

Risk Considerations for Field Work with Common Vertebrate Species in Virginia

General information on risks associated with work in natural environments in Virginia, with a special focus on disease risks associated with wild vertebrate animals, including a partial catalog of zoonoses.

For distribution to users of the University of Virginia's (UVA) biological field stations: Mountain Lake Biological Station, Blandy Experimental Farm, and the Anheuser Busch Coastal Research Center.

Part I - General Hazards

Some level of risk is associated with any activity. This is especially true for activities in uncontrolled natural conditions in remote locations where immediate medical care may be unavailable, or where participants may be exposed to greater than normal physical stresses or disease-bearing wildlife and their dens. Although primary responsibility for accepting and addressing these risks must be assumed by you, as a participant in activities at field stations, the University of Virginia is providing this information regarding the potential for exposure to hazards associated with working under natural field conditions in Virginia, including exposure to diseases transmitted from wildlife to humans (zoonoses). This document is structured to first provide general information and recommendations regarding "good practices" when working in natural environments near the field stations. The document further provides more specific information on risks related to exposure to wild vertebrate animals. In general, when working with wild vertebrate animals you should wear disposable gloves and wash your hands as soon as you are finished. Before wearing disposable gloves, be cognizant of the material the gloves are made of since some people are allergic to latex; if you have this allergy, use vinyl or nitrile gloves.

While working at a field station, you are exposed to a different set of "risks" than when you are in an indoor working environment. Perhaps most obvious are the risks inherent in being "out-of-doors," and possibly far from professional medical help. Station users should prepare for environmental conditions (weather, drinking water, trip hazards, and difficult terrain to traverse) and situations they might encounter on a camping, backpacking, or boating trip. Depending on the time of year, simple exposure to normal environmental conditions in Virginia can cause heat exhaustion or hypothermia in some individuals. Hypothermia is of greater concern if you are in watercraft from late fall to early spring on Virginia's eastern shore.

Common sense preparation (adequate clothing, water, and other supplies) can save your life when weather conditions change, if you have an accident, or if you become delayed or lost in the field. Similarly, making sure you have an extra supply of any medication you take routinely is advisable. Please consult your physician for advice that you can share with the field station staff if you have a special medical need or condition. This might include diabetes management, allergies to an insect bite or sting, asthma, chemotherapy, or other medical conditions that could put you at increased risk in the field.

Each station has policies and site-specific guidelines for working safely in the field. Become familiar with them. Also, be sure to consult station recommendations with regard to appropriate clothing and outdoor gear. Become familiar with common site-specific hazards such as weather, terrain or aquatic dangers, poison ivy, ticks and mosquitos, etc., when you arrive, or before you arrive by talking to the station staff or via the station-specific information on their websites. Accidents happen, but an educated responsible person can remain healthy and safe working at any of UVA's field facilities through the exercise of foresight and common sense.

Disease

Infectious disease and other hazards are not always obvious and can affect different people in different ways. For example, immunocompromised individuals may be at considerable risk of contracting an infectious disease after exposure to what are ordinarily harmless microorganisms to a person who is not immunocompromised. Many common microorganisms found in nature, or associated with wild animals or their dens and nests, can potentially make a person ill if they are inadvertently exposed to an infectious dose through insect bite, animal bite or scratch, ingestion of contaminated water, or inhalation of dust or aerosol droplets. Below is a partial list of some common conditions caused by microorganisms found in nature in Virginia, which sometimes cause disease in humans. This list is neither all-inclusive nor exclusive, and these microorganisms or conditions have not been definitively identified at any of the University's biological field stations. If you have any questions about your personal risk, please seek the advice of a physician. For additional site-specific information, contact the Director of the UVA Field Station you will be visiting.

Water-borne Pathogens

Drinking water from sources not known to be potable (especially "surface") water sources could expose you to coliform bacterial infections (like *E. coli* and *Salmonella*), leptospirosis, giardiasis, cryptosporidiosis, amoebiasis, and other viral, parasitic, and bacterial diseases. Such water sources may contain contaminants such as feces and urine of wildlife or farm animals as well as dissolved metals, pesticides, insecticides, or herbicides. Bring an adequate supply of drinking water on all outings of any duration, particularly if your trip requires a lot of physical exertion or if the weather is hot. There are excellent commercially available water purification devices for camping that remove infectious microorganisms, but these are not designed to remove chemical contaminants.

Insect- and Tick-borne Pathogens

Insects and other arthropods, particularly those that feed on animal and human blood, can transmit infectious diseases. For example, ticks may transmit Lyme disease and Rocky Mountain spotted fever and mosquitoes may transmit encephalitis viruses and the West Nile Virus. For this reason, protective clothing and insect repellent is strongly recommended, especially during seasons when insects are active. When returning from the field, you should thoroughly check your body to ensure that there are no ticks on you. Additionally, if you develop a skin rash or illness after working in an environment where you are exposed to arthropod pests, you should inform your physician so that they can include that fact in their diagnosis and treatment.

Exposure to Wild Vertebrate Animals

While many known infectious diseases are harbored by wildlife, this document covers more common ones that can be prevented by taking some simple and reasonable precautions. One can never be certain which wildlife species or individual animal may be harboring a potential human disease. The risk of acquiring zoonotic infection (i.e., disease acquired through contact with animals) is low, but it increases when handling animals, or their parts, secretions, or excreta as for scientific study. Sometimes just visiting a species' environment can increase your risk of acquiring certain diseases that the animal harbors (e.g., spelunking in caves where bats may harbor rabies). Some diseases are transmitted to humans by the bite of an infected tick, louse, flea, mite, or mosquito, which can pass an infection to humans from a wild or domestic animal that carries the disease.

You may request equipment and training when handling animals or specimens.

- Disposable gloves are available from the field station and can be worn when working with animals.
- Wear eye protection when dissecting any mammal that may have died under unexplained circumstances.
- If there are questions or concerns regarding an inhalation hazard, contact UVA Environmental Health and Safety (EHS) or an occupational health provider at your home institution for guidance before wearing a respirator. Medical clearance and training are required prior to wearing a respirator.
- When you are done collecting specimens, it is prudent to wash your hands with soap and water at the first opportunity (especially before eating or drinking) to diminish the number of microorganisms that may be on your hands.

Likewise, some insect-borne diseases can be acquired by direct contamination of a wound with infected animal blood or tissues without ever receiving an insect bite. It is worthwhile to clean wounds thoroughly with a disinfectant soap as soon as possible upon returning from field trips. Apply insect repellent to your exposed skin and your clothing if you are hiking where mosquitoes, ticks, and other biting insects are present. Wearing a properly fitted respirator may prevent the aerosol transmission of diseases acquired by inhalation (e.g., hantaviruses and Q-fever contained in dust from dried excreta of wild mice). The UVA EHS, occupational health providers at your home institution, onsite station staff, and your instructors can assist anyone interested in respiratory protection, but again, your physician or occupational health provider must provide medical clearance for you to wear a respirator.

Part II - Diseases Associated with Particular Vertebrate Groups, or Their Use in Teaching and Research

This section provides specific information on disease risks associated with contact with specific vertebrate groups. As noted in Part I, this list is not all-inclusive or exclusive. These microorganisms or conditions have not been verified to be found at any of the University's biological field stations.

Working with Avian Species

West Nile virus (WNV)

This is an endemic disease in Virginia, as well as in much of the United States. Native American birds and even some mammalian species are carriers of this viral disease. The severity of disease seen in individual birds depends on many factors. Younger birds and those dying with neurological or other disease signs should not be touched. Several species of birds can harbor and actively shed the virus without showing any clinical illness (specifically blue jays and crows). Anecdotal evidence suggests that virus transmission to humans can occur by handling dead bird carcasses or excrement; the virus is present in the stool of live birds. Because birds sick or dying from the disease may have very high levels of the virus in their tissues, post-mortem examinations or museum voucher skin preparations are particularly high-risk procedures. Chemically preserving tissues (i.e., 1 volume of tissue: 10 volumes of universal fixative or neutral buffered formalin) overnight will inactivate the virus, allowing safe handling. Of course, walking in the woods where WNV-laden mosquitoes may be present is also a potential risk. There are only a few species of mosquito that will feed on both human and birds; liberal use of insect repellent at dusk and after dark is a prudent safety precaution worth considering.

Newcastle Disease

This is a viral disease with some virulent strains associated with birds. Some Newcastle disease strains do affect people causing flu-like symptoms. Exposure, although unlikely, could occur from handling a wild bird exhibiting general debility, diarrhea, respiratory symptoms, or nervous system derangement.

Avian Influenza

Also known as bird flu or avian flu, this is a disease caused by the influenza A virus. Humans and other mammals can become infected with avian influenza after prolonged close contact with infected birds, though transmission is rare. Influenza A virus is shed in the saliva, mucus, and feces of infected birds. Symptoms of infection vary from mild to severe, including fever, diarrhea, and cough.

Mycobacterium avium

This is a non-tuberculosis mycobacterium that can cause respiratory disease in humans, particularly in those that are immunocompromised or have severe lung disease. It can spread from birds to humans but not between humans. The bacteria can enter the body when people inhale infectious particles or when they swallow contaminated water. Symptoms can vary but may include cough, fever, sweating, shortness of breath, weight loss, fatigue, diarrhea, and abdominal pain.

Yersiniosis

See under mammalian diseases below.

Working with Mammals

Hantavirus Pulmonary Syndrome (HPS)

This is believed to result primarily from transmission of aerosolized excreta or saliva from rodents infected with hantavirus. Transmission via a bite from an infected rodent is also a probable means of transmission. Clinical diagnosis of HPS in Virginia is considered rare; however, given the potentially fatal outcome of HPS (38% mortality), sensible measures for prevention are prudent. The following summary of preventive guidelines have been taken from “Guidelines for protection of mammalogists and wildlife researchers from hantavirus pulmonary syndrome (HPS)” *Am. Soc. of Mammologists J Mammalogy*, 91(6):1524–1527, 2010:

1. Field workers should not use a cabin or field bunkhouse that shows evidence of current or prior occupation by rodents until the structure is thoroughly cleaned. Because feces and other signs of rodents known to transmit hantaviruses can be difficult to distinguish from those of nonhantavirus-transmitting species, workers should be conservative and assume that small feces and other rodent signs pertain to hantavirus-transmitting species. Because hantavirus infection is thought to be acquired primarily by inhalation, efforts should be made to minimize aerosolization of dust inside the dwelling; we suggest that workers spray surfaces with disinfectant, use a mop rather than a broom, and use N95 respirators during initial cleaning if cabin dust is likely to be aerosolized. Once the dwelling is clean, workers should maintain a program of removal of small mammals from the structure by live or kill trapping, following the recommendations below. Hantaviruses are readily killed by contact with common disinfectants (e.g., 10% bleach, 3% Lysol), >30 min exposure to direct sunlight, and heat >60°C.
2. All handling of rodents known to transmit viruses that cause HPS should be done in the open air with the rodent (or trap containing the rodent) held away from the face and positioned such that direct wind (and wind vortices) do not blow aerosolized particles from the rodent toward the investigator.
3. Live traps containing rodents known to transmit viruses that cause HPS should not be transported within a vehicle unless they are securely isolated in sealed plastic bags (e.g., tied large garden bags) or otherwise placed in an area in which air circulation is separate from that of the driver and any passengers (e.g., the back of a truck).
4. Mammalogists should avoid direct contact of skin with urine, feces, saliva, blood, and internal organs of rodent species associated with HPS. Eye protection, respiratory protection, and rubber, latex, vinyl, or nitrile gloves are recommended when handling or doing invasive procedures with rodents that potentially transmit hantavirus.
5. Appropriate training in handling of small mammals must prioritize safe and secure methods to avoid being bitten or scratched. Rodents can be anesthetized or euthanized by placing the trap containing the rodent inside a disposable plastic bag containing the gaseous anesthetic agent. For mark-and-release studies, smaller rodents (<100 g) can be removed from traps using disposable plastic or washable cloth bags and handled safely and securely by grasping them firmly at the nape of the neck.
6. In the unlikely event that a field researcher is bitten, scratched, or comes into direct contact with the fluids of rodents that potentially transmit hantavirus, the affected area should be washed thoroughly with soap and water, then disinfected with an alcohol-based hand sanitizer or similar disinfectant, such as Lysol or Clorox hand wipes.

7. All mammalogists should be fully aware of the symptoms of HPS, which include severe muscle aches, fever, headaches, and cough. If these flu-like symptoms appear within 6 weeks after fieldwork, the person should seek advice from their physician and report potential exposure to hantavirus.
8. All field mammalogists should visit the CDC website regularly to get [updates on hantaviruses](#), HPS, and other [rodent-borne diseases](#), and [vector-borne diseases](#).

Rabies

This is endemic in wild unvaccinated carnivores and the incidence in the raccoon population of Virginia and Maryland is one of the highest in the country. Feral or potentially unvaccinated cats, dogs, foxes, coyotes, skunks, and bats are also carriers in Virginia. Wild rodents, opossums, and rabbits can also, less commonly, contract rabies; however, the raccoon is the wild animal that poses the greatest risk in Virginia. If you plan to work with high-risk species (e.g., raccoons, foxes, skunks, or bats), then you should be vaccinated beforehand against this disease. A safe vaccine is available, and your physician can determine if you have a protective antibody titer after vaccination. If you do not plan to work with these species, and will not handle them at all, then vaccination may not be needed; consult with your personal physician. When handling low risk species (such as rodents), vaccination is not warranted. In any case, wear suitable clothing to protect against injuries, including bites from small mammalian species. If you are bitten and it breaks the skin clean, scrub the wounded area as soon as possible with disinfectant soap, and soak the wounded area for 30 minutes in a disinfectant solution afterwards (a 5% dilution of household bleach in tap water is excellent for this purpose). Prompt and judicious wound care is the single most important thing you can do to prevent contracting a disease from an animal bite. Report the bite to the field station staff and inform them of any bizarre animal behavior or animal encounter you have if you suspect you've had a potential rabies exposure. The station staff may notify the local health department. In the case of a "true rabies exposure" where a bite wound was inflicted by an abnormally behaving mammal, the field station personnel may contact the local health department for advice. If the animal that bit you is available, either alive or dead, it is a valuable source for the health department to check to see if it was infected with rabies virus.

Rocky Mountain spotted fever (Rickettsia rickettsii)

This is a disease transmitted by a tick bite to people that become infected. Human symptoms generally occur 5-10 days after a tick bite and include: fever, headache, vomiting, muscle pain, severe headache followed several days later by abdominal pain, diarrhea, and a skin rash. The American dog tick (*Dermacentor variabilis*) and Rocky Mountain wood tick (*Dermacentor andersoni*) are the primary ticks (arthropod vectors) which transmit Rocky Mountain spotted fever in the United States.

Lyme disease (Borrelia burghdorferi)

This is a bacterium that commonly infects deer, white footed mice, and possibly other mammalian species that is transmitted to humans by seed ticks of the deer tick *I. scapularis*. Adult ticks and seed ticks (immature ticks the size of the head of a pin) are capable of transmitting this disease with their bite. A tick must drink your blood for at least 16 consecutive hours for you to contract this disease. Removal of a tick before that length of time prevents transmission of this bacterium. A reddish halo (bullseye ring around the bite) sometimes forms

approximately 2-12 weeks later at the site of the tick bite and is the earliest sign of Lyme disease. Lyme disease is a severe illness and symptoms may include: heart inflammation with arrhythmia, arthritis, and central nervous system disorders including peripheral nerve dysfunction.

Sarcoptic mange (*Sarcoptes scabiei*)

These mites are directly transferred by contact with an infested mammal, and infestation results in a spreading scabby, exuding, and intensely itchy skin lesion. The mites are microscopic so cannot be seen with the unaided eye. The mites cause an intensely itchy rash on the chest, legs, and arms.

Roundworms (*Baylisascaris procyonis* & *B. columnaris*)

These are parasitic nematode roundworms carried by skunks and raccoons. Contact with contaminated water, plants, or feces can pass the sticky and environmentally durable eggs to humans. Contracting this disease occurs by accidental ingestion of the eggs. Infection of humans can lead to larval parasite migration to the brain with the development of highly variable neurological symptoms. The disease can be prevented by hand washing before eating or drinking, and the use of disposable gloves.

Babesiosis (*Babesia microti*)

This is a protozoan blood parasite commonly infecting many species of rodents including wild mice, rats, and voles. The infection in humans causes flu-like illness that usually lasts for 1 or 2 weeks and is manifested as a self-limiting hemolytic anemia. Babesiosis is transmitted by tick bite (the deer tick commonly). In its mildest form it causes fever and enlargement of the spleen. Individuals infected with *Babesia* who previously had their spleen removed develop a more serious anemia.

Tularemia (*Francisella tularensis*)

Also called rabbit fever, this is a bacterial disease carried by rabbits, and less commonly rodents, which is readily transmissible to humans by inhalation of infectious aerosol, ingestion, and exposure of the eyes or skin. Tularemia is unusual in that it can penetrate intact undamaged skin. The disease is associated with stagnant water sources and it can be transmitted by mosquitoes and other biting arthropods. Field dissection of infected animals is a common cause of exposure, as is contact with contaminated food, water, or touching the eyes. In humans and other species, symptoms reflect the route of exposure such as necrosis of infected skin, pneumonia, or diarrhea; eventually the bacteria grows rapidly in the blood. High fever and death ensue if the infection goes untreated.

West Nile Virus

WNV has been associated with die-offs in squirrels in several parts of the U.S. It is assumed to affect other mammals as well, particularly other sciurid rodents. (See the disease risk and other information under “Working with Avian Species” above).

Yersiniosis (*Y. enterocolitica*)

This bacterium is carried by wild birds and mammals and concentrates in slow-moving water bodies under conditions of cold, wet weather. Individuals drinking from that water source can be

exposed to very high doses. Symptoms of yersiniosis are diarrhea and enlarged lymph nodes in the gastrointestinal tract. Yersiniosis is a cause of appendicitis.

Working with Reptiles and Chelonians

All reptiles (herbivore, omnivore, or carnivore) can carry the *Salmonella* and/or *Arizona* species of bacteria. Skin contact with reptiles has been directly implicated in many outbreaks of salmonellosis in people. Reptiles carrying these pathogenic bacteria typically exhibit no signs of illness themselves. Washing hands after handling reptiles and chelonians, or avoiding contact with reptiles if you have children under 5 years of age, are pregnant, or if you are immunocompromised, are CDC recommendations. Cleaning potentially soiled reptile utensils, capture tools, or housing should never be done in human food preparation areas. Symptoms of salmonellosis vary from a mild diarrhea to a severe and sudden onset dysentery with fever, muscle soreness, and hepatitis.

Working with Fish and Aquatic Amphibians

Aquatic species can carry pathogenic bacteria such as *Klebsiella* and other Gram-negative and Gram-positive bacteria, although these rarely lead to human infections under normal conditions. *Edwardsiella tarda* and some atypical *Mycobacteria* species carried by aquatic species can cause disease in humans.

APPENDIX

Disease agents known to be harbored by vertebrate host species in the state of Virginia (not all vertebrate hosts are found at all field stations).

This list was created to aid researchers, teachers, and students in assessing their own risk of disease exposure associated with handling a specific vertebrate species. It does not represent all animal species that might be contacted in a field situation or every conceivable disease that wildlife at the field stations might carry.

Rice Rats (*Oryzomys palustris*)

1. Hantavirus (Bayou virus) transmitted through inhalation of aerosolized feces or urine, resistant to drying.
2. Hantavirus Pulmonary Syndrome – flu-like symptoms, nausea, vomiting, and gastrointestinal pain followed by acute respiratory distress.
3. *Ornithonyssus bacoti* – large mite, Rocky Mountain spotted fever
4. *Ixodes scapularis* – Lyme disease tick

White Footed Mice (*Peromyscus sp.*)

1. Sin Nombre virus – fever, headache, cough, vomiting, muscle soreness.
2. Hantavirus Pulmonary Syndrome also called Four Corners Disease, flu-like symptoms, nausea, vomiting, and gastrointestinal pain followed by acute respiratory distress.
3. *Ornithonyssus bacoti* – large mite, Rocky Mountain spotted fever
4. *Ixodes scapularis* – Lyme disease tick
5. Lyme disease (*Borrelia burgdorferi*) – transmitted by tick bite (*Ixodes scapularis*, deer tick commonly) or direct exposure.
6. *Sarcoptes scabiei* – mite mites directly transferred by contact, intensely itchy skin lesion infested with microscopic mites.
7. *Babesia microti* – a flu-like illness that usually lasts for 1 or 2 weeks, self-limiting hemolytic disease transmitted by tick bite, commonly the deer tick.
8. *Rickettsia rickettsii* – Rocky Mountain spotted fever, transmitted by tick bite; symptoms are fever, headache and rash.

Spiny Mice (*Acomys cahirinus*)

1. *Streptobacillus moniliformis* – rat bite fever or Haverhill Fever, transmitted by bite wound, normal inhabitant of *Acomys* oral cavity. Symptoms most commonly associated with this disease are joint infection and pain near the site of the bite wound.
2. *Bartonella elizabethae* and *Bartonella birtlesii* – arthropod transmitted, but the vectors for these have not been identified. Symptoms are locally enlarged lymph nodes that abscess.
3. *Cryptosporidium parvum* – protozoal organism causing a self-limiting diarrhea.
4. West Nile Virus – mosquito transmitted flu-like symptoms in most people, potential encephalitis in elderly and immune-deficient people.

Wood mouse (*Apodemus sylvaticus*)

1. Tularemia – Rabbit fever, caused by the bacteria *Francisella tularensis*, pneumonia or localized lymph nodes abscess.
2. Lyme disease
3. Cryptosporidiosis
4. *Coxiella burnetii* – Q fever, highly infectious organism causes pneumonia.
5. *Rickettsia typhi* and *Rickettsia prowazekii* – murine typhus and scrub typhus caused by contacting the organism in the infected feces of mouse fleas or lice, respectively.
6. *Yersinia pseudotuberculosis* – bacterium causing intestinal infection; causes appendicitis.
7. *Trichophyton mentagrophytes* – ringworm; fungal infection of skin and hair.
8. *Emmonsia* – fungus, the causative agent of Adiasporosis, a cyst-like infection of bone.
9. *Bartonella birtlesii* – anemia and enlarged spleen

Voles (*Microtus sp.*)

1. *Babesia microti*
2. Lyme disease
3. Hantaviruses – Puumala
4. Leptospirosis – bacterial infection of liver and kidney caused by contacting contaminated urine or drinking water.
5. Tularemia
6. Emmonsia

Vole (*Clethrionomys sp.*)

1. Hantavirus – Puumala and hemorrhagic fever with renal syndrome
2. *Trichophyton mentagrophytes* – ringworm skin rash
3. Tularemia
4. Cryptosporidiosis
5. Emmonsia
6. Lyme disease
7. *Brucella abortus* – Maltese fever, a bacterium causing relapsing fever with dementia
8. *Campylobacter sp.* – Gram-negative bacteria causing self-limiting diarrhea

Raccoon (*Procyon lotor*)

1. Rabies – Flavivirus causing hydrophobia, very common in Virginia raccoon population, transmitted by bite or raccoon saliva, contamination of an open wound; vaccine for humans is available.
2. *Baylisascaris procyonis* – nematode parasite very common in raccoons; transmitted by ingesting food contaminated with raccoon excrement.
3. Leptospirosis
4. *Giardia lamblia* – protozoan causing diarrhea associated with ingesting food or water contaminated by excrement.
5. *Rickettsia rickettsii*
6. Salmonella
7. Lyme disease

Turtles, lizards, snakes

1. Salmonella

Amphibians

1. *Mycobacterium sp.* – localized proliferative skin nodules
2. Salmonella

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