. The team started looking for a common link, and the cases of the meat allergy were similar to the map of the lone star tick, that also carries Rocky Mountain spotted fever. What exactly is the allergy? Alpha gal is a sugar that animals make in the meat. This sugar comes from red meat-cows, pigs, and lamb. There are three theories of how the alpha-gal is introduced:

1. The tick has something in its saliva that causes the response.
2. Residual mammalian glycoproteins or glycolipids are present in the tick from a previous mammalian blood meal. That then causes the response when the tick gets a blood meal and transfers some of those mammalian glycoproteins or glycolipids into the human.
3. It is possible that the response is from something that has not been discovered yet, such as Rickettsia, the same bacteria that causes Rocky Mountain spotted fever.

Then the body, knowing the alpha gal is a foreign object, creates an IgE immune response to the alpha gal. When the human has a meal of a red meat with the alpha gal sugar, the body then has an allergic reaction. In an article in the Chicago Tribune, Kansas State found the species spreading from the eastern part of Kansas, where it was once to be contained, to central and western Kansas from



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findings in 2016 (Gibbens, 2017). These reactions have been going on for some time. According to Steinke et al, in their article published in the Journal of Allergy Clinical Immunology, these cases have been occurring since 1989. Mrs. Sandra Latimer and Dr. Anthony Deutsch from Athens, Georgia collected ten cases of delayed reactions to mammalian meat and the connection with tick bites. The reaction they saw happened several weeks to months after the tick bite and would see hives or even anaphylaxis. They presented the findings at the Georgia Allergy Society and to the CDC in 1991; however no additional reports or statements were issued from either organization.

One difference that physicians are seeing is the length of time a reaction takes to occur. Most normal allergic reactions happen immediately after a response. However, in the instance of the alpha-gal, most patients do not see reactions for 3-5 hours after a contact or even longer. Most of the patients had been eating meat for years before with no issues and rarely had any allergies prior to their diagnosis. Patients who have the alpha-gal allergy are also seeing a reaction when dairy products are consumed. The more severe reactions occur when cheeses or ice creams are eaten. Other countries are seeing a rise in meat allergies. However, the rise to the allergy is not seen in the species of tick as the United States. How has the rise in alpha-gal allergies increased so significantly in the past 10 years? There is a parallel in the increase of deer population that correlates with the alpha gal allergies. The deer is the major carrier of ticks in the United States.

There is still a chance that people who have the allergy will be able to eat meat again. Researchers hope that after the disease has been in the system for years, the allergic reaction will weaken. However there has been no successful research to document this.

## **Distemper**

Distemper clinical signs are similar to the symptoms that would be seen if an animal had rabies. That is why a group of researchers studied brain lesions from 192 skunks that had tested negative for rabies from two Illinois Public Health laboratories in 1986. Woolf et al noticed that 36 of the skunks had lesions in the brain that were concurrent with encephalitis. Of those 36 skunks 17, or 47.2% were positive for canine distemper virus, or CDV. The researchers did notice there was an elevation among skunks being submitted for testing during winter to spring (Woolf, 1986).

## **Parvo**

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Parvo is most commonly heard when discussing cats or dogs, but skunks can also harbor this deadly disease. Parvoviral enteritis is most similar to feline parvovirus, otherwise called Feline Panleukopenia. Clinical signs seen in skunks include bloody diarrhea, inappetance, and lethargy. The virus attacks rapidly dividing cells in the intestines, therefore causing the severe bloody diarrhea. Transmission to other animals is via fecal-oral route.

## **Hepatitis**

Infectious canine hepatitis is a disease that is caused by a virus, canine adenovirus 1. This same virus can be found in skunks. Urine, feces, or saliva are infective if consumed. The virus goes after the liver, spleen, lungs, and the kidneys, however other organs are occasionally involved. Clinical signs that can be seen include fever, inflammation of the eyes, loss of appetite, vomiting, or death. The fatality rate is highest in young dogs. This virus can be transmitted to dogs from skunks or vice versa. Prevention of this disease in dogs is making sure pets are properly vaccinated.

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## **Chapter 5-Opossums**

Opossums can be pests, but another name for them should be environmental stewards.

Opossums are the only marsupial in the United States and Canada, meaning the young stay in pouches in the abdomens. Baby opossums are the size of honeybees when born. Opossums do not stay long in the same areas, as temporary dens are made. Two years is the approximate life span for a wild opossum, while a captive opossum can live up to four years. The opossum helps greatly with decreasing the pest numbers in a neighborhood. Opossums are clean animals and if external parasites are on the body, opossums constantly remove and kill them. In a study done by the Cary Institute of Ecosystem Studies, it was estimated that opossums can eat up to 5,000 ticks in a season. Opossums keep their surroundings and clean from rotten carcasses, cockroaches, rodents, slugs, and snakes. Opossums are unique in that they rarely carry diseases. Rabies is almost never seen in opossums and most science says this is due to the opossum's lower body temperature. It is still possible for diseases to be transmitted from opossums, though it is less likely.

### **Infectious and Zoonotic Diseases**

#### **Rabies**

As seen from the figure 1 of the map of wild animals most likely to test positive in the United States, mentioned in chapter 3, opossums are not the main carrier for rabies anywhere in the United States. An article from 1998 in California had an Orange County employee bit by a rabid opossum after the opossum was found in the employee's vehicle. Since then there have been no active infections in opossums that have been reported. The most common domestic animals that are infected with rabies are cats and dogs (KSUVDL, 2016).

#### **The Plague**

Due to the fact that opossums are clean animals, they rarely have flea infestations. If fleas are on the body, the opossum will take the time to clean the fleas off. The likelihood of the plague from opossums is rare, but it is possible. Any animal that can feed fleas can harbor infection and transmit this disease.

#### **Leptospirosis**

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Opossums in Australia were tested for leptospirosis in 2007 by Eymann et al. The results were printed in the Journal of Wildlife Diseases. For the research, the team wanted to know if opossums could transmit this zoonotic disease that affects the kidneys. 192 opossums had blood samples collected and they found that 11 out of 136 that were tested did have positive results to leptospiral antibodies. 21 *Leptospira spp* were tested for by using a microscopic agglutination test. The most common subspecies by far was *Leptospira interrogans serovar Hardjo*, with *Leptospira ballum serovar Arborea* only being found in 2 out of 11 opossums. There was an association with age, and most of the older opossums had a higher incidence of leptospirosis. This research confirmed that the marsupial is able to transmit this disease in urban areas. This is why it is so important to make sure to not come into contact with wildlife and to make sure pets are vaccinated for this deadly disease.

### **Tick-borne Diseases**

Tick-borne diseases are becoming more frequent in the United States by the day. That is why opossums should be a staple in most neighborhoods! With opossums eating approximately 5,000 ticks per year, they are helping to decrease the chances of humans getting tick-borne diseases. With the opossum eating ticks that have diseases, they are able to decrease the amount of diseased ticks in the neighborhoods they live in.

### **Toxoplasmosis**

In an article written by Torres-Castro et al that was published in Open Veterinary Journal, concrete evidence was found of *Toxoplasmosis gondii* in opossums in 2016. This research was done in Mexico, a tropical region where *T. gondii* is able to remain infective for long periods of time. Opossums were caught in the Yucatan Island and taken to a University to be euthanized for this study. After the animals were euthanized, the brain cavities were examined. A PCR test was done to test for *T. gondii* using brain matter. Of the 13 opossums caught, 10 tested positive for the disease. This solidifies that opossums can transmit this disease (Torres-Castro, 2016).

### **Equine Protozoal Myeloencephalitis**

Equine Protozoal Myeloencephalitis, or EPM, is a parasite that is transmitted to horses by fecal oral transmission. Opossums are the definitive host, which obtains the organism from cats, raccoons, skunks, armadillos, and sea otters. The horse comes into contact with the infective feces while grazing

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or eating contaminated feed or water. Once the horse has ingested the infective feces, the protozoal parasite migrates to the intestinal tract and into the bloodstream where it goes to cross the blood/brain barrier. The parasite then attacks the horse's central nervous system. Signs that are seen in a horse that has EPM can include incoordination and weakness, paralysis, difficulty swallowing, seizures, abnormal sweating, head tilt, or loss of sensation of the face, neck, or body. If any of these signs in a horse are seen, call a veterinarian immediately. To prevent a horse from coming into contact with this disease, the American Association of Equine Practitioners recommends:

- Keep water tanks clean and filled with fresh water
- Keep food rooms and containers closed and sealed
- Use feeders that minimize spillage and are difficult for wild animals to access.
- Clean up dropped grain immediately to discourage scavengers. Do not feed on the ground.
- Have good rodent control in all barns.
- Properly dispose of any animal carcasses you may see on or near the property.
- Schedule regular appointments with a veterinarian.

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## **Chapter 6-Bats**

There are over 40 varieties of bats in the United States alone. Bats are the only mammals that are able to fly. Flying bats can navigate in the dark by using an acoustic orientation, otherwise known as echolocation. All 40 varieties are different in size and shape, even varying by color and fur texture. Bats are key players in the ecosystem. Bats feed on night-flying insects, including pests that can cost farmers up to billions of dollars annually. It has been shown that small insectivorous bats can eat up to 2,000 insects in one night (CDC, 2017). Bats also help by pollinating plants, spreading seeds, and making medical advancements for navigational aids for the blind. However, bats can also carry rabies and are the most common source of human rabies in the United States.

### **Infectious and Zoonotic Diseases**

#### **Rabies**

The CDC says that 92.4% of reported rabies cases in the United States are from wild animals. Of those, bats were the most frequently reported rabid animals, at 30.9% in 2015. According to the K-State Veterinary Diagnostic Laboratory, in 2017 in Kansas there these were the animals that tested positive: 3 big brown bats, 1 hoary bat, along with 2 bovines, 3 cats, 1 dog, 3 horses, and 26 skunks. Rabies is a zoonotic disease that is a worldwide problem.

Below is a picture from the CDC showing which wildlife animals are seen most for positive cases of rabies:

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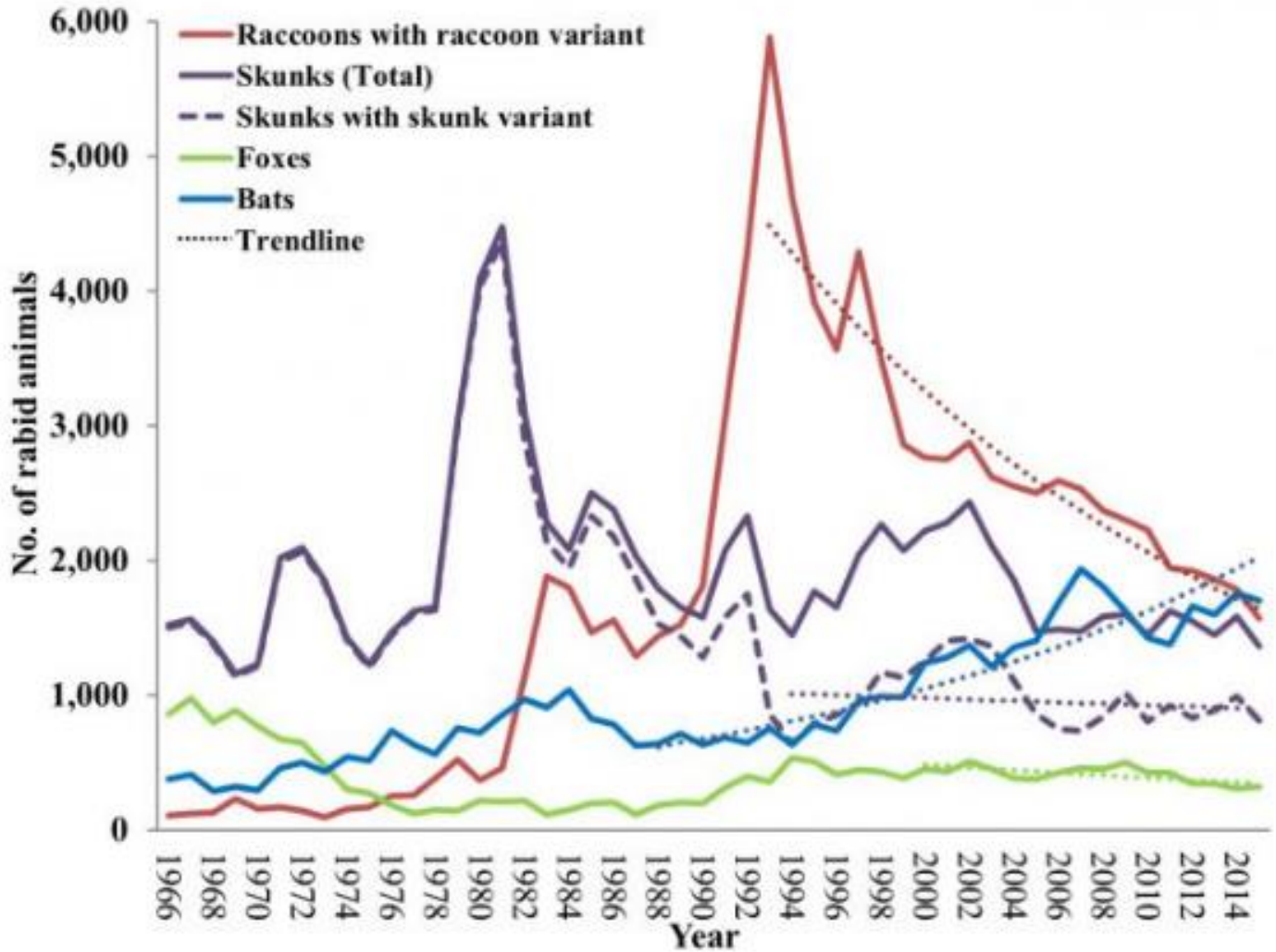
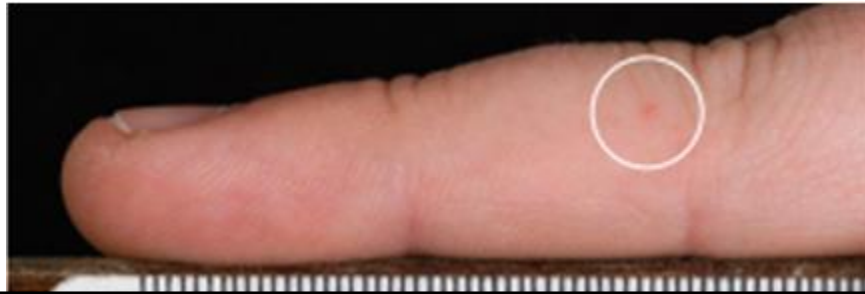


Figure 5-Number of Positive Rabies Cases per Wildlife Animal, 1966-2014, Center for Disease Control and Prevention

Bats are commonly found in homes across the United States. If the house is not correctly closed up before spring, bats can have colonies in chimneys or in walls. If a bat is discovered in a home, it is likely there are more. If a bat has been found in the home with people, it is good medicine to get the rabies post exposure prophylaxis immunotherapy done. Bats have been known to bite people when the people are sleeping. Bat's teeth are small, and it would be close to impossible to know if a person was bitten. Below is a picture from the CDC that shows a bat bite on a human finger:

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**Figure 6-Photo of a bat bite on a finger, Center for Disease Control and Prevention**

Bats are notorious for how clean their fur coat is. Bats constantly clean their fur and it is known that their saliva is heavily infected with the rabies virus if the bat has the disease. If a human were to pick up a bat that is sick, and the human has a cut on the skin, it is possible for rabies to be transmitted. Rabies can also be transmitted from saliva of a rabid bat getting into eyes, nose, or the mouth of a human.

### **The Plague**

In 2006, a group of scientists went into a cave to collect information on earwigs. Earwigs are an insect that are nocturnal and like to hide in moist crevices, like caves. When this group of scientists arrived, it was discovered that fleas were on the insect. The group discovered the fleas were using the earwigs to get to bats in the cave to feed off them. The bat fleas prefer bat blood, but will suck the blood of humans if needed. The plague could be transferred to the human from the bite of an infected flea. To prevent this disease, one should wear appropriate clothing when going to caves and if bats are in a house make sure to clean where the bats were living.

### **Ticks**

Bats do carry a type of tick known as a 'soft tick'. Its shell is softer than the normal tick we are used to seeing. These ticks are routinely found in houses and buildings that are infested with bats. They are able to hide in cracks and in the crevices where bats are roosting. Soft ticks are able to live for years without a host to feed on. If the bats are unable to feed the ticks, the ticks will find any type of blood source including humans or animals.



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**Figure 7-Soft Tick Magnified, Kansas State University Parasitology Laboratory**

### **West Nile Virus**

West Nile Virus, or WNV, is a virus that is most prominent in the months of July to the end of September. Symptoms that bats will show if infected with the virus include uncoordinated movement, paralysis, shaking, or circling. This disease is transmitted from an infected mosquito. Humans and horses can also get the virus. Having a positive bat in the area does not harm the people directly, but it does let the area know that West Nile Virus positive mosquitos are close and to be careful! If a dead bat is seen that previously showed some of these signs, make sure to use gloves to get rid of the bat either by burial or throwing it away in the trash.

### **White Nose Syndrome**

Bats in the United States are trying to keep from becoming extinct, yet little is heard about this in the media. A fungus by the previous name of *Geomyces destructans*, which has recently been renamed to *Pseudogymnoascus destructans*, has killed millions of bats and is continuing to wreak havoc on these small mammals. Why is this fungus a problem? Bats help control the pest populations by making mosquitoes and other night flyers the main source of food. As more bats are killed from this disease, it will allow for animals and humans to have more chances at getting diseases that are vector borne, like Zika virus. Farmers also depend on bats, since bats help by consuming harmful forest and agricultural pests that would otherwise ruin crops

White-Nose Syndrome (WNS) is a disease that has been spreading in bats all over the United States. A total of 31 states and five Canadian Provinces are confirmed infected (National Fish &

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Wildlife Foundation, 2017). In February of 2013, Illinois, which had not seen the disease in their caves, was testing to see if the disease had entered their state. A culture was run and it was confirmed that WNS was in Monroe and LaSalle County bat caves in Illinois. The little brown bats and the northern long-eared bats were the bats that were cultured; however seven bat species are affected by WNS. They are the little brown bat, the northern long-eared bat, the tri-colored bat, the big brown bat, the eastern small-footed bat, the endangered Indiana bat, and the endangered gray bat. That means that half of the bat species in North America have the potential to become infected with the fungus. 90% or more of some species of bats in caves have been killed by the fungus, with the fungus lasting for a year or even longer (U.S. Fish and Wildlife, 2013).

WNS is not zoonotic, and also has not been seen to affect livestock or pets. This is good news considering 5.7 million bats have been killed since 2006 when the disease first started to spread. The fungus is spread from bat to bat, but could be transmitted to other caves by humans, on their clothing, footwear, or caving gear. The fungus, *Geomyces destructans*, is non-native and is a cold-loving fungus, which is why it does so well in dark, cold caves. Bats help out by feeding on insects, and some say they save the United States billions of dollars in the agricultural industry by cleaning up the pests that would destroy crops. Bats are a major night-flying predator and they play an important role in decreasing pest populations. One big brown bat can eat between 3,000 to 7,000 mosquitos in a single night, and therefore large populations of bats can consume potentially thousands of tons of harmful insects annually (U.S. Fish and Wildlife, 2013).

Illinois and some other Midwestern states are home to federally endangered bats, making the WNS a more significant problem. Illinois is also home to some of the largest hibernating bat populations in the country. Therefore, Illinois is taking all precautionary measures and is closing all caves until the fungus takes its course. There is worry people would inadvertently carry fungus from one infected cave to another and infect more bats (U.S. Fish and Wildlife, 2013).

The fungus that is seen on bats with WNS in the United States is not new. A study done by Wibbelt et al in August of 2010 looked at the WNS in European bats. There had been bat researchers that had seen the white fuzz around the bats' nose, but no culturing had been done to confirm it was the same fungus. This study looked at hibernating bats with obvious fungal growth on their bodies. Samples were obtained in Germany, Switzerland, the United Kingdom, and Hungary. 366 hibernaculas were seen between mid-February and April of 2009. At each site, two to 214 hibernating animals were

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observed, except for two sites in Germany that housed 2,000-7,000 bats. Samples were taken either by touch imprinting with adhesive tape, or clipping the fur of the affected areas. There were two bat carcasses that were submitted from the United Kingdom; otherwise all other samples were touch imprints or fur clippings. By using direct PCR amplification the DNA sequence analysis of fungal rRNA gene, it was found there to be a 100% match to *G. destructans* with all bats tested but the 2 carcasses from the United Kingdom. *Penicillium* was grown from those bats but only in the nostrils with no area of white fungus seen on necropsy. The fungus was not on the epidermis, which was a requirement for the study and the bodies were too decomposed to do gross necropsy of body organs. Therefore the decomposed bats were not used in the study (Wibbelt et al, 2010).

Female and male bats were affected equally with WNS in the study. And even though the bats in Europe had *G. destructans*, deaths were not observed like in North America. Bats in Europe have been studied and have paperwork since the 1930s, and never in the history was there such a kill off like in North America today. Therefore, it is thought that the fungus has coexisted with the bats in Europe and they have some resistance to it. One main difference in organizations between North America and Europe is the amount of bats per roosting site. In Europe, most sites have >1,000 bats, with some of the largest caves having 13,000-18,000 hibernating bats. However, in North America there are large groups of hibernating bats ranging from 1,000 to 50,000 bats in caves and mines, with some having even more than that (Wibbelt et al, 2010).

It is still unknown how *G. destructans* was introduced to North America, but due to the area that the disease spread, it is thought to have come from Albany, New York, where a popular tourist cave is. This suggests that there could have been a human vector involved with the introduction to WNS into North America (Wibbelt et al, 2010).

Bats help keep insect numbers down in North America, more so than what people realize. There needs to be more done to explain this to the public and to teach people about WNS. Education is the only step currently that can be done to try to decrease the spread. The fungus can get onto cave dwellers clothes and go from one cave to the next, thus dispersing the fungus to more bats. All caves should be shut down during this outbreak to try to deter the fungus from spreading to different caves. There should be a social media post about WNS that can be shared with the contact information people can use if they find a dead bat. The Wildlife Service will necropsy the bats to see if there is evidence of WNS. The insect population will multiply if the bat populations continue to die off from this disease. There

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will be more crops eaten by pests and more diseases spread to humans from the insects. There is currently no treatment for the bats that have WNS, but hopefully that will soon change. It is imperative that they try to find a cure so as many bats as possible can be saved before it is too late and some bat populations become extinct.

## Chapter 7-Squirrels

Squirrels are seen in almost every habitat with over 200 squirrel species living all over the world with the exception of Australia. There are three types of squirrels: tree squirrels, ground squirrels, and flying squirrels. In Kansas, tree squirrels are the native inhabitants, with three species seen-gray squirrels, fox squirrels, and southern flying squirrels. Fox squirrels are by far the most commonly seen species and average 18 to 27 inches (including tail) and can weigh up to 2.25 pounds. Squirrels usually have around two litters of babies a year-once around March and another around August. Nests are in trees and it takes up to 3.5-4 weeks before baby squirrels open their eyes. At around 6 to 8 weeks, baby squirrels start to move around. Once they are 12 weeks old, squirrels are able to go out on their own. Though cute, these animals can carry dangerous diseases, creating a hazard for humans and other wildlife.

### Rabies

In 2014 a 7 year old boy in India went to the emergency room for cough, restlessness, fever, and aggressive behavior when oral fluids were attempted. The boy died after 4 hours of being in the hospital, and the fluorescent antibody test was positive for rabies post mortem. This child was bitten by a squirrel 2 months prior and went to a doctor who treated the child with antibiotics and tetanus toxoid. Rabies in India is highly endemic and is a major health problem. In the United States, there have not been positive cases of rabies from squirrels, but it's well known that rabies can infect any warm blooded animal. In 1972 a study done on experimentally infected squirrels by Winkler et. al, showed that when infected, half of the squirrels showed no clinical signs before death. This study was important to show that not all animals show clinical signs of the disease when spreading it.

### The Plague

In 2010 the Los Alamos Campground in Angeles National Forest was closed for 10 days due to a positive test of plague from a squirrel. Luckily no people were infected with the disease at the campground. That was not the case in 2015. The Tuolumne Meadows Campground in Yosemite National Park found one family looking for answers when a child fell ill with the plague. Several squirrels had also died from the disease and the national park knew precautionary measures needed to be taken to ensure public health safety. The campground closed for the week while workers applied flea treatments to squirrel barrows and surrounding areas.

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## **Leptospirosis**

Leptospirosis is a zoonotic disease transmitted to humans usually through contaminated water, soil or by contact with an infected animal. In an article by Diesch et al in 1967 written in the New England Journal of Medicine the doctors knew leptospirosis was going to be a disease that could cause severe disease in the wild animal and human populations. There were 106 southern flying squirrels imported to Japan from Miami, Florida on March 27, 2005. There were three people who handled the squirrels and two of the people became ill with clinical signs of uremia, vomiting, jaundice, nausea, and headache. Both people tested positive for leptospirosis by polymerase chain reaction (PCR). The southern flying squirrels from the United States were tested and came back positive for leptospirosis. The leptospirosis DNA from the squirrels and the humans were a complete match. Both people that were infected with leptospirosis were given antibiotics and survived the illness.

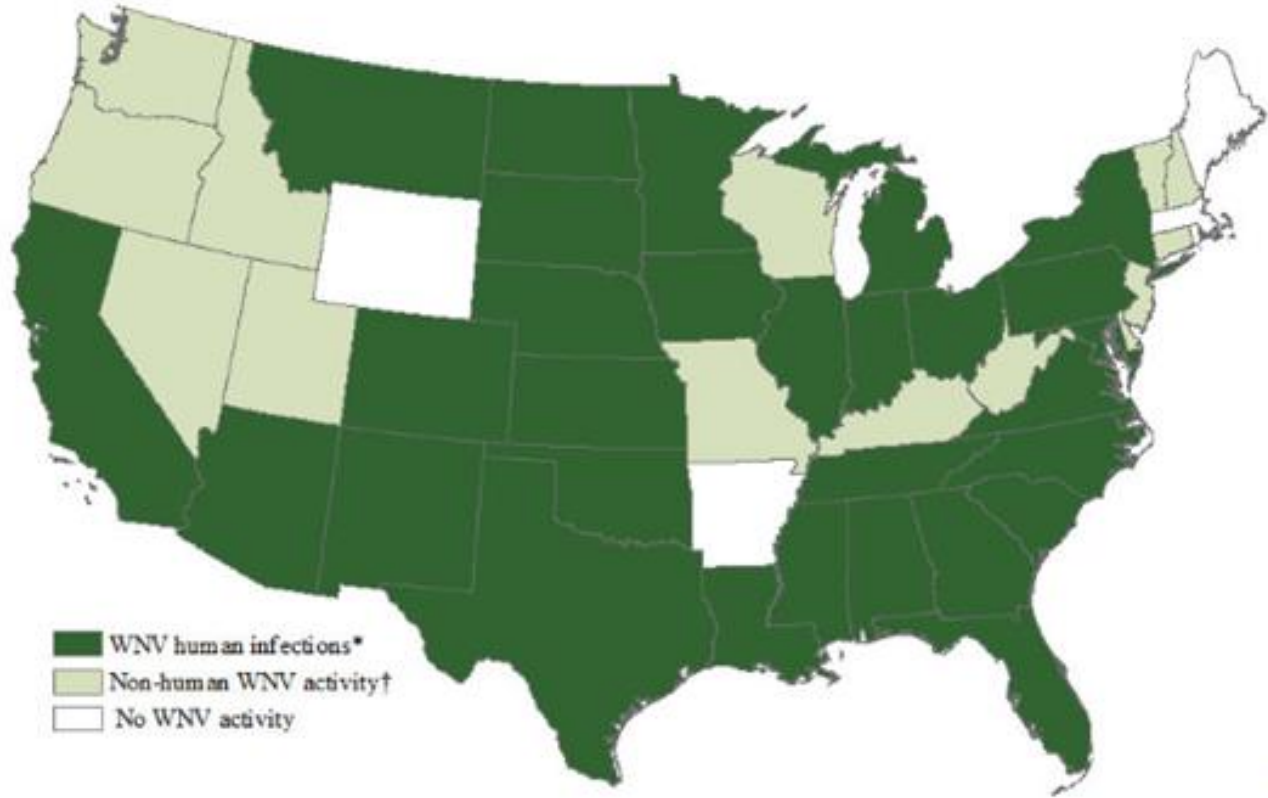
## **Tick-borne diseases**

Ticks carry many diseases-anaplasmosis, babesiosis, erlichiosis, lyme disease, powassan virus, and rocky mountain spotted fever. In 2012 there were 30,831 cases of lyme disease alone reported from the Centers for Disease Control and Prevention. Squirrels can carry ticks that harbor disease and transport those ticks to the backyards of millions of people's homes.

## **West Nile Virus**

West Nile Virus is a flavivirus, from the family of *Flaviviridae*. The virus is transmitted between mosquitoes and birds to mammals. In New York City in 1999, the public started seeing dead birds and squirrels that had neurologic signs before death. Testing was done on the deceased and the first confirmed cases of West Nile Virus were found in the United States. Since then, the disease has spread all over the United States. Most positive cases in humans are seen between August, September and October. Below is a map that shows the states that have already had positive cases in 2018 from the Centers for Disease and Control Prevention:

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**Figure 8—West Nile Virus Activity by State—United States 2018 (as of August 7, 2018), Centers for Disease Control and Prevention**

In 2002, Kansas saw the first confirmed cases of West Nile, with 22 positive, compared to 2016 where 37 cases were positive according to the CDC. Since 1999, West Nile Virus has killed 2,017 people in the United States. Symptoms of West Nile can range from high fever, neck stiffness, disorientation, vision loss, to no symptoms. Through the CDC’s research, on average 8 out of 10 people infected with West Nile do not develop any symptoms. There is no vaccine to prevent West Nile or antiviral treatment. The only real prevention of West Nile Virus is to wear long sleeves outside and to apply mosquito repellent.

### **Mange**

*Notoedres douglasi* is a small mite that commonly burrows into the skin of squirrels. Squirrels will itch from the burrowing mite and start to lose hair allowing infection to take over the skin. The more common name for this is mange. The infection can cause swelling around the eyes or complete hair loss, secondarily killing the squirrel from loss of vision and the inability to regulate their own

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temperature. The mites are treatable, however if the environment is infested, the squirrels will be re-infected even after treatment. In a study done by Foley et al, once a population is infected it was discovered that more than half of the population is killed by the disease. Mites are mainly host specific, meaning *Notoedres douglasi* prefer squirrels to feed on. However, if an infested squirrel is picked up by a human, the human can be bitten from the mite. Below is a picture of what a squirrel with mange might typically look like:



**Figure 9-Squirrel with Mange, The Mercury News**

## **Tularemia**

Tularemia, otherwise known as rabbit fever, is a disease caused by a bacterium called *Francisella tularensis*. It is transmitted to squirrels through contaminated water, ticks, fly bites, fleas, or contaminated soil from an open wound. This disease is able to be transmitted to humans from an infected animal from eating it to just skinning the animal and getting the bacteria near an open wound. In a study by Nelson et al, it was discovered that squirrels can have tularemia but no lesions externally or internally. In humans, symptoms can include skin ulcers, swollen lymph nodes, sore throat, muscles aches, joint pain, or weakness. Symptoms often develop three to five days following the exposure of the disease. Without treatment, 30 to 60% of people can die from this disease. The western and south-central United States are the most common areas for tularemia with around 200 people a year becoming ill from this disease (Minnesota Dept. Health, 2006). There is no vaccine available for this disease, and thus why tularemia is a possible biological terror weapon of mass destruction.



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Gardeners or landscapers are most likely to get the disease by working in contaminated soil. The most susceptible animals to this disease are rabbits, rodents, and cats. To prevent this disease, follow these tips:

- Make sure sick animals are not eaten and do not touch the animals with bare hands.
- Do not drink water from streams or lakes to decrease the chances of contracting tularemia.
- Do not mow over animal carcasses as the aerosolized bacteria could make people sick.
- When doing landscape work, use a dust mask.
- When in wooded areas, make sure to wear insect repellent to repel ticks and mosquitoes from transmitting diseases.

### **Salmonellosis**

Salmonella is a normal bacterium seen in the intestinal tracts of animals. However, once it is ingested by a human, salmonella can cause serious harm. Healthy animals can carry the disease, but show no clinical sickness. Salmonella is most dangerous for immunocompromised people such as infants and adults over 65. Clinical signs seen in people that are infected with salmonella include fever, abdominal cramps, diarrhea, or vomiting. Treatment for salmonellosis can be as simple as intravenous fluids. For healthy individuals, the clinical signs will usually resolve after 5-7 days with no treatment. The most critical part of treatment is fluid therapy since the body loses fluids due to diarrhea.

Household pets can also become infected with the disease. Pets that have salmonella can have diarrhea that may contain blood or mucus. Salmonella can be transferred from squirrels, but several dog food companies have recalled pet food and pet treats due to salmonellosis contamination. Make sure to contact your veterinarian if a pet has consumed a recalled item.

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## **Chapter 8-Core Area Competencies**

The Kansas State University Masters of Public Health program requires five core competency classes to be taken in order to acquire your degree. The courses that are taken provide a sustainable foundation of knowledge so that the masters candidate can complete the degree and enter the workforce prepared to compete in a competitive pool of applicants.

### **Biostatistics**

MPH 701 Fundamental Methods of Biostatistics is a class that will allow me to interpret and analyze research from the field. P values are used in almost all research projects, which as a veterinarian, I look at frequently. The p-value is the probability that when treatments are not different, a difference as great as or greater than that observed in the experiment could have been due to chance. If the p-value is equal to 0.05 that means the treatments are truly not different and that there is a 5% probability that the difference found could have been due to chance (Larson, 2014). I look at research to make sure I am using the correct medications for illnesses and to ensure that I am practicing the best medicine and the p-value allows me to do that.

### **Environmental Toxicology**

DMP 806 Environmental Toxicology helped me learn more about the health of the environment and how humans affect it. As a veterinarian, I was able to see the correlation between what humans use to fix one problem and how it can make 5 more problems for the environment by using a certain chemical. It was interesting to find out certain carcinogens that are in products that humans use in their houses. This class also opened my eyes to the amount of harmful substances animals and humans are exposed to on a daily basis.

### **Epidemiology**

MPH 754 Introduction to Epidemiology is a class that allowed me to look more at the herd, than at one single animal. As a veterinarian, I do see a lot of sick animals. However, this class allowed me to think outside the box, and that I should also think about the herd to help achieve a quicker diagnosis. This same logic can be used with people and diseases. Epidemiology is key to solving public health problems.

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## **Health Services Administration**

MPH 720 Administration of Health Care Organizations teaches students the importance of the health care system and how it can be difficult to understand. Before taking this class, I did not know how complicated the health care system is in the United States. As a public health worker, it is important to know the terminology of the health care system and this class was able to equip students with a better understanding of what health care means due to political, social, and technological meanings.

## **Social and Behavioral Sciences**

MPH 818 Social and Behavioral Bases of Public Health teaches students to better communicate with the public by understanding the audience and better analyzing the problems. Social, communities, institutional, interpersonal, and individual are determinants that are used to analyze a public health problem. Once the problem is analyzed, we were taught to look at the positive and negatives of each problem to determine what would be the best option for the health of the public. This class helped me to better understand how to discuss with clients why I think my medical treatment is the correct treatment for their pets. I am able to understand their concerns, and to have an answer for their questions on why I perform medicine the way that I do.

## Chapter 9-Conclusion

Zoonotic diseases are a major health problem worldwide. Wildlife pose as a great threat to the human species with the zoonotic diseases they are able to transmit. With the explosive growth of the human population in the United States, we are encroaching more into the habitats of these animals. Some animals seek refuge, like bats, into house attics, while others, like raccoons, will eat trash in our backyards. This is allowing wildlife and humans to come into contact one way or another on a daily basis. Kids want to touch wildlife, like pets, and are not aware of the dangers that these animals possess. As the population grows, so does the threat of zoonotic and infectious diseases in America. The deer population is growing and the deer are traveling places they did not travel to before. The deer are transporting tick borne diseases that animals and humans in those areas were not used to. The traveling of animals and humans is also allowing diseases that were never in the United States, like Zika virus, to enter and cause worry as to what the future will bring.

Educating the population on ways to prevent these zoonotic and infectious diseases will decrease the chances of humans transmitting the disease. According to an article by Sanyaolu et al in the Journal of Infectious Diseases and Epidemiology, estimates have shown that zoonotic diseases take up 58% to 61% of all communicable diseases causing illness in humans worldwide. Zoonotic diseases also take up to 75% of emerging human pathogens. It is highly unlikely to stop the diseases from being in America, but there are ways to prevent them. Douglas County is a good example of how the material to educate the public should come at the county level. Prairie Park Nature Center, in Lawrence, Kansas, has an area for children to learn about wildlife, while the educational brochures on zoonotic and infectious diseases are for adults to take home. Classrooms from the county come to the nature center during the school year to learn about wildlife and the correct way to live in harmony with them. There are classes that adults and children of all ages can take all throughout the year to learn about wildlife and the great outdoors. These classes allow Northeast Kansas to learn about the infectious and zoonotic diseases that could potentially make them ill. Giving the public the material to know how to prevent these diseases is key to making sure the future population can know what to look for if they believe they have been transmitted a zoonotic disease.

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## Appendix 1

# Bats



### **There is a bat in my house. What should I do?**

First, make sure your family and pets are away from the bat. If you need to move to a separate room, or get out of the house, do so. Next, assess the situation and call the Prairie Park Nature Center at 785-832-7980.

Here are the questions they may ask you:

- Is the bat hurt?
- Is the bat healthy, but needs to find a way out of your house?

### **The bat I found is hurt (inside your house or on the sidewalk outside), what do I do next?**

If you ever find a bat that could be hurt, contact the Prairie Park Nature Center. If the bat is able to be caught, first make sure you have thick leather gloves and a net to catch the bat. Once the bat is in the net, put it in a container that it cannot get out of, but can breathe in. Take the bat to the Prairie Park Nature Center as soon as possible.

### **The bat I found in my house is healthy. How do I get it out?**

If you have thick leather gloves and a net, it is possible for you to catch the bat to release it back into the wild. When doing so, make sure you release the bat into a tree. Bats cannot fly from the ground, they have to drop to fly so need to be released from high areas. However, it would be best to contact a professional wildlife catcher to get the bat and release it into the wild. If there was one bat in your house, it is possible there is a den in your house with more bats. The wildlife professional will be able to look into other areas of your house to see if there are more. If there are more bats they will help to get them out of your house and to seal your house to make sure more bats do not move in. If you would like suggestions on who to call to help you, call the Prairie Park Nature Center at 785-832-7980.

### **Should I keep a bat as a pet?**

No! It is illegal for people of the public to keep wildlife as pets in their house. Bats will bite if they feel threatened. Due to the risk of rabies, if you are bitten from a bat, you will need to contact the health department and your physician to decide the next steps. They are wild animals and they belong outside.

### **What diseases can bats carry?**

#### -Rabies

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals-including humans, dogs, cats, raccoons, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals. Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes.

In 2017, Kansas had 39 positive cases of rabies according to the K-State Veterinary Diagnostic Rabies Laboratory. The positive cases in Kansas were:

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- **3 big brown bats**
- **1 hoary bat**
- 2 bovines
- 3 cats
- 1 dog
- 3 horses
- 26 skunks

Since the rabies virus is concentrated in the salivary glands, there are several ways for the virus to be transmitted. The most commonly known way that the virus is transmitted is from the bite of an animal that is infected. However, if the person that comes into contact with a rabid animal has a cut on their skin, and they touch the animal with the cut on their hand rabies can infect the body. Lots of animals clean themselves, especially bats, and the saliva stays on their bodies. If a cut on a hand comes into contact with just the fur, a transmission of rabies can occur.

Rabies has also been transmitted through organ donations, contamination of mucous membranes (ex. eyes, mouth, nose), and aerosolized transmission. In animals, rabies can be transmitted through the placenta to the babies in the uterus. That means it is possible for the mother to transmit rabies to her young while they are in the womb. If the mother does not die from rabies before the babies are born, the babies will be born with the rabies virus already shedding making baby skunks not safe.

Once the rabies virus goes into the body, it travels to the nerves of the brain. There can therefore be a multitude of signs seen. Some of the signs you should watch for:

- Fearfulness
- Aggression
- Excessive drooling
- Difficulty swallowing
- Staggering
- Seizures
- Wild animals-Unusual behavior. For example, an animal that should only be seen at night may be seen in the daytime.
- Depression
- Self-mutilation
- Increased sensitivity to light

#### -Fleas (The Plague)

Bats can have fleas, but did you know that fleas can give your family a disease? *Yersinia pestis* is a disease that is transmitted through the bite of an infected rodent to humans, more commonly called the Plague. In March of 2017, there was a plague outbreak in Colorado. Bats might not even show signs or symptoms, but the animal may be seen scratching. Human symptoms start within 48 hours of exposure with high fever and enlarged lymph nodes. You can prevent your family from getting this disease by not approaching wildlife and making sure all of your animals are up to date on flea prevention.

#### -Ticks

Bats do carry a type of tick known as a 'soft tick'. Its shell is softer than the normal tick we are used to seeing. These ticks are routinely found in houses and buildings that are infested with bats. They are able to hide in cracks and in the crevices where bats are roosting. Soft ticks are able to live for years without a host to feed on. If the bats are unable to feed the ticks, the ticks will find any type of blood source including humans or animals.



#### -West Nile Virus

West Nile Virus, or WNV, is a virus that is most prominent in the months of July to end of September. Symptoms that bats will show if infected with the virus include uncoordinated movement,

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paralysis, shaking, or circling. This disease is transmitted from an infected mosquito. Humans and horses can also get the virus. Having a positive bat in your area does not harm you directly, but it does let you know that you have West Nile Virus positive mosquitos in your area and to be careful! If you see a dead bat that previously showed some of these signs, make sure you use gloves to get rid of the bat either by burial or throwing it away in the trash.

### **How can I keep my family and friends safe?**

- Don't feed wildlife! When you feed wildlife you are giving them a reason to live near your house, defecate near your house, and cause frequent sightings near your house.
- Make sure you cap your chimney before spring when animals are looking for places to put their nests.
- Remove outside food sources that wildlife can get to. If you have outdoor animals, make sure they are fed routinely and that their food is finished and not sitting out all day.
- Have your attic entrance correctly closed so no wildlife can enter. Professionals can help you make sure your attic is blocked shut and will check to make sure there are no holes that wildlife can enter.

Put together by Michelle Hall, DVM 2018

You can find more information on these topics at:

- Center for Disease Control and Prevention- <https://www.cdc.gov/ncezid/stories-features/browse/subjects/zoonotic-diseases.html>
- Kansas State University Rabies Laboratory-<http://www.ksvdl.org/rabies-laboratory/>
- American Veterinary Medical Association- <https://www.avma.org/public/Health/Pages/rabies.aspx>



# Opossums



## **I see an opossum outside that might need help. How do I know if I should help it?**

First, contact the Prairie Park Nature Center at 785-832-7980. Tell them what you are seeing. Some details they might ask you:

- Where was the opossum found?
- What is the opossum doing?
- Have any domestic animals had contact with it?
- Does it seem healthy?

There are several things to consider when watching a wild animal. For example, juveniles that are naïve do not know what they should fear and sometimes are comfortable coming up to a human. Also, a natural defense mechanism for many animals is to freeze, which people may take as being friendly. The nature center has staff that will tell you what to do next with the animal.

## **Should I keep an opossum as a pet?**

No! It is illegal for people of the public to keep wildlife as pets in their house. These animals could have diseases that could harm people or even kill them. They are wild animals and they belong outside. Opossums are also prone to Metabolic Bone Disease, or MBD. They need specific nutrition to make sure their body can grow correctly. If an opossum is not fed the correct diet, it could cripple the opossum or cause death. If you find an opossum that needs help, please call Prairie Park Nature Center at 785-832-7980. They have wildlife rehabilitators that will be able to give the opossums a fighting chance to get back to the wild.

## **Interesting facts about opossums:**

- ❑ The opossum is the only marsupial, or pouched animal, in the United States and Canada. This means they keep their young in the pouches on their bellies. When the opossums are born, they are the size of honeybees! If you accidentally hit an opossum or someone you know does, make sure to check its pouch. Young opossums could be in the pouch, even if the mom is dead. Call Prairie Park Nature Center at 785-832-7980 to ask what to do next for the babies if you find them in the pouch.
- ❑ Opossums only make temporary dens. They do not stay in one area for long amounts of time.
- ❑ They are super clean and like to stay that way. Opossums are the Ecological Service Technicians of the wild. They eat ticks while cleaning and are becoming more known for their activity of eating ticks to keep diseases like Lyme disease down. They also like to eat dead animals, so keep their areas clean from rotting carcasses. Opossums carry few diseases due to their low body temperature.
- ❑ Opossums in the chicken coop? Opossums don't like to eat adult chickens; they were likely getting in the chicken coop to have some eggs for breakfast! Eggs are some of their favorite foods. However, chicks and sick adult chickens could become a feast for an opossum. Make sure your chicken coop is free of holes for opossums to get into.
- ❑ Opossums are great for pest control! They love to eat cockroaches, rodents, slugs, fruits, and snakes. Opossums are assets to any neighborhood.
- ❑ Do you smell that? Opossums have a good sense of smell. They have 1,188 olfactory receptors, making them have the 3<sup>rd</sup> best nose in the United States! This could be why if you do not



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package your garbage up well enough, they will smell it before the garbage truck comes to pick it up!

❏ Opossums live approximately 2 years in the wild and around 4 years in captivity.

## **What diseases can opossums carry?**

### -Rabies

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals-including humans, dogs, cats, raccoons, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals. Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes. While opossums are able to be infected with rabies, due to their lower body temperatures and immune system, they are one of the least likely to have the disease.

### -Fleas (The Plague)

Wildlife can have fleas, but did you know that fleas can give your family disease? *Yersinia pestis* is a disease that is transmitted through the bite of an infected rodent to humans, more commonly called the Plague. In March of 2017, there was a plague outbreak in Colorado. Opossums might not even show signs or symptoms, but the animal may be seen scratching. Human symptoms start within 48 hours of exposure with high fever and enlarged lymph nodes. You can prevent your family from getting this disease by not approaching wildlife and making sure all of your animals are up to date on flea prevention.

### -Leptospirosis

Leptospirosis is transmitted from an infected animal usually in urine. It can be transmitted to other animals or to humans, making this a zoonotic bacterium. The bacterium can enter into a host by secretions in soil, water, bedding, or food that is contaminated with infected urine. In humans, symptoms are common to the flu and will appear around two weeks following exposure. You can prevent exposure by staying away from wild animals and by making sure your pets are properly vaccinated for the disease.

### -Tick-borne diseases-Do opossums actually help us?

Opossums are wonderful cleaners-they check their bodies constantly. That means if they have ticks, they usually clean them off their bodies before the ticks can transmit diseases. In a study done by the Cary Institute of Ecosystem Studies, they estimated that one opossum can eat up to **5,000** ticks in a season. This statistic is amazing for opossums-they help keep the tick populations at bay and are not likely to carry tick-borne diseases. To keep yourself, your family, and your pets safe, stay away from wildlife when possible and make sure your pets are up to date on tick prevention. When you are outside make sure to wear tick repellent and if you are going into heavily wooded areas wear pants and long sleeved shirts. If you see an opossum in your back yard, leave it be. It might be cleaning up the ticks in your back yard!



### -Toxoplasmosis

Toxoplasmosis is a protozoan disease that is transmitted from infected feces. The definitive host for this disease is cats, but it can be transmitted to opossums or any other warm blooded animal. Toxoplasmosis is especially scary for immunocompromised individuals such as the young, elderly, or pregnant women. Opossums that are infected with toxoplasmosis can show clinical signs anywhere

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from no signs to seizures once the disease is in the brain. Since the cat is the definitive host, meaning it spreads the disease; the raccoon is the dead end host and will die from the disease.

-Equine Protozoal Myeloencephalitis-Infectious disease transmitted to horses from opossums

Equine Protozoal Myeloencephalitis, or EPM, is a parasite that is transmitted to horses by fecal oral transmission. Opossums are the definitive host, which obtains the organism from cats, raccoons, skunks, armadillos, and sea otters. The horse comes into contact with the infective feces while grazing or eating contaminated feed or water. Once the horse has ingested the infective feces, the protozoal parasite migrates to the intestinal tract and into the bloodstream where it goes to cross the blood/brain barrier. The parasite then attacks the horse's central nervous system. Signs you can see in a horse include incoordination and weakness, paralysis, difficulty swallowing, seizures, abnormal sweating, head tilt, or loss of sensation of the face, neck, or body. If see any of these signs in your horse, call your veterinarian immediately. To prevent your horse from coming into contact with this disease, the American Association of Equine Practitioners recommends that you:

- Keep water tanks clean and filled with fresh water
- Keep food rooms and containers closed and sealed
- Use feeders, which minimize spillage and are difficult for wild animals to access.
- Clean up dropped grain immediately to discourage scavengers. Do not feed on the ground.
- Have good rodent control in all barns.
- Properly dispose of any animal carcasses you may see on or near your property.
- Schedule regular appointments with your veterinarian.

### **How can I keep my family and friends safe?**

- Don't feed wildlife! When you feed wildlife you are giving them a reason to live near your house, defecate near your house, and cause frequent sightings near your house.
- Make sure you cap your chimney before spring when animals are looking for places to put their nests.
- Opossums are smart, they can maneuver pet doors. Make sure your pet's door is secure and is locked when you are not home.
- Remove outside food sources that wildlife can get to. If you have outdoor animals, make sure they are fed routinely and that their food is finished and not sitting out all day.
- Make sure all garbage cans are secured that are outside your house.
- Close off areas that are easy for wildlife to get to such as patio areas and beneath concrete steps. Wildlife will take advantage of these areas, so do not give them an option.
- Have your attic entrance correctly closed so no wildlife can enter. Professionals can help you make sure your attic is blocked shut and will check to make sure there are no holes that wildlife can enter.

I hope you consider being nice to this creature the next time you see one. They might not be the most beautiful, but they do a considerable amount of clean up to the environment!

Put together by Michelle Hall, DVM 2018

You can find more information on these topics at:

- Center for Disease Control and Prevention- <https://www.cdc.gov/ncezid/stories-features/browse/subjects/zoonotic-diseases.html>
- Kansas State University Rabies Laboratory-<http://www.ksvdl.org/rabies-laboratory/>

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- American Veterinary Medical Association- <https://www.avma.org/public/Health/Pages/rabies.aspx>





# Rabies

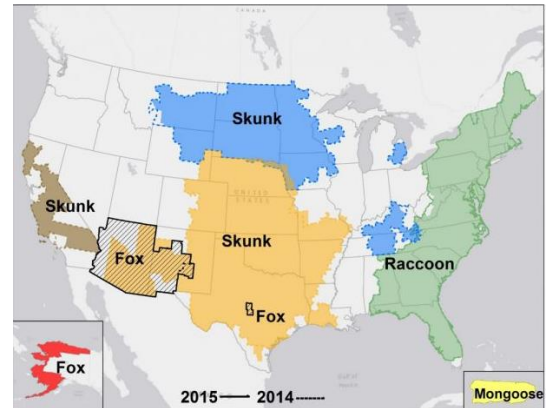


## What is Rabies?

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals-including humans, dogs, cats, raccoons, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals.

## What animals can get rabies?

Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes. In domestic animals, cats are now seen as the most common household pets to be infected with rabies when compared to dogs. Cows, horses, goats, pigs, and ferrets can transmit rabies, but are lower in comparison. To the right is a map of the most common wildlife that has tested positive for rabies in their respective areas of the United States.



In 2017, Kansas had 39 positive cases of rabies according to the K-State Veterinary Diagnostic Rabies Laboratory. The positive cases in Kansas were:

- 3 big brown bats
- 1 hoary bat
- 2 bovines
- 3 cats
- 1 dog
- 3 horses
- 26 skunks

## How is rabies transmitted?

Since the rabies virus is concentrated in the salivary glands, there are several ways for the virus to be transmitted. The most commonly known way that the virus is transmitted is from the bite of an animal that is infected. However, if the person that comes into contact with a rabid animal has a cut on their skin, and they touch the animal with the cut on their hand rabies can infect the body. Lots of animals clean themselves, especially bats, and the saliva stays on their bodies. If a cut on a hand comes into contact with just the fur, a transmission of rabies can occur.

Rabies has also been transmitted through organ donations, contamination of mucous membranes (ex. eyes, mouth, nose), and aerosolized transmission. In animals, rabies can be transmitted through the placenta to the babies in the uterus. That means it is possible for the mother to transmit rabies to her young while they are in the womb. If the mother does not die from rabies before the babies are born, the babies will be born with the rabies virus already shedding.

## What are the signs of rabies in animals?

Once the rabies virus goes into the body, it travels to the nerves of the brain. There can therefore be a multitude of signs seen. Some of the signs you should watch for:

- Fearfulness
- Aggression
- Excessive drooling
- Difficulty swallowing
- Staggering
- Seizures
- Wild animals-Unusual behavior. For example, an animal that should only be seen at night may be seen in the daytime.
- Depression
- Self-mutilation
- Increased sensitivity to light.

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### **Is rabies really a risk to me or my family?**

Yes! On January 16<sup>th</sup>, 2018 a 6 year old boy in Florida died of rabies after coming into contact with a bat that had rabies. The disease is still around in the United States, but if you take the correct steps the chances of getting the disease are greatly reduced. The U.S. has taken steps to decrease the number of cases of rabies by having vaccinations available for pets and for having protocols put in place for people who have been bitten. Right here in Lawrence, there was a bat that tested positive for rabies on December 9, 2016.

If you believe your family has potentially been in danger of transmitting rabies, you need to contact a medical professional to discuss the rabies post exposure immunotherapy series.

### **What can I do to keep myself and my family/friends safe?**

- If you see an animal acting strangely, **DO NOT PICK IT UP**. Contact the Lawrence Police Department non-emergency number at 785-832-7509 and let them know what you are seeing.
- Do not leave garbage or pet food outside, as this could attract stray or wild animals.
- Wild animals should **NEVER** be kept as pets. Not only is this illegal, but wild animals can carry diseases such as rabies and this could be a potential threat to people who live in the house and people you come into contact with daily.
- Observe all wild animals from a distance. A rabid wild animal could appear tame, but do not go near it.
- Teach children to **NEVER** hold or handle unfamiliar animals, even if they appear friendly.
- Contact your veterinarian about vaccinating your dogs, cats, ferrets, horses, and select livestock. Your veterinarian will be able to tell you if your animals need vaccinations and how frequently.
- Overall, reduce the possibility of exposure to rabies in your pets by not letting them roam free. Keep your cats and ferrets indoors, and supervise dogs when they are outside. By getting your animal spayed or neutered, it will decrease the chances of your pet wandering away to find a mating partner. Call your veterinarian to ask them questions you may have.
- As there was a positive bat case in Douglas County in 2016, bat proof your home to prevent bats from nesting at your house. Visit the CDC website for more ideas on how to keep your home bat proof.
- If you have questions about wildlife in the Lawrence area, please call Prairie Park Nature Center at 785-832-7980.

### **What if my pet has bitten someone?**

Make sure the person who is bit seeks medical attention. Call your veterinarian to ask about your pets' vaccinations. Explain the situation and your veterinarian will decide what the next step is. Make sure to keep your pet at home and to not let it run free outside during this process. After the observation period, if your pet is not vaccinated for rabies make sure to get the vaccination for your pet.

### **What if my pet has been bitten?**

Contact your veterinarian immediately to determine your pet's vaccination history and call the non-emergency Lawrence Police Department number at 785-832-7509. Your veterinarian will determine the next steps to keep you and your pet safe. Dogs, cats, and ferrets that have never been vaccinated for rabies and could have been exposed to a rabid animal may need to be euthanized or placed in a strict isolation for six months.

### **What if I am bitten?**

As stated previously, do **NOT** pick up wildlife. This can prevent you from getting bitten. If you have been bitten immediately wash your hands with warm water and soap. Call your physician immediately and follow your doctors' advice on what to do next. If you can, try to confine or capture the animal in a large

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box or other container. Once it is captured call the non-emergency Lawrence Police Department number at 785-832-7509 to collect it. If the animal cannot be captured and must be killed to prevent its escape, try to do so without damaging the brain. The brain is the organ that must be tested for rabies. If you have to kill the animal, once it is dead make sure to put it in a cool area, but do not freeze it! Make sure you report the bite to the local health department. If you seek treatment after being bitten and before the disease develops, you can stop the infection and prevent the disease.

Put together by Michelle Hall, DVM

Information was gathered by these agencies: Go to their websites for more information!

- Center for Disease Control and Prevention-Rabies page  
(<https://www.cdc.gov/rabies/index.html>)
- Global Alliance for Rabies Control- <https://rabiesalliance.org>
- Kansas State University Rabies Laboratory-<http://www.ksvdl.org/rabies-laboratory/>
- American Veterinary Medical Association-  
<https://www.avma.org/public/Health/Pages/rabies.aspx>



# Raccoons

## **I see a raccoon outside that might need help. How do I know if I should help it?**

First, contact the Prairie Park Nature Center at 785-832-7980. Tell them what you are seeing.

Some details they might ask you:

- Where was the raccoon found?
- What is the raccoon doing?
- Have any domestic animals had contact with it?
- Does it seem healthy?

There are several things to consider when watching a wild animal. For example, juveniles that are naïve do not know what they should fear and sometimes are comfortable coming up to a human. Also, a natural defense mechanism for many animals is to freeze, which people may take as being friendly. The nature center has staff that will tell you what to do next with the raccoon.

## **There is a raccoon that is frequently around my house. It doesn't seem sick. What should I do?**

The raccoon could be living in your house somewhere with a litter of baby raccoons. Baby raccoons are born late March to April and again in mid-summer. If there are babies in your house, you **do not** want to trap the mother as the babies would be left behind in your house. There are ways to make your house unfavorable to raccoons so that the mother will move the nest out of your house. Some suggestions that professionals have to get rid of raccoons in your house include bright lights, loud music, and wire mesh. For more suggestions, visit [http://www.humanesociety.org/animals/raccoons/tips/raccoon\\_eviction\\_exclusion.html](http://www.humanesociety.org/animals/raccoons/tips/raccoon_eviction_exclusion.html).

## **Should I keep a raccoon as a pet?**

No! It is illegal for people of the public to keep wildlife as pets in their house. These animals could have diseases that could harm people or even kill them. They are wild animals and they belong outside.

## **What diseases can raccoons carry?**

### -Rabies

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals-including humans, dogs, cats, raccoons, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals. Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes. In domestic animals, cats are now seen as the most common household pets to be infected with rabies when compared to dogs. Cows, horses, goats, pigs, and ferrets can transmit rabies, but are lower in comparison.

### -Raccoon Roundworm

*Baylisascaris procyonis* is a common parasitic roundworm that is transmitted in raccoon feces. It is a zoonotic disease, or a parasite that can be transmitted to humans from ingestion of

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the egg. This is most worrisome in young children as raccoons like to defecate in one area, often called a raccoon latrine. The latrines are commonly found along houses, in playpens, or on children's toys over the winter and are found once summer starts. Children commonly put their hands in their mouths, and if they come into contact with raccoon feces outside, they are at risk for getting a roundworm that can travel to the human brain. To prevent any contact with this worm, make sure to not come into contact with wildlife and to check your children's play area. If feces are found on toys, clean the toys with bleach, soap, and water and let the toys dry in the sun.

#### -Fleas (The Plague)

Wildlife can have fleas, but did you know that fleas can give your family disease? *Yersinia pestis* is a disease that is transmitted through the bite of an infected rodent to humans, more commonly called the plague. In March of 2017, there was a plague outbreak in Colorado. Raccoons might not even show signs or symptoms, but the animal may be seen scratching. Human symptoms start within 48 hours of exposure with high fever and enlarged lymph nodes. You can prevent your family from getting this disease by not approaching wildlife and making sure all of your animals are up to date on flea prevention.

#### -Leptospirosis

Leptospirosis is transmitted from an infected animal usually in urine. It can be transmitted to other animals or to humans, making this a zoonotic bacterium. The bacterium can enter into a host by secretions in soil, water, bedding, or food that is contaminated with infected urine. In humans, symptoms are common to the flu and will appear around two weeks following exposure. You can prevent exposure by staying away from wild animals and by making sure your pets are properly vaccinated for the disease.

#### -Tick-borne diseases

Just as your pet can develop a tick-borne disease from getting bit by an infected tick, raccoons can also harbor diseases that are transmitted from ticks. Some of these diseases, like Lyme disease, can be transmitted to humans. Ticks that have fallen off the raccoon can attach to your pet or you and transmit the disease. Other diseases that ticks carry that can be transmitted are Erlichiosis or Anaplasmosis. To keep yourself, your family, and your pets safe, stay away from wildlife when possible and make sure your pets are up to date on tick prevention. When you are outside make sure to wear tick repellent and if you are going into heavily wooded areas wear pants and long sleeved shirts. Tick borne diseases are becoming much more common.



#### -Toxoplasmosis

Toxoplasmosis is a protozoan disease that is transmitted from infected feces. The definitive host for this disease is cats, but it can be transmitted to raccoons or any other warm blooded animal. Toxoplasmosis is especially scary for immunocompromised individuals such as the young, elderly, or pregnant women. Raccoons that are infected with toxoplasmosis can show clinical signs anywhere from no signs to seizures once the disease is in the brain. Since the cat is the definitive host, meaning it spreads the disease; the raccoon is the dead end host and will die from the disease.



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### -Distemper

Canine distemper virus (CDV) is prevalent in the raccoon population. It is the second leading cause of death in raccoons. Symptoms seen in raccoons can start as an upper respiratory infection where people see eye drainage and nose drainage. They can have diarrhea, be thin, and even get pneumonia. Once the disease has taken over the raccoon, the animal may act strange: wandering around in daylight, being unaware of its surroundings, paralysis, or other bizarre behaviors that are not normal. This type of disease is transmittable to domestic dogs. Contact your veterinarian if you see a raccoon acting strangely in your area to make sure your animals are vaccinated for this deadly disease. People commonly compare this disease to rabies in the ending stages, and that is why it is always unsafe to come into contact with a raccoon that is not acting normal. If you are unsure of what to do, contact the Prairie Park Nature Center at 785-832-7980. If they believe it is possible the animal is sick, they will have you contact the Douglas County Police Department non-emergency number at 785-832-7509. Once the raccoon has the disease there is no way to treat it and the most humane treatment is euthanasia. Remember, your veterinarian will be able to tell you if your pets are up to date on vaccinations for diseases like distemper. Contact them if there is a sick raccoon on your property.

### -Parvo

Parvo virus is a common disease that you have heard of in your animals. The disease can occur in dogs and cats, but did you know that raccoons can also become infected with the virus? In cats, it is called Panleukopenia. Just like in domestic animals, some clinical signs you will see in a raccoon sick with parvo include bloody diarrhea, lethargy, and having an unwillingness to eat. If there is a sick raccoon with clinical signs similar to this disease on your property, make sure your animals are properly vaccinated by contacting your veterinarian.

### **How can I keep my family and friends safe?**

- Don't feed wildlife! When you feed wildlife you are giving them a reason to live near your house, defecate near your house, and cause frequent sightings near your house.
- Make sure you cap your chimney before spring when raccoons are looking for places to put their nests.
- Raccoons are smart, they can maneuver pet doors. Make sure your pet's door is secure and is locked when you are not home. In Lawrence there have been several calls of raccoons in homes that entered through the pet door.
- Remove outside food sources that wildlife can get to. If you have outdoor animals, make sure they are fed routinely and that their food is finished and not sitting out all day.
- Make sure all garbage cans are secured that are outside your house.
- Close off areas that are easy for wildlife to get to such as patio areas and beneath concrete steps. Wildlife will take advantage of these areas, so do not give them an option.
- Have your attic entrance correctly closed so no wildlife can enter. Professionals can help you make sure your attic is blocked shut and will check to make sure there are no holes that wildlife can enter.

Put together by Michelle Hall, DVM 2018

You can find more information on these topics at:

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- Kansas State University Rabies Laboratory-<http://www.ksvdl.org/rabies-laboratory/>
- American Veterinary Medical Association- <https://www.avma.org/public/Health/Pages/rabies.aspx>
- The National Humane Society-Getting Raccoons Out, and Keeping them out-  
[http://www.humanesociety.org/animals/raccoons/tips/raccoon\\_eviction\\_exclusion.html](http://www.humanesociety.org/animals/raccoons/tips/raccoon_eviction_exclusion.html).



Photo from Today's  
Homeowner



# Skunks

## **I see a skunk outside that might need help. How do I know if I should help it?**

The Prairie Park Nature Center does NOT accept skunks in the facility. There is too much risk of rabies when handling skunks and therefore it is recommended to stay away from them. If you see a skunk that is acting strange, you can call the nature center to see if they believe the animal is a danger to people. Tell them what you are seeing. Some details they might ask you:

- Where was the skunk found?
- What is the skunk doing?
- Have any domestic animals had contact with it?
- Does it seem healthy?

There are several things to consider when watching a wild animal. For example, juveniles that are naïve do not know what they should fear and sometimes are comfortable coming up to a human. Also, a natural defense mechanism for many animals is to freeze, which people may take as being friendly. If the skunk is acting odd, the nature center will have you call the Lawrence Police Department non-emergency number at 785-832-7509.

## **Should I keep a skunk as a pet?**

No! It is illegal for people of the public to keep wildlife as pets in their house. These animals could have diseases that could harm people or even kill them. The main disease we are concerned about with skunks is rabies. They are wild animals and they belong outside.

## **What diseases can skunks carry?**

### -Rabies

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals-including humans, dogs, cats, raccoons, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals. Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes.

In 2017, Kansas had 39 positive cases of rabies according to the K-State Veterinary Diagnostic Rabies Laboratory. The positive cases in Kansas were:

- 3 big brown bats
- 1 hoary bat
- 2 bovines
- 3 cats
- 1 dog
- 3 horses
- **26 skunks**

Skunks are the most common animal to test positive for rabies in Kansas. Since the rabies virus is concentrated in the salivary glands, there are several ways for the virus to be transmitted. The most commonly known way that the virus is transmitted is from the bite of an animal that is infected. However, if the person that comes into contact with a rabid animal has a cut on their skin, and they touch the animal with the cut on their hand rabies can infect the body. Lots of animals clean themselves, especially bats, and the saliva stays on their bodies. If a cut on a hand comes into contact with just the fur, a transmission of rabies can occur.

Rabies has also been transmitted through organ donations, contamination of mucous membranes (ex. Eyes, mouth, nose), and aerosolized transmission. In animals, rabies can be transmitted through the placenta to the babies in the uterus. That means it is possible for the mother to transmit rabies to her young while they are in the womb. If the mother does not die from rabies before the babies are born, the babies will be born with the rabies virus already shedding making baby skunks not safe. Once the rabies virus goes into the body, it travels to the nerves of the brain. There can therefore be a multitude of signs seen. Some of the signs you should watch for:

- Fearfulness
- Aggression
- Excessive drooling
- Difficulty swallowing
- Staggering
- Seizures
- Wild animals-Unusual behavior. For example, an animal that should only be seen at night may be seen in the daytime.
- Depression
- Self-mutilation
- Increased sensitivity to light

If you see any of these signs from a skunk that is on your property or a property close to a heavily population of people like a school, call the Lawrence Police Department non-emergency number at 785-832-7509

#### -Fleas (The Plague)

Fleas can be seen on wildlife, but did you know that fleas can give your family disease? *Yersinia pestis* is a disease that is transmitted through the bite of an infected rodent to humans, more commonly called the Plague. In March of 2017, there was a plague outbreak in Colorado. Skunks might not even show signs or symptoms, but the animal may be seen scratching. Human symptoms start within 48 hours of exposure with high fever and enlarged lymph nodes. You can prevent your family from getting this disease by not approaching wildlife and making sure all of your animals are up to date on flea prevention.

Photo credit: Pest World



#### -Leptospirosis

Leptospirosis is transmitted from an infected animal usually in urine. It can be transmitted to other animals or to humans, making this a zoonotic bacterium. The bacterium can enter into a host by secretions in soil, water, bedding, or food that is contaminated with infected urine. In humans, symptoms are common to the flu and will appear around two weeks following exposure. You can prevent exposure by staying away from wild animals and by making sure your pets are properly vaccinated for the disease.

#### -Tick-borne diseases

Just as your pet can develop a tick-borne disease from getting bit by an infected tick, skunks can also harbor diseases that are transmitted from ticks. Some of these diseases, like Lyme disease, can be transmitted to humans. Ticks that have fallen off the skunk can attach to your pet or you and transmit the disease. Other diseases that ticks carry that can be transmitted are Erlichiosis or Anaplasmosis. To keep yourself, your family, and your pets safe, stay away from wildlife when possible and make sure your pets are up to date on tick prevention. When you are outside make sure to wear tick repellent and if you are going into heavily wooded areas wear pants and long sleeved shirts. Tick borne diseases are becoming much more common.



### -Hepatitis

Canine hepatitis is a disease of the liver. It can be transmitted to dogs from skunks; however, it is commonly vaccinated against in dogs. It can be transmitted through urine or feces of the skunks and it is a zoonotic disease, making humans also susceptible. Symptoms seen in skunks with this disease include yellow tinted skin and mucous membranes, bloated abdomen, and not acting normal. Not only can the liver become enlarged in this disease, but the lungs, kidneys, and spleen can all be affected.

### **How can I keep my family and friends safe?**

- Don't feed wildlife! When you feed wildlife you are giving them a reason to live near your house, defecate near your house, and cause frequent sightings near your house.
- Make sure you cap your chimney before spring when animals are looking for places to put their nests.
- Skunks are smart, they can maneuver pet doors. Make sure your pet's door is secure and is locked when you are not home.
- Remove outside food sources that wildlife can get to. If you have outdoor animals, make sure they are fed routinely and that their food is finished and not sitting out all day.
- Make sure all garbage cans are secured that are outside your house.
- Close off areas that are easy for wildlife to get to such as patio areas and beneath concrete steps. Wildlife will take advantage of these areas, so do not give them an option.
- Have your attic entrance correctly closed so no wildlife can enter. Professionals can help you make sure your attic is blocked shut and will check to make sure there are no holes that wildlife can enter.

Put together by Michelle Hall, DVM 2018

You can find more information on these topics at:

- Center for Disease Control and Prevention- <https://www.cdc.gov/ncezid/stories-features/browse/subjects/zoonotic-diseases.html>
- Kansas State University Rabies Laboratory-<http://www.ksvdl.org/rabies-laboratory/>
- American Veterinary Medical Association- <https://www.avma.org/public/Health/Pages/rabies.aspx>



# Squirrels

## **I see a squirrel outside that might need help. How do I know if I should help it?**

First, contact the Prairie Park Nature Center at 785-832-7980. Tell them what you are seeing. Some details they might ask you:

- Where was the squirrel found?
- What is the squirrel doing?
- Have any domestic animals had contact with it?
- Does it seem healthy?

There are several things to consider when watching a wild animal. For example, juveniles that are naïve do not know what they should fear and sometimes are comfortable coming up to a human. Also, a natural defense mechanism for many animals is to freeze, which people may take as being friendly. The nature center has staff that will tell you what to do next with the animal.

## **I see a baby squirrel on the ground. Is that normal?**

No, that is not normal. However, the squirrel could have fallen out of the nest when just moving around. A few things to be aware of:

- Was there a windstorm recently? If so, leave the squirrel on the ground for a few hours to see if the mother comes to rescue it.
- Has an animal disturbed a nest? Did you see a cat go up the tree or other animal? If so, rehome by putting up another nest if the old nest is ruined. Put it in close proximity to the old nest.
- Make sure your attic openings are correctly covered, including your soffits. If they are not, call a professional to help you keep wildlife out of your home.

If you wait for a few hours and you do not see the mother coming to help the baby, go assess the situation. What does the baby look like? If it is wrinkly this could mean the squirrel is dehydrated and needs to seek medical help as soon as possible. Call the Prairie Park Nature Center at 785-832-7980 so they can help you decide if you need to bring the baby squirrel to a wildlife rehabilitator.

Squirrels usually have around two litters of babies a year—once around March and another around August. Around this time is when you will see baby squirrels on the ground. The nests are in trees, and squirrels like to have them in tree cavities, where they are safe. Baby squirrels have a long growth period and it takes them around 3.5-4 weeks to even get their eyes open. The baby squirrels do not move around much until they are 6-8 weeks old. Once they are 12 weeks old they are able to go on their own.

## **Should I keep a squirrel as a pet?**

No! It is illegal for people of the public to keep wildlife as pets in their house. Squirrels will bite if they feel threatened. Due to the risk of rabies, if you are bitten from a squirrel, you will need to contact the health department to see what needs to be done next with the squirrel and your bite wound. They are wild animals and they belong outside.

## What diseases can squirrels carry?

### -Rabies

Rabies is a disease that can cause encephalitis (or inflammation of the brain) that is nearly 100% fatal after neurological symptoms have developed. The disease infects mammals—including humans, dogs, cats, raccoons, squirrels, and skunks. Rabies virus targets the brain and viral shedding is mainly seen in the salivary glands of mammals. Only mammals can become infected with rabies. Most cases of rabies occur in wild animals, mainly bats, skunks, raccoons, coyotes, and foxes. In domestic animals, cats are now seen as the most common household pets to be infected with rabies when compared to dogs. Cows, horses, goats, pigs, and ferrets can transmit rabies, but are lower in comparison

### -Fleas (The Plague)

Squirrels can have fleas, but did you know that fleas can give your family a disease? *Yersinia pestis* is a disease that is transmitted through the bite of an infected rodent to humans, more commonly called the Plague. In March of 2017, there was a plague outbreak in Colorado. Squirrels might not even show signs or symptoms, but the animal could be seen scratching. Human symptoms start within 48 hours of exposure with high fever and enlarged lymph nodes. You can prevent your family from getting this disease by not approaching wildlife and making sure all of your animals are up to date on flea prevention.

### -Leptospirosis

Leptospirosis is transmitted from an infected animal usually in urine. It can be transmitted to other animals or to humans, making this a zoonotic bacterium. The bacterium can enter into a host by secretions in soil, water, bedding, or food that is contaminated with infected urine. In humans, symptoms are common to the flu and will appear around two weeks following exposure. You can prevent exposure by staying away from wild animals and by making sure your pets are properly vaccinated for the disease.

### -Tick-borne diseases

Just as your pet can develop a tick-borne disease from getting bit by an infected tick, squirrels can also harbor diseases that are transmitted from ticks. Some of these diseases, like Lyme disease, can be transmitted to humans. Ticks that have fallen off the squirrel can attach to your pet or you and transmit the disease. Other diseases that ticks carry that can be transmitted are Erlichiosis or Anaplasmosis. To keep yourself, your family, and your pets safe, stay away from wildlife when possible and make sure your pets are up to date on tick prevention. When you are outside make sure to wear tick repellent and if you are going into heavily wooded areas wear pants and long sleeved shirts. Tick borne diseases are becoming much more common.



### -West Nile Virus

West Nile Virus, or WNV, is a virus that is most prominent in the months of July to end of September. Symptoms that squirrels will show if infected with the virus include uncoordinated movement, paralysis, shaking, or circling. This disease is transmitted from an infected mosquito. Humans and horses can also get the virus. Having a positive squirrel in your area does not harm you directly, but it does let you know that you have West Nile Virus positive mosquitos in your area and to be careful! If you see a dead squirrel that previously showed some

of these signs, make sure you use gloves to get rid of the squirrel either by burial or throwing it away in the trash.

### -Mange

Mange is a parasite that affects the skin on squirrels. *Notoedres douglasi* is a small mite that commonly burrows into the skin of squirrels. Squirrels will itch from the burrowing mite and start to lose hair allowing infection to take over the skin. The infection can cause swelling around the eyes or complete hair loss, secondarily killing the squirrel from loss of vision and the inability to regulate their own temperature. Mites are mainly host specific, meaning *Notoedres douglasi* prefer squirrels to feed on. However, if an infested squirrel is picked up by a human, the human can be bitten from the mite. If you see something like this on squirrels, it could also be a fungal disease called ringworm. To keep your family and friends safe from this disease, do not approach wildlife. A wildlife professional will know how to treat this disease if found on a sick squirrel.

### -Tularemia

Tularemia, otherwise known as rabbit fever, is a disease caused by a bacterium called *Francisella tularensis*. It is transmitted to squirrels through contaminated water, ticks, fly bites, fleas, or contaminated soil from an open wound. This disease is able to be transmitted to humans from an infected animal from eating it to just skinning the animal and getting the bacteria near an open wound. Gardeners or landscapers are most likely to get the disease by working in contaminated soil. The most susceptible animals to this disease are rabbits, rodents, and cats. To make sure you do not get this disease:

- When in wooded areas, make sure you wear insect repellent to repel ticks and mosquitoes from transmitting diseases to you.
- Make sure sick animals are not eaten and you do not touch the animals with your bare hands.
- Do not drink water from streams or lakes to decrease your chances of contracting tularemia.
- Do not mow over animal carcasses as the aerosolized bacteria could make you sick.
- When doing landscape work, use a dust mask.

### -Salmonellosis

Salmonella is a bacterium that can be found in the feces of most wildlife species, including squirrels. Squirrels may not show any clinical signs or could have diarrhea. Salmonella is transmitted from fecal-oral contamination. Symptoms in humans include stomach cramps, diarrhea, vomiting, or nausea.

### **How can I keep my family and friends safe?**

- Don't feed wildlife! When you feed wildlife you are giving them a reason to live near your house, defecate near your house, and cause frequent sightings near your house.
- Make sure you cap your chimney before spring when animals are looking for places to put their nests.
- Remove outside food sources that wildlife can get to. If you have outdoor animals, make sure they are fed routinely and that their food is finished and not sitting out all day.



- Make sure all garbage cans are secured that are outside your house.
- Close off areas that are easy for wildlife to get to such as patio areas and beneath concrete steps. Wildlife will take advantage of these areas, so do not give them an option.
- Have your attic entrance correctly closed so no wildlife can enter. Professionals can help you make sure your attic is blocked shut and will check to make sure there are no holes that wildlife can enter.

Put together by Michelle Hall, DVM 2018

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- American Veterinary Medical Association- <https://www.avma.org/public/Health/Pages/rabies.aspx>





# RABIES

Dr. Michelle Colgan-Hall  
Hall Veterinary Services

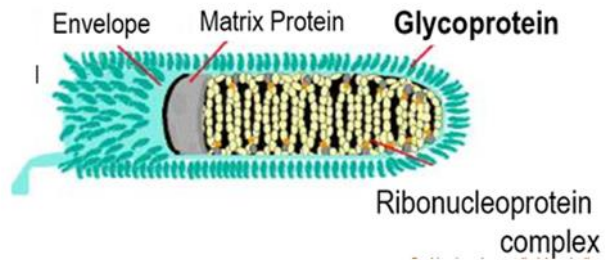
## MICHELLE COLGAN-HALL

- ◉ Kearney, Nebraska
- ◉ Wakarusa Valley → South Junior High → Lawrence High School
- ◉ Kansas State University
  - Food Science and Industry
  - Doctorate of Veterinary Medicine
  - Masters of Public Health



## WHAT IS RABIES?

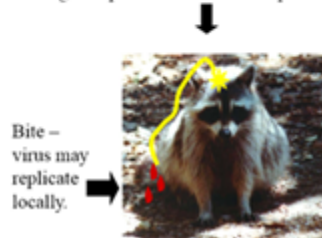
- ◉ Bullet-shaped, negative stranded virus.
- ◉ Genus: Lyssavirus
- ◉ Family: Rhabdoviridae
- ◉ Infects mammals



## WHAT KIND OF VIRUS?

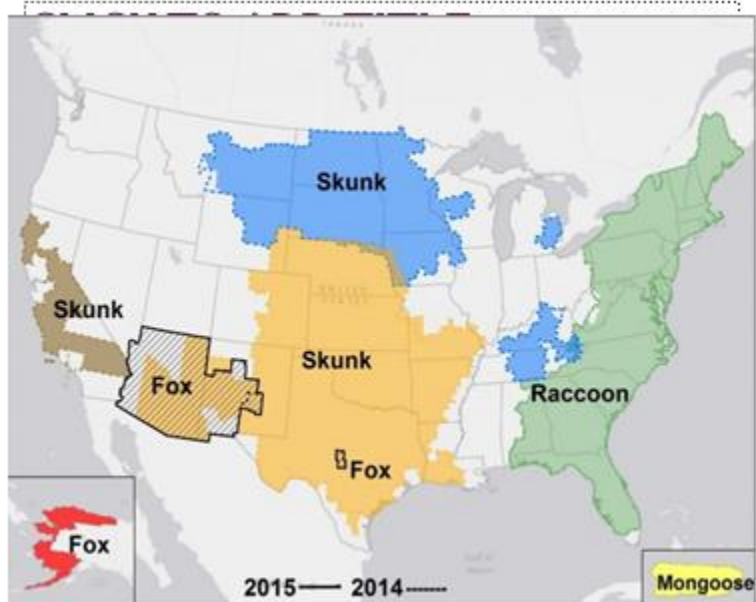
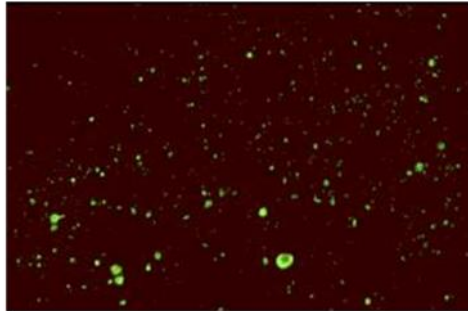
- ◉ Fragile, easily disinfected
- ◉ Neurotropic
  - Brain is the target organ
  - Behavior changes
- ◉ Transmitted from a bite
- ◉ Incubation-10 days to 6 months

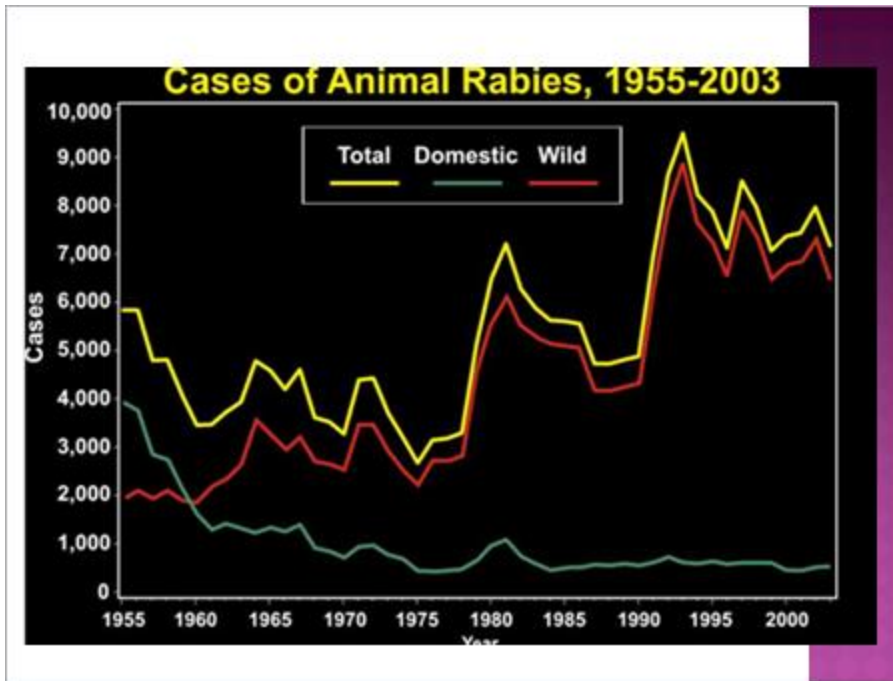
Virus goes up the nerves into the spinal cord and brain.



## DIAGNOSIS

- Direct fluorescent antibody test (dFA)
  - FRESH brain tissue (No freezing!)





## KANSAS RABIES TOTALS

- ⦿ Skunks: 26 positives
- ⦿ Horses: 3
- ⦿ Cats: 3
- ⦿ Big Brown Bats: 3
- ⦿ Bovines: 2
- ⦿ Dogs: 1
- ⦿ Hoary bat: 1



From the Kansas State Veterinary Diagnostic Laboratory in 2017

## CLINICAL SIGNS?

- ⦿ Aggression
- ⦿ Not normal activity
- ⦿ Vocalization
- ⦿ Loss of normal protective aversion
  - Self mutilate
- ⦿ Driven to perpetuate the virus
- ⦿ Anything NOT normal!



Management of Animals Exposed to Rabies

Animal Vaccination Status	Animal Type	Recommendation	Updated Recommendation?	
Currently Vaccinated	Dog, Cat, Ferret, Horse, Cattle, Sheep	<ul style="list-style-type: none"> <li>• Booster (w/in 96 hours of exposure*)</li> <li>• Observe <b>45</b> days</li> </ul>	No	
Overdue for Vaccination	Dog, Cat	<ul style="list-style-type: none"> <li>With appropriate documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Booster (w/in 96 hours of exposure*)</li> <li>• Observe <b>45</b> days</li> </ul>	Yes
		<ul style="list-style-type: none"> <li>Without appropriate documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Consult with KDHE (required) prior to booster w/in 96 hours of exposure*</li> <li>- Prospective Serological Monitoring</li> <li>- Animal in quarantine until results available</li> <li><b>OR</b></li> <li>• Treat as never vaccinated</li> </ul>	<ul style="list-style-type: none"> <li>Proper anamnestic response: Observe <b>45</b> days</li> <li>Inadequate anamnestic response: <b>4-month</b> quarantine</li> <li><b>4-month</b> quarantine</li> </ul>
	Ferret, Horse, Cattle, Sheep	<ul style="list-style-type: none"> <li>With appropriate documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Case by case basis</li> <li>• Consult with KDHE</li> </ul>	Yes
	<ul style="list-style-type: none"> <li>Without appropriate documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Euthanize</li> <li><b>OR</b></li> <li>• <b>6-month</b> quarantine</li> </ul>	No	
Never Vaccinated	Dog, Cat	<ul style="list-style-type: none"> <li>• Euthanize</li> <li><b>OR</b></li> <li>• Booster (w/in 96 hours of exposure*)</li> <li>• <b>4-month</b> quarantine</li> </ul>	Yes	
	Ferret, Horse, Cattle, Sheep	<ul style="list-style-type: none"> <li>• Euthanize</li> <li><b>OR</b></li> <li>• <b>6-month</b> quarantine</li> </ul>	No	

\*If rabies booster necessary to prove risk levels after exposure the observation (all) quarantine period may be extended.

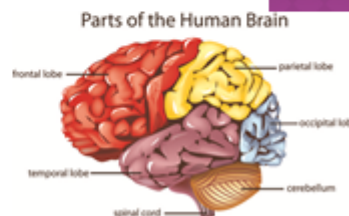
## BITES?

- ◉ If humans are bit, they **HAVE** to see a physician/Go to the emergency room.
- ◉ Post Exposure Prophylaxis
- ◉ 100% fatality



## EUTHANIZING

- ◉ To test for rabies, you need the brain
- ◉ Humane euthanasia
  - Carbon dioxide, carbon monoxide, and other inert gases
  - Gunshot-heart, chest, or neck (vertebrae, with the intent of severing the spinal cord) **NOT THE HEAD**
  - Hope you never have to use:
    - Exsanguination
    - Cervical dislocation or decapitation
    - Thoracic compression



## REFERENCES

"The Kansas Department of Health and Environment Rabies Investigation Guideline." *Kansas Department of Health and Environment*, 4 Oct. 2017, [www.kshhs.gov/epi/Investigation\\_Guidelines/Rabies\\_Disease\\_Investigation\\_Guideline.pdf](http://www.kshhs.gov/epi/Investigation_Guidelines/Rabies_Disease_Investigation_Guideline.pdf).

"Rabies and Your Pet." *American Veterinary Medical Association-AVMA*, 2018, [www.avma.org/public/Health/Pages/rabies.aspx](http://www.avma.org/public/Health/Pages/rabies.aspx).

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