MICROSCOPIC Monsters

Just another part of the job

By Kevin L. Clayton, Massachusetts Environmental Police and Catherine Brown, DVM, MSc, MPH

Leptospirosis was postulated as the cause of an epidemic among Native Americans along the coast of present-day Massachusetts that occurred immediately before the arrival of the Pilgrims in 1620 and wiped out most of the native population.

Conservation Officers never know when parasites will show them "1000 Ways to Die".

When I'm relaxing after a long day, I take in a few guilty pleasures on cable television. One of my favorites is "1000 Ways to Die" on SPIKE[1] which depicts methods of death, often unintentionally self-inflicted. The second program, "Monsters Inside of Me" on Animal Planet[2], follows the ordeals of citizens who have been infested or infected by various critters and bugs. Internal and external parasites, bacteria and viruses all seem to be members of "P.I.T.H."... the critter group called, Parasites Ingesting Tasty Humans. As I watch the program, each episode more disturbing than the last, I realize that we, in conservation law, enforcement are often exposed to death or monsters such as those depicted in these programs.

This brings us to the following important questions: which diseases carried by animals can also infect people (such diseases are called zoonoses) and pose the greatest risk to conservation law enforcement officers and which methods are most effective at reducing our chances of finding one of 1000 ways to die from a zoonotic disease or parasite? Let's look at a few scenarios through which we may find ourselves exposed and what we can do to reduce the chances that PITH members will have their way with us and our insides.

Scenario #1:

Officer H receives a call for service to assist a citizen with a raccoon trapped in a basement. The furry beast "somehow" accessed the basement through an unblocked chimney flue. The citizen was opening the house after being away for some time when he discovered the B & E specialist.

Officer H dons gloves before using a "rabies pole" (metallic pole with a noose-like strap or cable, often used to restrain dif-

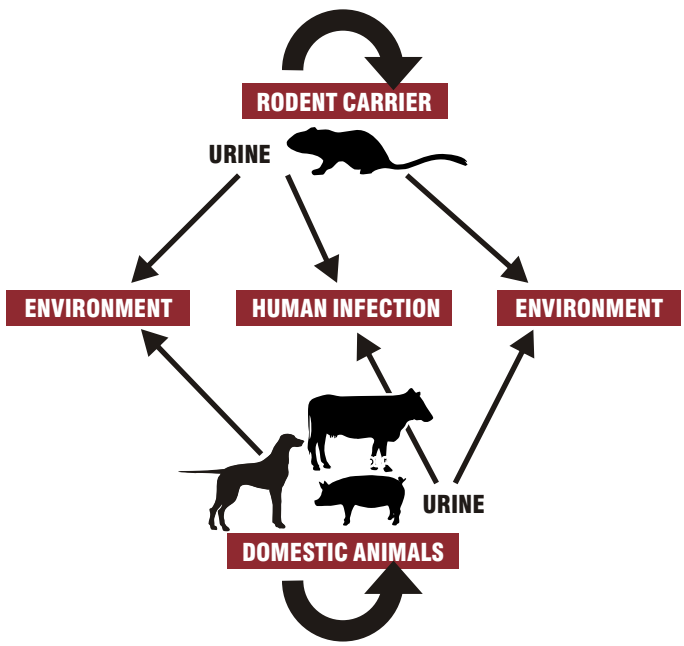
Leptospirosis

Leptospirosis was postulated as the cause of an epidemic among Native Americans along the coast of present-day Massachusetts that occurred immediately before the arrival of the Pilgrims in 1620 and wiped out most of the native population.

While the disease may have been brought to the New World by Europeans, its spread was also influenced by the high-risk quotidian activities of the Native Americans. The leptospirosis hypothesis is supported by the occurrence of modern outbreaks identified as severe leptospirosis, some accompanied by high mortality rates.

The cause of this epidemic has been a mystery, while other outbreaks in the same time frame are fairly well established. The epidemic is considered a pivotal event in American history since the failure of the Plymouth Bay colony might have meant the failure of British colonization in North America. A noted historian has said that the epidemic was the most important event in American history between the discovery of America by Columbus and the signing of the Declaration of Independence.

Before Weil's characterization in 1886, the disease known as infectious jaundice was very likely the same as Weil's disease, or severe icteric leptospirosis. During the Egyptian campaign, Napolean's army suffered from what was probably infectious jaundice. Infectious jaundice occurred among troops during the Civil War. It was also reported among troops at Gallipoli and other battles of World War I, where the sodden conditions of trench warfare favored infection.



ficult animals). The raccoon urinates everywhere but Officer H successfully wrangles the animal into a cage she brought along for that purpose. The officer and homeowner afterward observe that the raccoon defecated throughout the basement area. It is evident that the raccoon has been in this space for some time.

In her haste to leave, Officer H strips off her heavy gloves and accidentally drops the pole. Picking it up with an ungloved hand, she shoves it in behind the back seat of her patrol vehicle. While picking up the caged raccoon, she catches an ungloved finger on a protruding bit of metal. Surprised, she instinctively puts the finger in her mouth, sucking off the blood. She says goodbye to the citizen. Still nursing the throbbing finger in her mouth, she rushes off to meet some coworkers for pizza and chicken wings.

Two weeks later Officer H complains of muscle aches, diarrhea and headaches. After many complicated and undignified tests, the diagnosis is made, leptospirosis. A bacterial infection, leptospirosis is caused by contact with the urine of infected animals. Multiple animal species can be infected with *Leptospira spp*. without appearing ill.

Apparently, the only handwashing that was done the day Officer H captured the raccoon, occurred when she put an unwashed and bleeding finger into her mouth. Failing to clean the raccoon immobilization equipment and not washing her hands before a finger-food lunch likely contributed to her illness. She was lucky though; leptospirosis is usually treatable and she will make a full recovery. She could have become infected with *Baylisascaris procyonis*, the raccoon roundworm, an intestinal parasite spread through the animal's feces. Human infection with this P.I.T.H. member, while rare, is usually fatal.

Finally, Officer H never informed the homeowner about his risks for exposure to disease when cleaning up after the raccoon.

Scenario #2:

In 2007, National Park Service employee Eric York, formerly of Massachusetts, succumbed from a disease many people believe died out in the Middle Ages...the plague.

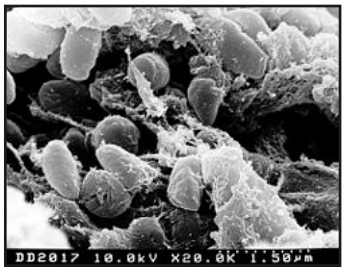
According to reporter Astrid Galvan of The Arizona Republic, as posted in USA TODAY[3] in November of 2007, York was employed as a wildlife biologist at the Grand Canyon National Park when he performed a necropsy on a mountain lion. Three days later, York died of plague. York is believed to have inhaled the bacterium *Yersinia pestis* which led to pneumonic plague, a serious form of the disease. Symptoms of this form of plague present themselves as flu-like…featuring fever, chills, coughing and difficulty breathing.

According to the Centers for Disease Control and Prevention the disease progresses quickly. Shock is rapid and death results if treatment is delayed.[4] Was it possible for York to have protected himself from this disease? What may we learn from his misfortune?

Yersinia pestis

Y. pestis was discovered in 1894 by Alexandre Yersin, a Swiss/French physician and bacteriologist from the Pasteur Institute, during an epidemic of plague in Hong Kong. Yersin was a member of the Pasteur school of thought. Shibasaburo Kitasato, a German-trained Japanese bacteriologist who practiced Koch's methodology was also engaged at the time in finding the causative agent of plague. However, it was Yersin who actually linked plague with *Yersinia pestis*. Originally named *Pasteurella pestis*, the organism was renamed in 1967.

Originally three biovars of *Y. pestis* were thought to correspond to one of the historical pandemics of bubonic plague. Biovar Antiqua is thought to correspond to the Plague of Justinian; it is not known whether this biovar also corresponds to earlier, smaller epidemics of bubonic plague, or whether these were even truly bubonic plague. Biovar Mediaevalis is thought to correspond to the Black Death. Biovar Orientalis is thought to correspond to the Third Pandemic and the majority of modern outbreaks of plague. However, calculations of *Y pestis's* evolutionary age, found using number of synonymous single nucleotide polymorphisms (sSNPs) in conjunction with molecular clock rates, date the emergence of the biovars prior to any of the historical epidemics due to the length of time needed to accumulate such mutations . Additional evidence against this hypothesis includes the fact that Medievalis is likely too young to have produced the Black Death due to its recent divergence from Orientalis.



A scanning electron micrograph depia mass of Yersinia pestis bacteria

Every year thousands of cases of plague are still reported to the World Health Organization, although with proper treatment the prognosis for victims is now much better. A five to sixfold increase in cases occurred in Asia during the time of the Vietnam war, possibly due to the disruption of ecosystems and closer proximity between people and animals. Plague also has a detrimental effect on mammals other than humans. In the United States of America, endangered animals such as the black-tailed prairie dog and the black-footed ferret are both under threat from the disease.

Anaplasmosis

Anaplasmosis is a disease caused by a rickettsial parasite of ruminants, *Anaplasma spp*. The organism occurs in the white blood cells and is transmitted by natural means through by a number of haematophagous species of ticks. It can also be transmitted iatrogenically by the use of surgical, dehorning, castration, and tattoo instruments and hypodermic needles that are not disinfected between uses.

In the United States, anaplasmosis is notably present in the south and west where the tick hosts *Dermacentor* spp. are found. Although vaccines have been developed, none is currently available in the United States. Early in the 20th century, this disease was considered one of major economic consequence in the western United States. In the 1980s and 1990s, control of ticks through new acaricides and practical treatment with prolonged-action antibiotics, notably tetracycline, has led to the point where the disease is no longer considered a major problem.

In 2005, *Anaplasma ovis* was found in reindeer populations in Mongolia. This pathogen and its associated syndrome (characterized by lethargy, fever and pale mucous membranes) was previously only observed in wild sheep and goats in the region, and is the first observed event of *A. ovis* in reindeer.

On July 30, 2009, David Letterman announced that he had been infected with anaplasmosis. He believes he was most likely bitten by an infected tick while camping with his 5-year-old son in their tree house.

Giardia cell

Giardiasis

Giardiasis in humans is caused by the infection of the small intestine by a single-celled organism called *Giardia lamblia*. Giardiasis occurs worldwide with a prevalence of 20–30% in developing countries. Additionally, Giardia has a wide range of human and other mammalian hosts, thus making it very difficult to eliminate. Giardia infects over 2.5 million people annually.

It is likely that plague bacteria became airborne when York cut open the chest cavity of the infected mountain lion. According to Arizona Daily Sun[5,6] reporter, Cyndy Cole, the National Park Service report stated, "York wasn't wearing gloves when he handled a mountain lion four days before becoming ill, according to photographs he had taken, and was not likely wearing a mask."

We may be assured that the National Park Service report contains recommendations for risk management, standardization of animal handling protocols and enhanced protections of park staff and visitors to the Grand Canyon against plague and other issues.

Plague exists in the southwestern states. Five to fifteen people develop this disease annually. This may demonstrate that this disease is not a common threat to the general population but certain professions, like wildlife biologists and veterinarians, may be at higher risk, especially in specific geographic locations. Think about it! Before the biologists and the vets show up, who gets called out to deal with the problem animals? As wildlife enforcement professionals, we get those calls first.

Scenario #3:

Officer C is ordered to perform daily fish house dealer inspections under a Joint Enforcement Agreement (JEA) with the National Oceanic and Atmospheric Administration. (JEA work is an article for another day.) In the course of wandering around the numerous fish boxes the officer handles hundreds of fish. While measuring a redfish, a spine pierces his glove. Instinctively and frantically tearing off

It's not too much time to save your life!

the punctured glove, the officer sees the end of a broken spine protruding from the flesh between the thumb and forefinger of his right hand. He sucks and bites the spine out of his hand. Not seeing any blood and not feeling any pain, he resumes his fish size monitoring duties.

The next morning, his left hand has swollen to a disturbing size. The officer is scared and heads off to the local hospital. He did not report the injury to a supervisor at the time nor did he make an appropriate note of this injury in his daily reports or paperwork. As we know, for legal purposes of proper injury documentation, if it isn't written down somewhere, it didn't happen. RIGHT?

At the hospital, it takes awhile, but the officer is eventually diagnosed with either an infection with *Vibrio vulnificus*, (a bacterium that normally inhabits warmer waters but has been found off the coast of New England), or *Erysipelothrix rhusiopathiae*. Luckily, both are treatable, although a *Vibrio* infection can turn fatal if not identified and treated early.

Our conservation law enforcement profession is demanding on many levels. We handle the physical demands: making arrests, hiking in remote areas, searching and working long hours. There are psychological demands: interviews, office politics, stress and the ever-challenging, balance of personal against professional life. The need to be vigilant against exposure to zoonoses, is one thing that we often overlook. "Who's got time for that? I've been running all day and I need to get some lunch before I get to my next call!"

However, conservation officers may be exposed to a myriad of zoonotic diseases of wildlife and exotic pets. In all cases, it may be extremely beneficial to medical personnel and to you (if you are the patient) to be knowledgeable about exposures you may have during your daily work.

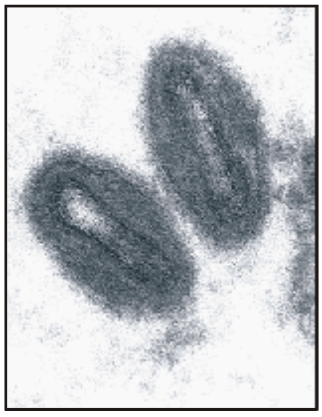
The CDC and the United States Geological Survey recently created a medical alert card for wildlife professionals to carry. While not all of these diseases are normally found in native wildlife in the United States, they are included because of the increasing number of exotic pets present in this country. The list includes: *an*thrax, arbovirus encephalitis including West Nile virus, brucellosis, giardiasis, hantavirus, hendra Virus, highly pathogenic avian influenza, histoplasmosis, leptospirosis, Lyme disease, monkeypox, mycotoxicosis, Nipah virus, psittacosis, Q fever, rabies, Rocky Mountain spotted fever, salmonella, sylvatic plague, tularemia, and typhus...and this list isn't even close to complete. We must also consider *Baylisascaris procyonis* and *columnaris* infection, anaplasmosis, ehrlichiosis, babesiosis, sarcoptic mange, mycobacteriosis, echinococcosis, toxoplasmosis, lymphocytic choriomenigitis virus infection, *Vibrio vulnificus, Eryisipelothrix rhusiopathiae*, cryptosporidiosis, cryptococcosis, and bartonellosis.

The good news is that you can protect yourself from many zoonotic disease risks by taking some basic precautionary measures, the first of which you probably learned in preschool.

Monkeypox virus

Monkeypox virus is the virus that causes the disease monkeypox in both humans and animals. It was first identified in 1958 as a pathogen of crab-eating macaque monkeys (Macaca fascicularis) being used as laboratory animals. The crab-eating macaque is a laboratory species used for neurological experiments. Monkeypox virus is an *Orthopoxvirus*, a genus of the family *Poxviridae* that contains other viral species that target mammals. The virus is mainly found in tropical rainforest regions of central and West Africa.

The virus was first discovered in monkeys (hence the name) in 1958, and in humans in 1970. Between 1970 and 1986, over 400 cases in humans were reported. Small viral outbreaks with a death rate in the range of 10% and a secondary human to human infection rate of about the same amount occur routinely in equatorial Central and West Africa. The primary route of infection is thought to be contact with the infected animals or their bodily fluids. The first reported outbreak in the United States occurred in 2003 in the midwestern states of Illinois, Indiana, and Wisconsin, with one occurrence in New Jersey. The outbreak



was traced to pet prairie dogs infected from an imported African rodent. No deaths occurred.

The virus can spread both from animal to human and human to human. Infection from animal to human can be from an animal bite or direct contact with an infected animal's bodily fluids. The virus can spread from person to person through both their breath and through contact with an infected person's bodily fluids. Animal to human transmission is more common. The virus then incubates in the host for 10-14 days. Symptoms then start to show including swelling of lymph nodes, muscle pain, headache and fever. Sometimes a rash appears.

AVOIDING EXPOSURE TO ANIMAL DISEASES:

- ☒ After handling animals or cleaning equipment, if you suffer a bite, scratch or cut, AND before you eat or drink, **wash your hands using soap and warm water.** As lather builds, vigorously rub all surfaces. Continue washing during the time it takes to sing the "Happy Birthday" song twice, about 15- 20 seconds. If you did not wear gloves during an animal handling incident, use a brush to scrub under your fingernails. Rinse well under running water.[7]
- ☒ Wear appropriate personal protective gear before interactions with animals or their bodily fluids. Don't hesitate to alter or add PPE (Personal Protective Equipment) as the situation evolves.
- ☒ Wash and disinfect equipment thoroughly after each use. Most disinfectants are inactivated by the presence of organic material. Wash equipment first to remove any visible dirt, feces, blood or urine. Then disinfect. Use a 1:10 bleach and water solution (add 1 part bleach to 9 parts clean water.[8]) or follow directions on other appropriate disinfectant solutions.
- ☒ Inspect all equipment regularly for defects and damage. Defects to equipment may cause injuries to both you and the animal(s) you handle. Injuries from defective equipment may serve as a source of exposure to a disease.
- ☒ Use mosquito and tick repellants as required. Using a repellant that contains the active ingredients DEET or permethrin as directed on the label during mosquito and tick seasons. This may help reduce your exposure to many diseases carried by these insect vectors.

Wildlife disease exposure risks vary. If you have immediate questions about your likelihood of exposure, please contact your health care provider or your state department of health/public health.

When we were younger and were afraid of the dark, we didn't know that the monster under the bed was not real. Now that we are older and more "mature", we know monsters exist, but for us, they now take a different form. We don't really want to see ourselves on "1000 Ways to Die".

The Monsters versus the Conservation Officer: Death Match. It's one fight we simply cannot afford to lose. And winning the fight only takes twenty seconds, and some soap and water. Twenty seconds.

It's not too much time to save your life!

Some internet resources related to this topic may be found at the Internet Center for Wildlife Damage Management:
(*http://icwdm.org/handbook/damage/WildlifeDiseases.asp*), the Centers for Disease Control and Prevention (*www.cdc.gov*),
USGS medical alert Medical Alert Wallet Card—National Wildlife Health Center (*www.nwhc.usgs.gov/outreach/wallet_card.jsp*) or your local state department of health/public health.

References:

[1]*http://www.spike.com/show/27237?sicontent=0&sicreative=4453674525&siclientid=2389&sitrackingid=120358495&refsite=7190&cmpnid=865&pt=pr&lkdes=NET_spike*
[2]*http://animal.discovery.com/tv/monsters-inside-me/*
[3]*http://www.usatoday.com/news/health/2007-11-10-plague_N.htm*
[4]*http://www.cdc.gov/Features/HandWashing/*
[5]*http://www.upi.com/Science_News/2008/10/22/Plague-kills-Grand-Canyon- biologist/UPI-12371224650123/*
[6]*http://azdailysun.com/news/article_60d8cb3d-96e0-502e-8a8c-2f36d7d0bf2e.html*
[7]*http://www.cdc.gov/ncidod/dvbid/plague/facts.htm*
[8]*http://www.who.int/csr/resources/publications/surveillance/Annex7.pdf*

About the Authors

Dr. Catherine Brown (Katie) is currently serving as the State Public Health Veterinarian at the Massachusetts Department of Public Health. She has a Bachelor's Degree in Molecular Biology and Biochemistry from Wesleyan University, a Doctor of Veterinary Medicine from the University of Minnesota, a Master's of Science from the Royal Veterinary College, University of London and a Master's of Public Health from Boston University.

Katie was a wildlife veterinarian from 1997 - 2005. She worked for DuPage County's Willowbrook Wildlife Center in Illinois as their Staff Veterinarian and then moved to The Humane Society of the United State's Cape Wildlife Center in Massachusetts. From 2005-2006 she completed an Applied Epidemiology Fellowship sponsored by the CDC and the Council of State and Territorial Epidemiologists, with the Bureau of Communicable Disease Control's Zoonoses Program.

Kevin L. Clayton, pictured at right, is a 23 year veteran of the Massachusetts Environmental Police and is their NAWEOA jurisdictional rep. He currently serves as the acting training officer for the Massachusetts Environmental Police. Kevin is active in union activities and is a graduate candidate in Suffolk University's Master of Public Administration degree program (2011).

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As you can see Kevin was laid up for awhile over the winter but his misfortune was also our good fortune, as he had some extra time on his hands to co-author this highly informative article for us.

In his own words...
"There I was....searching for a manatee that wandered into New England. This was the second manatee in our waters in as many years. I was on board a local harbor-master's boat and he inadvertently hit the throttle and I went flying...patellar tendon rupture, surgery, cast (ankle to mid-thigh) for six weeks…physical therapy since then, two to three days/week. I'm usually in therapy for an hour or two each time I go."