USGS
science for a changing world

National Wildlife Health Center

Sylvatic Plague Vaccine and Management of Prairie Dogs

Scientists at the USGS National Wildlife Health Center (NWHC), in collaboration with colleagues at the University of Wisconsin (UW), have developed a sylvatic plague vaccine that shows great promise in protecting prairie dogs against plague (Mencher and others, 2004; Rocke and others, 2010). Four species of prairie dogs reside in the United States and Canada, and all are highly susceptible to plague and regularly experience outbreaks with devastating losses. Along with habitat loss and poisoning, plague has contributed to a significant historical decline in prairie dog populations. By some estimates, prairie dogs now occupy only 1 to 2 percent of their former range (Proctor and others, 2006), with prairie dog colonies being now much smaller and fragmented than they were historically, making individual colonies more vulnerable to elimination by plague (Antolin and others, 2002). At least one species, the Utah prairie dog (*Cynomys parvidens*) is listed by the U.S. Fish and Wildlife Service (FWS) as "threatened". Controlling plague is a vital concern for ongoing management and conservation efforts for prairie dogs.

Sylvatic Plague: A Continued Threat to North American Wildlife

Sylvatic plague, caused by *Yersinia pestis*, is a bacterial disease transmitted by fleas that afflicts many mammalian species, including humans. For many species of wildlife, plague mortality is a serious conservation issue. In fact, more than half of North American rodent species considered of conservation concern by the International Union for Conservation of Nature reside within the range of plague outbreaks in the western United States. The bacterium that causes plague was inadvertently introduced into North America in the early 1900s. Because it is foreign to the evolutionary history of North American mammals, most species have little or no immunity and succumb quickly to the disease. Prairie dogs are particularly susceptible to plague and suffer high mortality rates (90 percent or more) during outbreaks, often resulting in local or even regional extinctions. Plague is now considered widespread throughout the western states and may exist in an enzootic, or low level, state in some prairie dog colonies, contributing to decreased survival of prairie dogs even in the absence of plague epizootics (outbreaks).

Current efforts to halt the spread of plague in prairie dog colonies typically rely on dusting individual prairie dog burrows with pesticides to kill plague-infected fleas. Although flea-control insecticides, such as deltamethrin, are useful in stopping plague outbreaks in these prairie dog colonies, dusting of burrows is labor intensive and time consuming and may affect other insects and arthropods.

Vaccine-Laden Bait: A New Method of Plague Control

As an alternative approach, NWHC and UW scientists developed a sylvatic plague vaccine (SPV) for prairie dogs that can be delivered via oral bait. Laboratory studies have shown that consumption of this vaccine-laden bait by different prairie dog species results in significant protection against plague infection that can last for at least 9 months (Rocke and others, 2010; Rocke, unpublished). Work has now shifted to optimizing baits and distribution methods for field delivery of the vaccine. Peanut butter-flavored baits were shown to be preferred by prairie dogs in laboratory studies, and preliminary field studies using baits without vaccine have shown rates of uptake among wild prairie dogs to be greater than 90 percent within 3–4 days of distribution. The vaccine remains viable within the baits for up to 7 days at 28°C. Fieldwork is ongoing to establish the optimal time for baiting in different prairie dog species and methods and density of bait distribution that will maximize bait consumption. An effective biomarker (Rhodamine B) incorporated into baits is being used in field studies to easily determine bait uptake by both prairie dogs and non-target animals. Ultimately, the bait will be formulated in a size and shape that facilitates distribution by plane or overland vehicle. Field studies to assess the safety and efficacy of SPV are being planned. These studies will require involvement from numerous partners, including state and federal land management agencies, tribal organizations, private landowners and non-government agencies.

Photos from top to bottom. Prairie dog adult and young (Dean Biggins, USGS), peanut butter baits (NWHC), prairie dog eating bait with biomarker (Tonie Rocke, NWHC).

Prairie Dogs as a Keystone Species

Prairie dogs play a vital role in the grassland ecosystem by supporting a different set of species than those in areas that are not colonized. Thus, conservation of prairie dogs has important consequences for many other species of animals in the grassland ecosystem. Prairie dog colonies serve various functions for several animals, including the endangered black-footed ferret (*Mustela nigripes*), which depends almost exclusively on prairie dogs for food and for shelter in their burrows and is itself highly susceptible to plague. Many other species rely heavily upon prairie dogs for prey (raptors and swift fox (*Vulpes velox*)) or use their burrows for shelter and protection from predators (burrowing owl (*Athene cunicularia*)). Other species take advantage of the effects of prairie dog grazing for nesting sites (mountain plover (*Charadrius montanus*)) or for feeding on nutritious young grasses (bison (*Bison bison*), other rodents). Thus, plague control in prairie dogs would have a beneficial influence on the preservation of other dependent species.

Photo credits. Background image, prairie dog town in fall, Wind Cave National Park (NPS). Burrowing owl, bison, and mountain plover, FWS. Black-footed ferret, NWHC. Swift fox, C. Burnett, CC BY SA, Wikipedia. Prairie dog, Tonie Rocke, NWHC.

SPV as a Management Tool

Vaccination with SPV could provide an additional tool for plague management. Whereas dusting is most often done in areas with suspected or confirmed plague, SPV could be used as a preventive tool in areas of conservation concern, especially in areas where enzootic plague decreases survival of prairie dogs and black-footed ferrets.

For example, use of SPV may ensure survival of larger numbers of threatened Utah prairie dogs, enabling managers to balance land-use needs with prairie dog conservation in targeted areas. If plague can be controlled, eventual delisting of the species may become possible, and restrictions on development and agricultural use of land could therefore be lifted. Similarly, management of plague through SPV use in other prairie dog species could prevent precipitous population declines that could lead to future ESA listing.

SPV could also be distributed in prairie dog colonies where black-footed ferrets reside in order to preserve their prey and decrease the source of plague infection. If SPV is successful in eliminating or curtailing plague epizootics in prairie dog colonies, establishment and maintenance of ferret recovery sites will be enhanced.

References

Antolin, M.F., Gober, P., Luce, B., Biggins, D.E., Van Pelt, W.E., Seery, D.B., Lockhart, M., and Ball, M., 2002, The influence of sylvatic plague on North American wildlife at the landscape level, with special emphasis on black-footed ferret and prairie dog conservation, Transactions of the 67th North American Wildlife and Natural Resources Conference: Wildlife Management Institute, p. 104–127.

Mencher, J.S., Smith, S.R., Powell, T.D., Stinchcomb, D.T., Osorio, J.E., and Rocke, T.E., 2004, Protection of black-tailed prairie dogs (*Cynomys ludovicianus*) against plague after voluntary consumption of baits containing recombinant raccoon poxvirus vaccine: Infection and Immunity, v. 72, p. 5,502.

Proctor, J., Haskins, B., and Forrest, S.C., 2006, Focal areas for conservation of prairie dogs and the grassland ecosystem, *in* Hoogland, J.L., ed., Conservation of the black-tailed prairie dog: Washington, D.C., Island Press, p. 232–247.

Rocke, T.E., Pussini, N., Smith, S.R., Williamson, J., Powell, B., and Osorio, J.E., 2010, Consumption of baits containing raccoon pox-based plague vaccines protects black-tailed prairie dogs (*Cynomys ludovicianus*): Vector-Borne and Zoonotic Diseases, v. 10, p. 53–58.

For additional information, please contact:

Tonie E. Rocke
U.S. Geological Survey
National Wildlife Health Center
6006 Schroeder Road
Madison WI 53711-6223
(608) 270-2451 FAX (608) 270-2415
www.nwhc.usgs.gov