# The Role of Wildlife Rehabilitation in Wildlife Disease Research and Surveillance

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**$A$Introduction**

The large number of animals that are admitted annually to rehabilitation centers provides a unique opportunity to conduct investigations on pathogens that may be important to the health of not only wildlife species, but also domestic animals and humans. Worldwide, it is estimated that 75% of emerging human diseases originate from animals while 77% of livestock and 91% of domestic animal pathogens also infect wildlife species (Taylor et al. 2001; Cutler et al. 2010; Siembieda et al. 2011). Numerous examples of wildlife pathogens causing disease in domestic animals exist; because of the close contact of wildlife rehabilitators with the wildlife they are caring for, transmission of zoonotic pathogens is a concern. Details of these pathogens will be covered in another chapter of this text. This chapter will review selected examples where wildlife rehabilitation centers have facilitated or conducted research on the ecology of pathogens in wildlife populations, as well as general recommendations for those interested in conducting similar studies. In addition, this chapter highlights the large number of parasites, bacteria, viruses, and other agents that animals may have upon admission, which is why proper husbandry,

quarantine, and testing, are critical to prevent spread and clinical disease within your center (Porter 1996).

**$A$Surveillance for rabies**

Rabies virus is an important pathogen of wildlife, domestic animals, and people. Many rehabilitation centers admit animals because they are either captured or injured due to unusual behavior. Although all neurologic mammals are rabies suspects, in specific geographic regions certain hosts are more likely to have rabies virus infections. Euthanasia is generally elected for animals displaying neurologic signs, but due to various factors such as finances, logistics, and human resources, these animals may not be submitted for diagnostic evaluation. For those centers that do submit animals or samples for testing, the results can represent an important contribution to understanding the ecology of rabies in wildlife, especially when data are collected over numerous seasons or years (e.g., Kelly and Sleeman 2003; Blanton et al. 2010, Patyk et al. 2012).

**Commented [E1]:** You might want to include a statement in here that many states/public health departments won't test for rabies unless there is a known bite or scratch. We have actually had labs refuse to test samples we submitted because no one was bitten! Of course, we've also been known to lie now and then and say there was human exposure when there wasn't, just so we could get the animal tested….

**$A$ Surveillance for raccoon roundworm, *Baylisascaris procyonis***

The raccoon roundworm is a large nematode that lives in the intestinal tract of raccoons. Eggs passed in the feces can remain infective for a long period of time; when ingested, larvae can migrate through the tissues of a wide range of avian

and mammal species, many of which may develop severe disease. Prevalence of the parasite is highest in young raccoons and shedding of eggs has been noted in kits as young as 8 weeks of age (Kazacos 2001). Prior to 2002, this parasite was not known to occur, or was very rare, in the southeastern United States. During a study in Georgia, the parasite was found in raccoons from Atlanta, Georgia and this report led to the finding of the parasite in a rehabilitated raccoon (Eberhard, et al. 2002). Following this, talks with rehabilitators in Florida lead to the discovery of *B. procyonis* in raccoons in several sites in Florida (Blizzard et al. 2010). This finding was facilitated by the proactive efforts of a wildlife rehabilitator who saved large worms passed in the feces of raccoons that were treated with anthelmintics upon admission.

**$A$Surveillance for West Nile virus**

In 1999, West Nile virus was introduced into the United States and it spread throughout North America during the next several years. Although the virus infects a wide range of birds and mammals, corvids and raptors frequently develop more severe disease. Therefore, since its introduction, rehabilitation centers have obtained a large number of corvids and raptors infected with West Nile virus. Data collected on birds submitted to centers has improved the understanding of this important

pathogen of raptors. For example, these data has shown that the clinical presentation varies by species (Nemeth et al. 2009), that West Nile virus is more pathogenic to raptors in the US compared to Europe (Lopez et al. 2011), and has provided information on transmission localities (by testing resident species) (Llopis et al. 2015).

**$A$Epidemiology of a unique parvovirus in raccoons**

Historically, parvoviruses detected in free-ranging raccoons were mostly believed to be feline panleukopenia virus (FPV) variants (Parrish et al. 1987; Parrish et al. 1988). Among domestic dogs, canine parvovirus (CPV) emerged in 1978, spread rapidly worldwide, and mutated to CPV-2a. Since then, two additional variants, CPV-2b and CPV-2c, have emerged. This presumption changed in 2007 when a group of rehabilitated raccoons in Virginia died of parvoviral enteritis caused by a CPV-2 variant (Allison et al. 2012). This was interesting as a previous experimental study found that raccoon inoculated with CPV-2 failed to develop disease (Barker et al. 1983). After this initial finding in Virginia, numerous outbreaks in rehabilitation centers throughout the eastern United States were subsequently investigated and genetic characterization indicated most were infected with a CPV which was most similar to CPV-2a; only a single outbreak in California was associated with a FPV

(Allison et al. 2012; K. Bailey unpublished data). Subsequent surveillance of free-ranging carnivores indicated that both CPV-like and FPV-like viruses were circulating, but CPV-like viruses predominated (Allison et al. 2013).

**$A$Identification of novel pathogens or investigating the epidemiology of known pathogens**

Identification of novel pathogens in wildlife is often time consuming and expensive. Many wildlife rehabilitators do not have the facilities to detect novel pathogens that are easily missed by the handful of commercially available tests that can be run patient-side. However, some rehabilitation facilities are associated with veterinary schools with large research programs which can investigate mortalities for novel causes of death. Independent rehabilitation centers, veterinary clinics, or individuals that have unexplained mortalities must submit animals for necropsy to private, state, regional, or federal diagnostic laboratories. Depending on the history of the animal, this is sometimes done at no cost to the submitter, while at other times there may be a charge. In addition, it is often known that certain hosts may be infected with a particular organism, but little is known about the transmission, pathogenicity, or natural history of the organism. Animals admitted for rehabilitation may be tested pre- or postmortem for

various pathogens and the resulting data increase our knowledge. Hopefully, these data can then be used to minimize morbidity and mortality caused by these pathogens in free-ranging and captive animals.

It is not possible to provide details on all of the new pathogens that have been detected in wildlife admitted to rehabilitation centers. However, details from the identification of some novel pathogens or disease syndromes that have been recently published are summarized in Table 1. Also, a few examples of the new information on the epidemiology of pathogens using data collected from rehabilitated animals are summarized in Table 2.

**$A$Getting involved in wildlife disease surveillance**

Pathogen surveillance is often not conducted on animals undergoing rehabilitation for numerous reasons including time, money, lack of training, resources, and logistics. The act of rehabilitation is extremely time-consuming and most centers utilize a team of volunteers to care for the animals. Surveillance for pathogens takes away time that people could be using to care for an animal. However, some of these pathogens may be clinically relevant to the health of these animals, so this time could be justified as it will help maintain the health of other animals in care. Some pathogen surveillance can be

simple – for example, if routine fecal exams are conducted, make note of parasites found or at least those that are of importance to the health of those animals, domestic animals, or people. Surveillance of raccoons for *B. procyonis* is a great example. In some areas, little is known about the prevalence and distribution of this parasite in raccoons; therefore, these data are important.

Investigating causes of mortality can provide critical data on pathogens but often there are financial concerns with conducting investigations. However, under certain circumstances there are labs (e.g., Southeastern Cooperative Wildlife Health Study and the National Wildlife Health Center) that will investigate the cause of disease in animals that have been in care or are admitted showing signs of disease. Also, there are numerous researchers who may be interested in collaborating on certain pathogens in wildlife species. Often, supplies are provided for the collection of samples.

**$A$Conclusions**

Over time, surveillance for single or multiple pathogens or investigations of mortality events can lead to data sets that allow questions to be asked regarding host-pathogen-environment interactions. Publication of these data allows others to have access to the data which ultimately will improve animal care

(e.g., Hanni et al. 2003; Kelly et al. 2003; Lierz et al. 2008; Innis et al. 2009; Mühldorfer et al. 2011). With a little time and collaboration, great advances in our understanding of wildlife pathogens can be accomplished.

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