



**Point Defiance Zoo & Aquarium**  
**Conservation Committee**  
**GRANT APPLICATION**

**Grant Purpose – To support the conservation, research and education goals of Point Defiance Zoo & Aquarium (PDZA) and the ZAA (Northwest Zoo and Aquarium Association), with particular reference to projects related to animals/habitats represented in PDZA’s collection. ConCom projects will:**

1. Contribute to the conservation of animals in the wild and in the PDZA collection by promoting research that improves animal health and husbandry, exhibit environments, animal management concepts and animal propagation.
2. Develop or contribute to animal biological and behavioral databases with particular emphasis on applied studies for: *in situ* conservation and *ex situ* husbandry, population management and habitat conservation.
3. Develop or contribute to education initiatives that promote animal conservation and habitat preservation, with particular emphasis on species in the PDZA collection.
4. Enhance PDZA conservation, science and education goals.

The conservation and science focus areas for PDZA are:

**Green Initiatives**

**Sustainable Seafood Purchasing**

**Red Wolf Recovery**

**Pacific NW Amphibians**

**Healthy Washington Waters**

**Mega-Vertebrates of the Arctic**

**Sharks & Corals of the South Pacific**

**Carnivores of Southeast Asia**

**Veterinary Medicine**

**Sustainable Collections**

**Animal Nutrition**

**Wildlife Endocrinology**

**Note –** at the discretion of ConCom, grant requests may require review of PDZA research guidelines and submission/approval of research proposal application through the PDZA Animal Welfare Committee.

**Project Title:** Initial development of a canid disease monitoring and prevention program plan for the conservation of endangered red wolves (*Canis rufus*).

**Project Summary:** The red wolf is one of the most endangered canids in the world. Historically occurring throughout the eastern and south-central United States, the species was decimated due to habitat loss and intense predator control programs, and declared extinct in the wild by 1980. Two populations of red wolves were reintroduced into designated sites in northeastern North Carolina (1987) and the Great Smoky Mountains, Tennessee (1991). In 1998, the recovery efforts in Tennessee were discontinued due to poor pup survival and suspected parvovirus infections. As a result, the northeastern North Carolina (NENC) population represents the only wild red wolf population. Diseases outbreaks are a serious threat to both wild and captive populations. The Endangered Species Act listing and review process requires disease risk to be evaluated as one of a five factor analysis for recovery efforts and management. To date, the risk of disease is partially offset by intensive vaccination programs for both wild and captive red wolves. However, veterinary research scientists caution we should not presume vaccinated red wolves are adequately protected against diseases. The development of a disease monitoring and prevention plan would provide a summary baseline of red wolf epidemiology, an analysis of existing assumptions with current vaccination programs, and a systematic approach to outline standard operating procedures for disease prevention and management. This guiding document would greatly enhance the ability of the Red Wolf Recovery Program to conserve and support recovery for red wolves. To begin the process of canid disease monitoring plan development, current knowledge of disease occurrence and frequency in red wolves, and efficacy of current red wolf vaccination programs must first be assessed. Initial synthesis and evaluation (Phase 1; this proposal) will provide an understanding of recovery needs and identify knowledge gaps related to red wolf disease risks and the utility of preventive care applications. These necessary elements and findings can then be used to pursue additional funding for the construction of a comprehensive canid disease plan (Phase 2; long-term goal).

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**Amount Requested from ConCom: \$4,500**

**The project narrative should not exceed 5 pages maximum and must include the following sections:**

**Introduction:** Canid diseases are a serious threat to the NENC wild red wolf population as well as captive red wolves in facilities participating in the Species Survival Plan (SSP). The magnitude of risk to the red wolf species overall is partly offset by the occurrence of a restored wild population and ~190 captive red wolves held in >40 SSP facilities across the United States, and would be further reduced with the addition of restoration populations at other isolated geographic sites. Until additional future wild populations are established, the NENC remains the only wild red wolf population, containing between 90-110 individuals. The vulnerability of this population to disease exposure and potential outbreaks (e.g. from local wildlife, domestic dogs, etc.) highlights the critical need for a disease monitoring and prevention plan. Scientists on the Red Wolf Recovery Implementation Team suggested that a red wolf disease prevention and surveillance program be developed to achieve long-term survival in the NENC red wolf population. Similarly, the most recent 5-year status review also recommended an effective disease prevention and management plan for red wolves and other canids be established for NENC. We will use 25+ years of data from the wild NENC population in conjunction with data collected in the captive population to summarize disease trends and occurrence in red wolves, identify disease risks, and evaluate current vaccination programs. Synthesis of these critical elements is an important first step in moving towards the development of a comprehensive disease monitoring and prevention plan for red wolves.

The diseases of greatest concern are canine distemper (Genus *Morbillivirus*; *CDV*), canine parvovirus (Genus *Parvovirus*; *CPV1*, *CPV2*), leptospirosis (Genus *Leptospira*), hemobartonellosis (*Haemobartonella canis*), borreliosis (Lyme disease, *Borrelia* sp.), demodectic mange (*Demodex canis* mites), sarcoptic mange (*Sarcoptes scabiei* mites), heart worm (*Dirofilaria immitis*), and rabies (Genus *Lyssavirus*, *rabies virus*). To date, none of these diseases have occurred at sufficiently high levels to cause an epidemic in the current wild red wolf population. However, mange has contributed to the death of 17 red wolves in the wild NENC population since 1993. Heartworms are regularly reported in the majority of wild red wolves, but have only been confirmed as the cause of mortality for seven cases in the NENC population. While there has only been one documented mortality case due to parvovirus in the NENC population, CPV2 is suspected to have contributed to multiple mortalities and overall low pup survival in the Great Smoky Mountains population (Harrenstein et al. 1997, Henry 1998). Tick-borne diseases are also of increasing concern as warmer winters associated with climate change can affect vector presence and distribution (Randolph 2004, Olsen and Patz 2010). Tick paralysis and the presence of Lyme disease causing bacteria *Borrelia burgdoferi* previously have been reported in red wolves (Beyer and Grossman 1997, Penrose et al. 2000). Pilot efforts are currently evaluating pathogen prevalence in wild red wolves through the assessment of helminth infections, tick borne diseases, and ectoparasite loads (K. Brezski, personal communication). These results are part of a larger project examining how low genetic variation in red wolves may affect immunocompetence.

Disease risk is currently partially offset by intensive vaccination programs for both captive red wolves and the wild population. Current efforts within the NENC population include vaccinating animals during periods of opportunistic capture or recapture during the fall/winter trapping

season and administering an 8-way vaccination (CDV, CPV2, Adenovirus Types 1 and 2, parainfluenza, 2-Leptospirosis and corona virus), and a rabies vaccination, in addition to application of flea/tick prevention medicines. While there is some evidence of seroprevalence of antibodies to diseases post-vaccination (Anderson et al. in prep), veterinary research scientists caution against assuming red wolves are adequately protected against diseases (Acton et al. 2007). The relationships between titers against some of these diseases in wild canids are not completely understood, as the efficacy of these vaccines is developed primarily for domestic dogs and assume an initial neonate vaccination series followed by repeated vaccination efforts. For example, Acton et al. (2007) found that titers against parvovirus are not detectable in a large portion of vaccinated red wolves, indicating the wild population is still very much at risk to CPV2 parvovirus. This is of particular concern, as CDV and CPV2 have been identified in mass mortalities within several endangered or vulnerable populations including black footed ferrets (Williams et al. 1988), harbor seals (Härkönen et al. 2006), African wild dogs (Alexander and Appel 1994, Woodruffe et al. 2012), bush dogs (Janssen et al. 1982), and gray wolves (Mech et al. 2008).

Prevalence trends of canine distemper and canine parvovirus have not been studied in eastern North Carolina, but are expected to be similar to prevalences reported elsewhere along the east coast for black bears, gray and red foxes (Davidson et al. 1992), coyotes, and raccoons (see Acton 2000 and references therein). High mortality rates are common for young animals infected by either virus. There is little baseline data on the distribution of most carnivore species within the NENC recovery area and population estimates are crudely estimated through harvest reports from self-reported trapper surveys or population surveys conducted by the North Carolina Wildlife Resources Commission. As a result, there is great concern about the import of existing and new strains of canid disease carried into the wild red wolf population by sources such as domestic hunting dogs, foxes, and coyotes from outside areas in association with controlled hunting reserves (i.e., fox pens).

The current monitoring approaches utilized by the Red Wolf Recovery Program (RWRP) will be evaluated to assess potential diseases, disease vectors, and risk factors combined with the trends of disease occurrence and prevalence within the wild red wolf population. The current vaccination program will be evaluated for effectiveness, testing for assumptions related to disease prevalence detection techniques. Standard operating procedures for vaccination protocols will be developed or modified to assist day-to-day field operations. These findings will be used to address the disease threats, identify patterns of pathogen transmission and persistence, formulate appropriate responses and vaccination guidelines, as well as identify any knowledge gaps in the current protocols. Ultimately, this project will allow for the timely development of a canid disease monitoring and prevention program to guide future implementation of these recommendations within the NENC wild red wolf population and future restored populations.

### **Objectives:**

Our objectives and efforts can be divided into two phases. Phase 1 objectives would be funded by this proposal, whereas Phase 2 would require additional efforts and funding from outside sources. Phase 1 is critical to provide the best available data and summary for continuation of work toward of Phase 2.

- I. Synthesize current knowledge and literature on disease occurrence, trends, and risks in wild canids in the southeastern U.S. (Phase 1)

- II. Utilize baseline findings to create a grant proposal to support development of a canid disease monitoring plan (Phase 1)
- III. Publish review paper for peer-reviewed publication (Phase 1)
- IV. Develop a comprehensive disease prevention and management plan for wild red wolves and other canid species in northeastern North Carolina (Phase 2)

**Methods/Plan of Action:**

The approach to developing a canid disease monitoring and prevention plan includes three initial investigations in Phase 1. These findings would guide the future development of a canid disease monitoring and prevention plan of Phase 2:

- 1) Synthesize current knowledge and literature on disease occurrence, trends, and risks in wild red wolves. Identifying any data gaps will inform where focus on disease monitoring is needed within red wolf populations (Phase 1).
- 2) Summarize the current recommended protocols and procedures of the RWRP. Although there is a vaccination program in place, most are performed opportunistically. Because wild animals are not necessarily captured and vaccinated consistently every year, we assume that some level of vaccination protection is preferable to none. The assumptions related to disease risks and priorities require further evaluation (Phase 1).
- 3) Evaluate efficacy of current vaccination program of the RWRP. We cannot assume that current vaccination efforts adequately protected against diseases. Research has shown that in some cases, titers against diseases are not detectable in a large portion of vaccinated free-ranging red wolves (Acton et al. 2007, Phase 1)
- 4) Determine appropriate response and plan of action given information gained from vaccination program assessment. After disease levels are assessed in red wolf populations, information about disease prevalence and trends can be combined with vaccination efficacy data to define specific management applications in the wild population (Phase 2).

The synthesis of current protocols and methods will allow summary of disease occurrences and trends, vaccination procedures, and field assessment. Documentation from this step will result in the creation of updated standard operating procedures that can then be evaluated further and modified accordingly. These initial steps will provide a solid framework to create a grant proposal for the support of the larger efforts of building and implementing a comprehensive canid disease monitoring and prevention plan.

[References available upon request]

**Project Start/Stop Dates and Major Timeline Milestones:** Investigation of materials will begin in the spring of 2013 (Phase 1). As summaries of protocols and assessments of Phase 1 study components are completed, these findings will be used as planning tools for future drafting of a comprehensive disease and monitoring plan (Phase 2). Phase 1 completion is expected in the winter of 2014.

**Evaluation:** The achievement of outcomes will be determined by a comprehensive review and synthesis of the current vaccination program assessment and subsequent acceptance of the summary of efforts for publication through a peer-reviewed professional journal (Phase 1).

**Deliverables:** We envision three related products from these efforts: 1) a review paper for peer-review publication, 2) a grant proposal to support future funding needs, and 3) recommendations for vaccination standard operating procedures to guide red wolf recovery efforts. The results of this study will be prepared and submitted as a review paper for publication of wild red wolf diseases in a peer-reviewed journal. The article will be submitted to the Conservation Committee upon publication. If there is a delay in publication through the peer-review process, a brief report will be provided to the Conservation Committee by the end of the year in addition to a final programmatic report upon completion of the study.

**Budget:**

Budget Item	Category	Cost
Travel for PIs to recovery site	Travel x 2	\$ 2,500
Publication printing and access costs	Publication	\$ 2,000
Total Expenses:		\$ 4,500
Matching Funds		
U.S. Fish and Wildlife Service	In kind support (field vehicle, salary, etc.)	\$ 5,000

ConCom funds will be spent on travel for K. Wolf and W. Waddell to visit the recovery area in NENC to participate in red wolf vaccinations, and observe field protocols and vaccination program database. Additional funds will be used for publication costs, e.g. J. Zoo & Wildlife Medicine/ J. Wildlife Management ~ \$100-\$150/page.

**Investigators' Qualifications:**

Will Waddell has been the Red Wolf SSP Coordinator for 20 years. His interests include the role of zoos in supporting interactive management between in situ and ex situ populations, factors affecting reproduction, health, and stress in zoo populations, and the long-term viability and sustainability of zoo-based populations in the modern zoo paradigm.

Dr. Karen Wolf is the Head Veterinarian at Point Defiance Zoo & Aquarium and is serving as the Red Wolf SSP Veterinary Advisor. Her graduate work focused on reproduction in captive black-footed ferrets. Dr. Wolf's interests include infectious diseases of captive and free-ranging wildlife. She has a strong interest in epidemiology, specifically the interface between wildlife, domestic animals and people.

Dr. David Rabon is the Coordinator of the U.S. Fish and Wildlife Service's Red Wolf Recovery Program. Dr. Rabon's research interests include the restoration, conservation, and management of endangered species, particularly wild canids and other carnivores. His focal research/study areas include the behavioral ecology, reproduction, and social behavior of wild canids; intra- and inter-species relationships; population assessment and species-habitat relationships; mitigation of human-predator conflicts; and, resolution of complex problems related to carnivore management.

Dr. Becky Bartel is the Assistant Coordinator of the U.S. Fish and Wildlife Service's Red Wolf Recovery Program. Dr. Bartel's research interests include assessing species interactions and community dynamics and patterns in a conservation-driven framework. Her previous work evaluated the links between animal behavior and movements to infectious disease dynamics.