

Wildlife diseases in national park ecosystems

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Should diseases in wildlife be controlled by managers of the National Parks? Are they a naturally occurring part of the ecosystem we should leave alone? What effect do humans have on wildlife diseases? These authors consider these questions.

Until 1991, the U.S. National Park Service (NPS) managed 337 areas covering some 32 million ha (79 million acres) in 50 states, the District of Columbia, Guam, Puerto Rico, and the Virgin Islands. Several additions, redesignations, and incorporations have occurred since then. The diversity of national parks is reflected in their titles, including national monuments, national preserves, national lakeshores, national seashores, national rivers, national recreation areas, and others.

The role of wildlife disease in these protected ecosystems has received relatively little attention in the past, which is reflected in the limited discussion of disease in the *Management Policies* for the National Park System (NPS 1988). Diseases are mentioned briefly as part of exotic species and pest management. Diseases are discussed in more detail in the NPS's natural resources guidelines (NPS 1991).

This discussion focuses on conditions which might justify control of diseases in native animal populations such as exotic disease, threat to human health, threat to relict species, as well as the control of arthropod disease vectors. Our information is derived from a mail questionnaire and an extensive literature review performed in 1990-1991. Individuals representing a total of 179 national parks, 123 state agencies, 103 federal agencies, and 98 colleges and universities responded to our questionnaire. The literature survey gathered information on diseases re-

ported in wild mammals in national parks. Information also was gathered on zoonoses, domestic animal diseases, animal health programs, pack animals and pets in national parks, livestock grazing in park ecosystems, and policies and regulations on domestic animal management within parks. The literature review and survey results were published in a technical report (Aguirre et al. 1993), available from the Denver Service Center, Technical Information Center, P.O. Box 25287, Denver CO 80225. Although our survey design did not permit strong inferential uses, herein we highlight our findings and discuss potential problems and policy implications that may warrant more detailed scrutiny.

Existing problems and practices

Diseases reported

Aguirre et al. (1993) analyzed and summarized all the survey information including isolated reports, outbreaks, confirmed cases, and serologic surveys of disease agents by state, park, year, and species affected. Lungworm-pneumonia complex in bighorn sheep (*Ovis canadensis*) and epizootic hemorrhagic disease in white-tailed deer (*Odocoileus virginianus*) were the most common diseases reported as affecting wild ungulates in national parks. Meningeal worm (*Parelaphostrongylus*) infections in wapiti (*Cervus elaphus*) and deer, psoroptic sca-

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bies (*Psoroptes ovis*) in bighorn sheep, leptospirosis (*Leptospira* spp.) in deer, and pseudorabies in feral pigs (*Sus scrofa*) were reported as increasing in cases and distribution. Serologic studies demonstrating previous exposure to pathogenic agents that cause disease in domestic livestock were commonly reported.

Rabies, sylvatic plague (*Yersinia pestis*), canine distemper, borreliosis (*Borrelia burgdorferi*), and filarial (*Dirofilaria* spp.) infections were the most common diseases reported in wild carnivores in national parks. Diseases judged to be increasing in zoonotic importance included trichinosis in wild carnivores; tularemia in rabbits (*Sylvilagus* spp.) and American beavers (*Castor canadensis*); and leptospirosis (*Leptospira* spp.), giardiasis (*Giardia* spp.), and Rocky Mountain spotted fever in rodents (Aguirre et al. 1993).

Domestic animal policies

Over 50% of the park personnel responding to the survey reported pack animals or grazing animals within or adjacent to park boundaries. Pack animals and grazing allotments in national parks represent important issues to be addressed as they relate to possible transmission of diseases among wildlife and livestock.

Regulations in most parks allow pets on a leash and in restricted areas; however, several respondents were seriously concerned because the leash requirement is overlooked by many visitors. Pets from different geographic regions represent a health risk to wildlife in national parks. Although most units observe Title 36 Code of Federal Regulations (36 CFR 2.15) as the pet policy, enforcement is difficult. This section of CFR is a compendium of designations, closures, permit requirements, and other restrictions under discretionary authority by the superintendent.

Animal health programs

Implementation of a wildlife health program (e.g. vaccination, medication, herd management, quarantine, and habitat management) was reported by 19 of 138 national parks surveyed. Treatment and control of sylvatic plague in small rodents by dusting burrows and closing visitor areas were the most common practices implemented by park personnel. Other health programs have been developed to control lungworm-pneumonia complex, psoroptic scabies, rabies, relapsing fever, and histoplasmosis (Aguirre et al. 1993).

Sixteen percent (22/138) of the parks responding had health programs for working domestic animals. The programs included deworming and vaccination

of domestic horses at least yearly against equine encephalitis, equine influenza, tetanus, rhinopneumonitis, and Potomac horse fever. Cattle were treated against coccidiosis and endoparasites 1-3 times/year in specific park units. Sixteen parks with a domestic animal disease prevention program required resident dogs and cats to be vaccinated against rabies according to local law. Other vaccines required by parks included canine distemper, feline panleukopenia, and canine parvovirus. Preventive programs against heartworm (*Dirofilaria immitis*) and other endoparasites were common (Aguirre et al. 1993).

Disease management in park ecosystems

Over one-third of the respondents considered diseases and parasites in wildlife in national parks to be part of a naturally functioning ecosystem. The general consensus in the survey was that native diseases should be protected even if they are detrimental to wildlife populations. Parasites and diseases should be allowed to perform their natural functions in the ecosystem within the full range of what might be considered natural. Native diseases should only be managed for the following reasons: to protect adjacent areas or to preserve ecosystems that have been altered or threatened by human influences; for protection of endangered species and species of special concern; for public health reasons; and for display populations (those very important for visitor enjoyment), to the extent that treatment does not detract from the appearance of naturalness.

Preventing native diseases from spreading to populations outside a park may be justified. Several issues to be considered with a disease outbreak in a national park include status of the infected animal population, classification of disease as exotic or native, pathogenicity and infectiousness of the etiologic agent, and capacity to infect other hosts or vectors. Management is justified when other mechanisms such as overpopulation, habitat deterioration, and lack of predation are involved. Most responses from parks indicated that diseases introduced by humans, domestic livestock, and pet animals should be eradicated (Aguirre et al. 1993, 1994).

Several respondents suggested that animal disease-related issues in these protected areas have been underestimated and underfunded. Management has been reactive rather than proactive and has focused on cases of epizootic proportions (i.e., respiratory disease in bighorn sheep), endangered and threatened species (i.e., black-footed ferret [*Mustela nigripes*]), or domestic animal health (i.e., brucellosis and tuberculosis in large ungulates) (Roelke 1990,

Tessaro et al. 1990, Thorne et al. 1991a,b, Williams et al. 1991, Aguirre et al. 1993, Aguirre and Starkey 1994).

Native versus exotic

The origin of most diseases and pathogens could not be determined as native or exotic. Of those which could be classified, most were considered to be native, but this finding cannot be extrapolated to those diseases which we were unable to classify. Viral and bacterial diseases were more difficult to classify than parasitic diseases. In general, parasitic infections of wildlife have been studied for a longer period of time than those with a viral or bacterial etiology. Also, many parasitologists have a taxonomic orientation. Taxonomic, molecular, and historical studies will improve our ability to classify disease organisms as exotic or native (Aguirre and Starkey 1994).

Monitoring and research

A national surveillance program for wildlife diseases should be implemented in national parks. An early warning system for disease is needed because populations of ungulates have dramatically increased and concentrated in some national parks (Porter et al. 1994). Demonstrated exposure of park wildlife to diseases of domestic animals (Aguirre et al. 1995) and increased ecological isolation of many parks and their wildlife populations will require a surveillance system that could be integrated with other wildlife management activities. This program could be complemented by participation with other ongoing serologic surveys conducted by state wildlife agencies during trapping or hunting seasons.

Specific diseases should be confirmed in all cases of animal morbidity or mortality. In the past, assumptions have been made about causes and presence of disease based on minimal observations. These unconfirmed observations inhibit parks from documenting data necessary to develop programs to achieve meaningful goals. Confirmed data could support management recommendations related to specific diseases. Furthermore, a well-designed program of disease surveillance would help detection of emerging diseases.

Research is needed to analyze basic epidemiologic data. These actions could involve serologic and parasitologic surveys, historical accounts of disease outbreaks, comparison of die-offs within and among parks, identification and control of vectors and reservoirs, trends of epizootics, emerging and newly introduced diseases, and population dynamics of disease (Potts 1937, Oberhansley 1940, Nelson and Smith 1976, Jessup et al. 1981, Rabinowitz and

Potgieter 1984, Pinter et al. 1988, Forrester 1990, New et al. 1993, Aguirre et al. 1995).

Public health

Issues related to public health in national parks need to be addressed by the NPS. Intentionally or inadvertently, parks essentially put wildlife on display in a natural setting and allow visitors access to and sometimes contact with wildlife. Each park has its own zoonotic diseases which may become a real risk to the public. Past efforts to obtain background information (Stark and Kinney 1969, Boyer et al. 1977, McLean et al. 1989) and future surveys to assess the risks of zoonoses in national parks could provide information upon which to base strategies and plans for prevention and control.

Domestic animal management

Livestock and pets are common in and adjacent to national parks. Many parks reported that they did not have a comprehensive animal health program or management plan. Such programs should be elements of natural resources management plans.

Although caged birds and cats are allowed in many parks, dogs are the most common pet in national parks. Dogs from local and distant geographical locations represent potential risks to park wildlife. Canids such as wolves (*Canis* spp.), coyotes (*Canis latrans*) or foxes (several genera) are at greatest risk of acquiring an injurious infectious disease. In some areas of the NPS, park canids may be at risk from free-ranging domestic dogs belonging to local residents. This is likely to be the case for parks located in relatively developed areas. In larger wilderness parks, visitors' dogs potentially represent the most significant disease risk for park canids.

For some parks, such as those with wolf populations, aggressive enforcement of existing dog policies or development of more restrictive policies may be appropriate. Although there is no guarantee of safety short of prohibiting the entrance of dogs, health risks may be reduced by minimizing access of feral dogs and by requiring park visitors to provide a recent certificate issued by a veterinarian certified by Animal and Plant Health Inspection Service. Dogs entering parks should have current vaccinations for canine distemper, infectious canine hepatitis, leptospirosis, canine parvovirus, canine coronavirus, and rabies.

In special cases such as sled-dog competitions, dogs should have fecal parasite examinations the week prior to entry (with negative results). Other requirements may include removal of all scats, veterinary examination on race day, confinement to a pre-

scribed race course, and avoidance of territories known to be used by wolves. To avoid introduction of canine heartworm to wild canids, dogs admitted during the mosquito season should have tested negative for the disease and be given preventive medication if they are from a locale in which canine dirofilariasis may occur.

Implementation of these precautions would be a challenge in most parks. Disease risks from domestic pets, however, must be considered during resource management planning for the National Park System. Many areas will not require special precautions, but others, such as those with endemic canid populations, may benefit from improved enforcement or strengthening of pet policies.

Ecosystem perspectives

Disease management in national parks should recognize that disease, both clinical and subclinical, stems from complex interactions of pathogens, host, and environment. Introduction of exotic pathogens or evolutionary change in native pathogens may result in disease (Aguirre and Starkey 1994). Introduction of wildlife species (or individuals) with little resistance to native pathogens or increased environmental stress (e.g., reduced habitat or pollution) also can cause disease. Therefore, disease management must be an integral component of ecosystem management. Important topics to be addressed include the role of disease in population dynamics of park wildlife, the effects of environmental stress, and the conservation biology of disease-causing organisms.

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