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 potential human pathogens.

Prepared 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 under 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 at 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 gloves and wash your hands as soon as you are finished. When wearing gloves, be cognizant that 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 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 and situations they might encounter on a camping, backpacking, or boating trip. Simple exposure to normal environmental conditions in Virginia may cause heat exhaustion or hypothermia in some individuals. Hypothermia is of greater concern if you are in watercraft on Virginia’s eastern shore.

Common sense preparation (adequate clothing, water, and other supplies) can save your life when weather conditions change, you have an accident, or you become delayed or lost in the field. Similarly, making sure you have an extra supply of any medication you take routinely is advisable (consult your physician as appropriate). Please consult your physician and inform the 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 special risk in the field. Each station has policies and site-specific guidelines for staying safe 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 weather, geographic or aquatic dangers, poison ivy, poisonous snakes, etc. when you arrive, or before you arrive by talking to the station staff or via the station-specific information on their web sites. Accidents happen, but an educated responsible person can remain happy and safe working at any of UVa’s field facilities through the exercise of foresight and common sense.

Disease

Disease and other hazards are not always obvious, and can impact different people in different ways. For example, immune compromised individuals may be at considerable risk of contracting a disease after exposure to what are ordinarily harmless organisms to a person of normal immune status. Many normal and common microorganisms found in nature, or associated with wild animals or their dens and nests, can be potentially pathogenic for humans. Below is a catalog of the more common conditions or organisms found in Virginia that have the potential to cause disease in humans. This list is not meant to be either all-inclusive or exclusive, and these microorganisms or conditions may or may not be found 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, you can contact the Director of the UVa Field Station you will be visiting.

Water-borne Pathogens

Drinking from non-approved (especially ‘surface’) water sources may expose you to coliform bacterial infections (like Salmonella), leptospirosis, giardiasis, amoebiasis, and other viral, parasitic, and bacterial diseases. Such water sources may contain environmental contaminants such as feces and urine of wildlife, heavy metals, pesticide or insecticide or herbicide compounds. Drinking seawater will dehydrate you sooner than not drinking at all. 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.

Insect and Tick-borne Pathogens

Insects and other arthropods, particularly those that feed on animal and human blood, can act as vectors for the transmission of diseases. For example, ticks may transmit Lyme disease and Rocky Mountain spotted fever and mosquitoes may transmit the West Nile Virus. For this reason, protective clothing and insect repellent is 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 illness after working in an environment where you are exposed to arthropod pests, you should inform your physician so that she or he 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 only the most common ones and some simple and reasonable precautions that can be taken. In general, 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) increases when handling animals, or their parts, secretions, or excreta. Sometimes just visiting a species’ environment can increase the risk for acquiring certain diseases that the animal harbors. For example, some diseases are transmitted to humans by the bite of an infected tick, louse, flea, or mosquito, which can pass an infection to humans from a wild or domestic animal that carries the disease. Therefore, it is prudent to take some reasonable precautions. Disposable gloves and respirators will be available from the station when working with species where special protections are warranted. Before using a respirator, a pulmonary function test is required that would have to be done by your physician or an occupational health provider. In addition, proper fit testing of your selected respirator style is required. The respirators, respirator fit testing, instructions for respirator use, and other safety procedures can be provided as needed by project leaders or instructors. You may request equipment and training when handling animals or specimens. 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 have contaminated 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 where mosquitoes and other biting insects are present, both to your exposed skin and your clothing. Wearing properly fitted HEPA cartridge full-face respirators prevents the aerosol spread of diseases acquired by breathing (usually dust that contains dried excreta of wild mice such as Hantaviruses and Q-fever). The Office of Environmental Health and Safety at the University of Virginia or onsite station staff or course instructors can assist anyone interested in fit testing for full-face respirators, but again you must first pass a pulmonary function test administered by your physician or by an occupational health provider.

**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 meant to be all-inclusive or exclusive. These microorganisms or conditions may or may not be found at any of the University’s biological field stations.

**Working with Avian Species:**

West Nile virus (WNV) is an endemic disease in Virginia, as well as in much of the United States. Native American birds and even some mammalian species are assumed to be highly susceptible to this 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 actively harbor and shed the disease 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 wastes; the virus can also be 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 skin preparations are particularly high-risk procedures. Preserving tissues (i.e., 1 part tissue: 10 parts universal fixative [Haemo D, Fisher Scientific] by volume) overnight will inactivate the virus, allowing safe handling. Of course, walking in the woods with WNV-laden mosquitoes is also a potential risk. Liberal use of insect repellent after dark is a prudent safety precaution worth considering.

Newcastle Disease 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 a wild bird exhibiting general debility, diarrhea, respiratory, or nervous system signs.

Yersiniosis - See under mammalian diseases below.

Working with Mammals:

Rabies is endemic in wild unvaccinated carnivores and the incidence in the raccoon population of Virginia and Maryland is the highest in the country. Feral or potentially unvaccinated cats, dogs, and bats are also carriers in Virginia. Wild rodents, metatherians (opposums), foxes, skunks and lagomorphs (rabbits) can also contract rabies. However, the raccoon is the wild animal that poses the greatest risk in Virginia. All other mammals are assumed to be susceptible, including humans. If you plan to work with high-risk species (e.g., raccoons, foxes, skunks, or bats), then you must receive vaccination against this disease. A safe vaccine is available, but you should have an antibody titer determined after vaccination to be assured that you are protected. 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 lower risk species (such as rodents), vaccination may or may not be warranted depending on the level of risk you consider acceptable. In any case, wear suitable clothing to protect against injuries, particularly mammalian animal bites. As soon as possible after receiving a bite from a mammal that breaks the skin clean, scrub the wounded area with disinfectant soap, and soak 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 prevention of contracting any disease from an animal bite. Report to station staff any bizarre mammalian animal behaviors or any encounter you have where you suspect that you’ve had a potential rabies exposure. The station staff will
notify the local health department. In “true rabies exposures,” where bite wounds are incurred by any abnormally behaving mammal, contact the local health department for immediate prophylactic vaccination. 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 truly harbored rabies. Eye protection should be worn when dissecting any mammal that may have died under unexplained circumstances.

Rocky Mountain Spotted Fever (Rickettsia rickettsii) is a disease requiring a tick vector for people to 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 organism that causes Rocky Mountain spotted fever is transmitted by the bite of an infected tick. The American dog tick (Dermacentor variabilis) and Rocky Mountain wood tick (Dermacentor andersoni) are the primary arthropods (vectors) which transmit Rocky Mountain spotted fever bacteria in the United States.

Lyme disease (Borrelia burgdorferi) is a bacterium commonly infecting deer, white footed mice, and possibly other species that is transmitted to humans by pin head-sized (or smaller) ticks of the genus Ixodes, most commonly the deer tick I. scapularis, or occasionally by direct contact with the infected vertebrate. You must have a tick drinking your blood for at least 16 hours to contract this disease. Removal of a tick before that length of time is preventative. A reddish halo (bull’s eye ring around the bite) sometimes forms approximately 2-12 weeks following a tick bite, and is the earliest sign of Lyme disease. After this, severe illness may develop including: heart inflammation with arrhythmia, arthritis, and nervous system disorders including peripheral nerve dysfunction.

Sarcoptic mange (Sarcoptes scabei) mites are directly transferred by contact, and result in a spreading scabby, exuding, and intensely itchy skin lesion. The mites are microscopic so cannot be seen with the unaided eye.

Roundworms (Baylisascaris procyonis & B. columnaris) are parasitic nematode roundworm parasites carried by skunks and raccoons. Contact with feces contaminated water or plants can pass the sticky and environmentally durable eggs to humans. Contracting this disease occurs by accidental ingestion of the eggs (i.e., in the absence of hand washing or gloves). Infection of humans can lead to larval parasite migration to the brain with the development of highly variable neurological symptoms.

Babesia (caused by the intracellular parasite Babesia microti) is a protozoan parasite commonly infecting many species of rodents including mice, rats, and voles. The infection in humans causes flu-like illness that usually lasts for 1 or 2 weeks, that is commonly a self-limiting hemolytic disease transmitted by tick bite, (the deer tick commonly). In its mildest form it causes fever, spleen enlargement and a mild fever. Individuals who have had to have their spleen removed for any reason develop a very serious anemia disease compared to other people.
Tularemia (caused by \textit{Franciella tularensis}) is a severe bacterial disease carried by rodents and lagomorphs (rabbits) that is readily transmissible to humans by inhalation of infected aerosol, exposure of mucous membranes (the eyes), ingestion, and inoculation into skin wounds. The disease is most commonly associated with water sources. There is also some suggestion that 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 hands in the eyes. Also, the bacterium is unusual in that it can penetrate intact undamaged skin. In humans and other species, the agent rapidly grows in the blood, produces high fever, and can lead to death if it goes untreated.

West Nile Virus 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 \textbf{Avians} above).

Yersiniosis (caused mainly by \textit{Y. enterocolitica} in people) is an organism carried by wild birds and mammals that concentrates in water bodies under conditions of cold wet weather. Individuals drinking from that water source can be exposed to very high doses. The agent causes diarrhea, enlarged lymph nodes in the gastrointestinal tract and is a cause of appendicitis.

\textbf{Working with Reptiles and Chelonians:}

All reptiles (herbivore, omnivore, or carnivore) can carry the \textit{Salmonella} species of bacteria. Contact with reptiles has been directly implicated in human Salmonellosis outbreaks. Reptiles carrying the pathogenic agent 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 typical CDC recommendations. Hand-washing after handling is prudent. Cleaning potentially soiled reptile utensils, capture tools or housing accoutrements in human food preparation areas is to be avoided. Symptoms of Salmonellosis can be variable from a mild diarrhea to a fulminent dysentery with fever, muscle soreness, and hepatitis.

\textbf{Working with Fish and Aquatic Amphibians:}

Aquatic species can carry pathogenic bacteria such as \textit{Klebsiella} and other gram negative and gram positive bacteria, although these rarely lead to human infections under normal conditions. In addition, \textit{Edwardsiella tarda} and atypical \textit{Mycobacteria} species, carried by aquatic species are known human pathogens.

\textbf{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 be used 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 could be carried.

**Rice Rats** (Oryzomus palustrus)
1. Hantavirus (Bayou virus) transmitted through inhalation or aerosolized feces or urine, resistant to drying.
2. Hantavirus Pulmonary Syndrome - flulike symptoms, nausea, vomiting, and gastrointestinal pain followed by acute respiratory distress.

**White Footed Mice** *(Peromyscus sp.)*
1. Hantaviruses – transmitted through inhalation or aerosolized feces or urine, resistant to drying.
2. Sin Nombre virus – fever, headache, cough, vomiting, muscle soreness.
   Hantavirus Pulmonary Syndrome also called Four Corners Disease, flulike symptoms, nausea, vomiting, and gastrointestinal pain followed by acute respiratory distress
3. Seoul virus – hemorrhagic renal syndrome, milder degree of bleeding and liver dysfunction. Five phases: (1) febrile phase, (2) hypotensive phase, (3) oliguric phase, (4) diuretic phase and (5) convalescent phase
4. Lyme disease *(Borrelia burgdorferi)* – transmitted by tick bite *(Ixodes dammini)* deer tick commonly) or direct exposure. Three forms of the disease in humans are described: 1. mild heart inflammation with electrical conduction abnormalities, 2. neurologic disease, peripheral nerve dysfunction, and 3. Classic form--the target lesion or bull’s eye appearance of redness of the skin at the bite wound.
5. *Sarcoptic scabei* – mange mites directly transferred by contact, intensely itchy skin lesion infested with microscopic mites.
6. *Babesia microti* – a flu-like illness that usually lasts for 1 or 2 weeks, self-limiting hemolytic disease transmitted by tick bite, deer tick commonly.
7. *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 lymphnodes that abscess most commonly.

**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
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, infection generally of bone.
9. *Bartonella birtlesii*

**Voles (Microtis 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
7. Hantavirus Pulmonary Syndrome

**Vole (Clethrionomys sp.)**
1. Hantavirus – Puumala and hemorrhagic fever with renal syndrome
2. *Trichophyton mentagrophytes*
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. *Trypanosoma cruzi* – American trypanosomiasis, seen in the southwest US;

associated with ingesting food contaminated with excrement from the “kissing” bug (Reduvidae beetles) that have acquired the infection from a mammalian source.

6. *Rickettsia rickettsii*
7. Salmonella sp – bacteria causing severe diarrhea and abdominal cramping.
8. Lyme disease

**Turtles, lizards, snakes**
1. Salmonella species

**Amphibians**
1. Mycobacterium sp. – localized proliferative skin lesion or nodules in the internal organs (nonspecific)
2. Salmonella species